Crop and Livestock Improvement in Mashreq Region

Nasri Haddad
Richard Tutwiler

editors

UNDP

International Center for Agricultural Research in the Dry Areas

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Crop and Livestock Improvement in Mashreq Region

Proceedings of The Mashreq Workshop on Increased Productivity of Barley, Pastures and Sheep in the Critical Rainfall Zones
13-15 December 1992, Amman, Jordan

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Sponsors

International Center for Agricultural Research in the Dry Areas (ICARDA)
United Nations Development Programme
Arab Fund for Economic and Social Development

International Center for Agricultural Research in the Dry Areas (ICARDA)

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Citation: Haddad, Nasri and Tutwiler, Richard (eds). 1994. Crop and livestock improvement in Mashreq region. Proceedings of the Mashreq Workshop on Increased Productivity of Barley, Pastures and Sheep in the Critical Rainfall Zones, 13-15 December 1992, Amman, Jordan. ICARDA, Aleppo, Syria. vii + 347 pp.

AGROVOC descriptors: *Hordeum vulgare*; barley; plant production; plant breeding; feed legumes; animal feeding; pastures; sheep; nutritive value; goats; animal breeding; reproduction; technology transfer; economic analysis; Iraq; Jordan; Cyprus; Syria.

ISBN: 92-9127-021-0

Language/Production editor: Linda J. Sears

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* English abstract and full paper in Arabic.

Foreword

The Mashreq Project countries — Syria, Jordan and Iraq — are characterized by high population growth rates and, in some cases, rising incomes not matched by increases in agricultural production, which leads to a widening gap between supply and demand of all food commodities including meat and milk. In response, livestock producers have been increasing flock sizes, which has led to overgrazing of rangeland. Moreover, to meet the feed demand, farmers have increased barley production by cultivating marginal lands and replacing the fallow/barley rotation with continuous barley. These practices are a threat to the agricultural resource base in the three countries, causing soil depletion, range degradation and pest problems.

The Mashreq Project was initiated in 1989 with the aim of improving the production of barley, forages and sheep to meet the large shortages in feed and red meat in the three countries in a way that is not detrimental to the resource base. Co-funded by the United Nations Development Programme (UNDP), the Arab Fund for Economic and Social Development (AFESD) and ICARDA, which is also the executing agency, the work is being implemented by national scientists. ICARDA plays a primarily catalytic role and provides technical support to the project when and where needed.

The project focuses on the transfer of available technology to farmers and sheep owners. A feature of the Mashreq Project is its integrated system approach, which has been implemented by multidisciplinary teams that link researchers with extension agents and work with farmers in their fields. The result is a better understanding of farmers' needs. This is reflected by a high rate of technology adoption.

This workshop was a good occasion for scientists from the project countries, ICARDA and other West Asian countries to present and discuss the results of their work and exchange ideas on the future direction of their activities. We hope that the findings and recommendations reported in these proceedings will be of benefit to a larger sector of scientists working in the region. ICARDA will continue to support and back up these efforts.

Nasrat Fadda

Nasrat Fadda
Director General

Acknowledgements

We wish to convey our thanks and appreciation to those who contributed to this proceedings: the authors, the participants and ICARDA staff at the Regional Program in Amman. Our thanks are also extended to the United Nations Development Programme and the Arab Fund for Economic and Social Development whose financial support of the Mashreq Project made the workshop possible.

We are grateful to the Government of Jordan, represented by the Ministry of Agriculture, the National Center for Agricultural Research and Technology Transfer (NCARTT) and the University of Jordan for their assistance and hospitality in hosting the workshop.

Special thanks are extended to ICARDA headquarters, especially to Ms Jouhayna Issa of CODIS for editing the Arabic papers and to Ms Linda Sears for help in editing and producing these proceedings.

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R. Tutwiler
Editors

Introduction

The countries of the Arab Mashreq region, including those covered by the Mashreq Project — Syria, Jordan and Iraq — are facing an increased demand for red meat which is now being met by higher imports. Not only has this increase in consumption increased the pressure on pastures in the Mashreq countries, it also has raised the demand for forage, feed grain and concentrates beyond the local production.

A traditional production environment continues to dominate the cereal and livestock sectors in the three countries, where cereal productivity averages much less than 1 t/ha. Production has been highly unstable and the feed supply still does not meet the needs of the livestock sector. Policies in the Mashreq countries have generally favored wheat production.

Despite the high demand for barley as a major animal feed, it remains a low-priority crop, concentrated in dry areas with an average annual rainfall of less than 300 mm. Barley yield can be improved profitably by adopting barley production technologies such as improved cultivars and fertilizer application. It also can be improved by introducing forage legumes for grazing in rotation with barley. This will increase feed production and expand the cultivated area. Moreover, several technologies are now available to improve sheep milk and meat productivity.

To address these issues, a regional project — Mashreq Project (RAB/89/016) — was developed to improve the production of barley forages and sheep in Syria, Jordan and Iraq in zones with an average annual rainfall of 200-350 mm. The project, financed by the United Nations Development Programme (UNDP) and the Arab Fund for Economic and Social Development (AFESD), is executed by the governments of the three countries. The project started its activities in mid-1989 and is managed and technically supported by the International Center for Agricultural Research in the Dry Areas (ICARDA).

Project Approach and Methodology

The Mashreq Project adopts an innovative "integrated approach" to this task, recruiting the skills of multidisciplinary teams of extension agents, plant breeders, animal production specialists and socioeconomists. By bringing together people with such diverse skills, the Mashreq Project joins all the strands of agricultural research, linking the researchers with the person most familiar with farmers' conditions, the extension agent. This guarantees a comprehensive response to the challenges of agriculture and the team members develop a better understanding of all the facets of the area's farming systems.

These multidisciplinary teams are responsible for formulating workplans for their countries in close coordination with ICARDA, UNDP and AFESD. The national teams take the lead in determining the focus of the project's research. ICARDA, as the implementing agent, provides technical and scientific support.

The annual workplans are developed following several scientific meetings: a planning meeting organized in each country, at which the results are reviewed and a national workplan is developed for the following year; a regional technical meeting where the results in the three countries are discussed and the regional workplan is developed; followed by a steering committee meeting at which representatives of the three countries, ICARDA, UNDP and AFESD discuss and approve workplans and budget.

Project Activities

In each country, the national program is fully responsible for implementing the project in close cooperation with ICARDA. The assigned scientific support staff is sufficient to carry out project activities with back-up support from ICARDA headquarters in Aleppo, Syria. The project emphasizes on-farm researcher-managed trials and on-farm demonstrations in addition to on-station back-up research. For all program activities, fields as well as flocks are provided by the selected farmers actively involved in the project, who are identified by the national programs.

Monitoring studies are being carried out to determine the farmers' acceptance of the new technologies and their effectiveness at the farmer level.

Human resource development is a major project focus, achieved by organizing training courses, travelling workshops, seminars and study tours. The project technical teams participate in these activities. Training for farmers also is given serious consideration by the project, which organizes 1-day training sessions on specific skills. Field days are organized to allow farmers and technicians to observe the field results.

The Workshop

The workshop was organized to allow for more interaction and exchange of ideas and research findings, not only among scientists directly involved in the project, but also among scientists from the six West Asia countries: Iraq, Cyprus, Jordan, Lebanon, Syria and Turkey, in addition to a group of scientists from ICARDA. During the workshop many research findings were presented and discussed. The major focus was on results of adaptive research and technology transfer. In addition, two panels met during the workshop: one on crop livestock integration and the second on the Mashreq Project's future direction. The texts of these research and panel presentations comprise this proceedings.

The workshop was a good opportunity to strengthen the interaction and networking between scientists and countries in West Asia. The Mashreq Project teams look forward to more such cooperative activities in the future.

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Production Technology and Systems

Some Aspects of the Fertilization of Barley (*Hordeum vulgare*) in Iraq

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Abstract

Barley is an important grain crop all over the world as well as in Iraq. It has many uses, such as in livestock and poultry feeding, and in industry. Production of this crop in Iraq is very low because of the agricultural practices followed, which include poor soil preparation, use of low-quality seed and imbalanced fertilization. In this article the importance of using chemical fertilizers to increase barley production is discussed and some of the work that has been done in this respect is reviewed. It is concluded that the use of chemical fertilizers is necessary to increase barley production under both irrigation and rain-fed conditions, and that more work in this direction is needed to complement breeding programs to improve barley production in Iraq.

Introduction

Barley (*Hordeum vulgare* L.) is an important grain crop all over the world because of its many uses in industry, as livestock and poultry feed and as green fodder.

In Iraq, barley is the second crop after wheat in area cultivated. Over 1 million hectares are planted yearly. Barley's relative resistance to salinity makes it a preferred crop over wheat in the central and southern parts of the country where the soil is affected by different levels of salinity. It is also preferred in the marginal rain-fed area (250-350 mm) because of its relative drought resistance.

Iraq may be considered one of the oldest countries in which barley has been grown; barley has been mentioned in the early writings. However, although the climatic conditions are suitable for this crop, its productivity is very low in comparison with the world average. The average yield for barley from 1986 to 1990 was 828 kg/ha in the irrigated areas and 648 kg/ha in the rain-fed area. The world average is reported to be around 2000 kg/ha, and for developed countries it is around 2500 kg/ha (Arab Food Annuity Program 1980). The low yield per unit area in Iraq is due to many factors including poor soil preparation, use of the wrong varieties and infestations of weeds and pests. Imbalanced or no fertilization may be considered a main factor affecting crop yield. FAO reports (Sodhi 1982) indicated that over 50% of the increase in grain production in the past 20 years was due to the increased use of chemical fertilizers. This effect may be even greater in developing countries. Pretly and Stangel (1985) reported that 75% of grain production in India from 1965 to 1975 was due to the use of chemical fertilizers. The response to fertilization in many developing countries ranged from 56% in the Near East and North Africa region to 99% in Latin America (FAO 1981). In Pakistan, for example, the response to fertilizer addition was 62.3% for irrigated wheat, 59.8% for rice, 56% for cotton and 47.2% for sugar cane (Suleman 1983).

Developed countries achieve high production levels by using efficient varieties and good management, including expanded use of chemical fertilizers. For example, barley production in France was increased from 2.03 t/ha in 1955 to 5.19 t/ha in 1984 (Ministry of Agriculture 1986). At the same time there was an increase in the use of fertilizer elements. Nitrogen consumption was increased from 12 to 80 kg/ha, phosphorus (P_2O_5) increased from 23 to 58 kg/ha and potassium (K_2O) from 18 to 63 kg/ha in the same period.

This increase in production in the developed countries, and the sustained production in developing countries, widened the nutrition deficit between developed and developing countries. Before World War II, most of the developing countries were self-sufficient for many agricultural commodities including small grains. Some of them, like Iraq, were even exporting countries. Now developing countries are the main importing countries for grains including barley. Vertical expansion in production by increasing productivity is therefore necessary, since lateral expansion is limited by the shortage of water resources. One of the main factors in increased productivity is balanced fertilization.

Barley Fertilization in Iraq

The use of chemical fertilizers in Iraq is a relatively new practice. It began on a small scale in the mid-1960s for vegetables and fruit trees. At that time grain crops did not receive chemical fertilizers. It was only after 1971, when the national production of nitrogenous fertilizers was started, that the use of chemical fertilizers, especially nitrogenous fertilizers, began to develop and expand. Barley does not receive chemical fertilizers. The use of chemical fertilizers for that crop has been limited to some experiments in research centers. There was a belief that barley does not need fertilization and that chemical fertilizers cause crop lodging. Even in the last fertilizer recommendations from the fertilizer committee in the Ministry of Agriculture (Adary *et al.* 1991), the recommended rate for barley is limited to the use of 27-27-0 fertilizer at 200 kg/ha with TSP fertilizer at 25 kg/ha in the reclaimed irrigated areas and under high rainfall conditions. No fertilization was recommended for the marginal area (250-350 mm), where most of the barley is grown.

The results of many soil sample studies reveal that the soils in the country have low nitrogen and available-P contents. Nitrogen and phosphorus addition is therefore necessary to increase production, especially under intensive farming. Barley may need less fertilizer than wheat, but if productivity is to be increased for barley, especially when more efficient varieties are introduced, chemical fertilizers must be used. The results of many experiments in different parts of the country have shown that barley gives a high response to chemical fertilizers. The results of 3 years of experiments on barley (var. Arivat), carried out by Ameen (1979) in a brown soil in Sulaimania, showed that barley responds to chemical fertilization, especially nitrogen fertilizer. The highest yield (4580 kg/ha) was obtained under 180 kg N/ha + 120 kg P_2O_5/ha + 60 kg K_2O/ha (Table 1) in comparison with no fertilization (1924 kg/ha). The percent increase due to nitrogen alone was 105%. The addition of phosphorus or potassium without nitrogen had little effect. These results may be due to the low content of organic matter in soils and the loss of nitrogen by volatilization or leaching.

Many workers (Luebs and Lagg 1967; Dwiredi *et al.* 1989) reported that nitrogen fertilization would improve root growth, which makes it possible for the plant to absorb phosphorus, potassium and other nutrients from a larger volume of soil.

Different varieties differ in their requirement for fertilizers, and the amount of nutrients needed increases with the increase in productivity. Adari *et al.* (1991) have shown that the variety Rihane gave a higher response to N-P fertilization than the local variety Asswad under rain-fed conditions as well as with supplementary irrigation.

In the rain-fed area, which constitutes the main area for grain production in the country, the local variety Aswad (*Hordeum distichum* L.) is usually grown. Some new varieties like Rihane (*H. vulgare*) from ICARDA were introduced recently. In this area, barley is usually not fertilized, partly because of the limited rainfall and partly because of the belief that fertilization causes lodging. On the contrary, many workers have shown that barley responded to relatively high fertilizer levels, whether under irrigated or dry farming conditions. Stanberry and Lowery (1965) showed that barley production was increased with the addition of up to 135 kg N/ha, when they used 1010 mm water, but under limited moisture (470 mm) the response was only up to 65 kg N/ha. On the other hand, Luebs and Laag (1967) pointed out that the yield of barley was reduced when a high amount of nitrogen was used under high water tension. Dwiredi *et al.* (1989) showed that increasing nitrogen fertilization up to 80 kg/ha increased the number of tillers, spike length

Table 1. Effect of fertilization on yields of Arivat barley (1976-1979), Bakrajo, Sulaimania.

Fertilizer (kg/ha)			Grain yield (kg/ha)	Increase over control (%)
N	P_2O_5	K_2O		
0	0	0	1924	0
0	0	60	1636	0
0	60	0	2108	10
0	60	60	2396	25
60	0	0	2520	43
60	60	0	352	83
60	0	60	3136	65
60	60	60	2992	56
60	60	120	3524	83
60	120	60	3340	74
120	0	0	3720	93
120	60	0	3656	90
120	0	60	4200	118
120	120	0	3740	48
120	120	60	4324	125
120	120	120	3960	106
180	0	0	3960	106
180	60	0	4140	115
180	120	120	4476	133
180	120	0	4052	111
180	120	60	4580	138
180	120	120	4460	132

and grain yield. It is clear that the extent of barley response to fertilization, apart from variety, soil and climatic conditions, depends on balanced fertilization. The addition of nitrogen fertilizer without adequate amounts of available phosphorus and potassium will result in more vegetative growth and weak stems, which cause lodging and low yield. Schjorring (1986) reported that NO_3-N absorption by barley was reduced by 58% when phosphorus was deficient in the nutrient solution in comparison with adequate P levels. The effect of potassium in increasing the efficiency of plants to use nitrogen is referred to by many workers (PPI 1984; Kaddar *et al.* 1985; Pretley and Stangel 1985). Phosphorus and potassium are known to increase drought resistance of crops and must be used under dry farming conditions. Iraqi soils generally contain enough potassium for grain crops, but nitrogen and phosphorus addition is necessary.

Adari *et al.* (1991) showed that the highest yield of local varieties Rihane and Harmal was obtained when 80 kg N-P/ha were added, whether under dry farming conditions or with supplementary irrigation. Fertilization increased the number of spikes/m^2, number of grains/spike, weight of 1000 grains and grain yield. The response was higher under high-rainfall conditions. It must be noted, however, that this amount of fertilization was the highest level used by the authors, which revealed that more levels of fertilizers may be used.

It is concluded that little work on the fertilization of barley has been done, and that more work in this direction is needed to go hand in hand with the breeding programs, in order to improve barley production in the country. International as well as regional cooperation is needed.

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Crop Sequence Options

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Abstract

Arable cropping in the barley-livestock zone of West Asia has intensified in recent years. Much of the land is now cropped annually, mainly to continuous cereals. The earlier research priority of fallow replacement is rapidly evolving into studies of crop sequence and rotation. Major concerns in optimizing crop sequence are (1) water-use efficiency, (2) nutrient cycling, with especial reference to biological nitrogen fixation, and (3) avoidance of pest and disease build-up. Further, in an agricultural zone strongly oriented to animal production, sequences involving forage legumes, notably *Vicia* and *Lathyrus* species, are of particular interest. Data are presented from the 6th to 10th seasons of two trials in Syria, which compare various 2-year rotations involving barley. Highest barley yields are usually obtained after fallow, but barley-fallow is not the most productive 2-year sequence. Barley-forage legume rotations show real advantages over barley-only rotations (barley-fallow and barley-barley), but these advantages exist largely and most consistently in quality factors invisible to farmers: crop N output per rotation and barley N status (protein content). To facilitate farmer adoption we need forage legumes with enhanced biomass production and/or barley yields after legumes that match barley yields after fallow. New treatments added to the above trials in the 9th and 10th years show some promise in this respect: *Vicia narbonensis* has so far outyielded the ongoing *Vicia sativa* and *Lathyrus sativus* at both sites in both years, and barley yields following *V. sativa* 'harvested' as green grazing have equalled yields after fallow.

Introduction

Our focus is on the drier arable areas, the barley-livestock zone, of West Asia. Until recently, the crop sequence options utilized in that zone were few. Most farmers grew mainly cereals, wheat and barley, in rotation with fallow. That is, most land produced a crop only once every 2 years, and, between crops, the cereal stubble. Later, weed growth provided grazing for sheep and goats. Some forage legumes were grown, particularly when there were still draft animals to feed, and food legumes and summer crops could be locally important on land favored by high rainfall, deep soils or helpful topography. However, generally the pattern of the arable landscape each winter was approximately 50% under cereals, 50% fallow.

Rapid increases in demographic and economic pressures in recent years have greatly changed this pattern. Many farmers now plant all of their fields to crops every year or nearly every year, depending on seasonal rainfall distribution and seed availability. We have previously labelled this intensification of land use 'fallow replacement.' Now that there is little fallow left to replace, the issue is more one of crop sequence: which order are crops grown in; does it matter; is there an optimum?

In fact, the commonest sequence in many areas is cereals (usually barley) every year, broken only occasionally by fallow, and then probably by accident rather than through deliberate planning. Although deplored by agronomists, continuous cereals still appear to most farmers to give the best returns for effort and low-volume inputs. Market prices are good and animal feed is in short supply. Again, does it matter? Who is right?

To judge this, two basic aims or interests — of farmers and those who try to advise them — should be kept in mind:

1. To optimize current output (biological **and** economic) per unit area, taking account of the requirements of the whole farm enterprise. This will likely include food for the family, feed for animals and products for sale, but time left available for other enterprises also may be important. (Recent surveys have shown the number of part-time farmers to be increasing.)

2. To maintain the productivity of the land and its potential for continued production in the future, i.e., protection of the soil fabric, maintenance of fertility, avoidance of pest build-up, etc.

Farmers give more weight to the first of these interests, while researchers, planners and environmentalists worry (or should worry) more about the second. Yet, it is in the long-term interests of everyone (including economists and political leaders) to reconcile the two interests: production today **and** tomorrow. For arable land, we need crop sequences that optimize (and are seen by the farmer to optimize) production each year and will sustain the potential for future production. This does not necessarily rule out growing cereals continuously, although it will probably be more difficult and less profitable in the end to do so. Nor does it necessarily rule out fallowing. Turkish studies suggest that, for the riskier areas of the Anatolian plateau, rotations that include a fallow one year in every three or four may provide the best option (Karaca *et al.* 1991). Local circumstances (rainfall and temperature regimes, soil types, traditional systems and modern market forces) will always determine local optima, and we should not expect research to identify any universal best-bet rotation for dry barley-growing areas but rather to provide a better understanding of the underlying principles.

Those principles include, importantly, the management of soils and crops for more efficient use of water and of nitrogen. Two recent ICARDA workshop proceedings cover these topics in some detail (Osman *et al.* 1990; Harris *et al.* 1991a) and this paper does not re-review all that material. Instead, the aim is to identify and describe briefly the main biophysical processes that appear to influence both the short-term and long-term success of dry-area arable rotations, and then to draw on recent data from ongoing barley rotation trials at ICARDA to highlight current issues and future research directions.

Rotational Processes

These may be conveniently considered under three headings: water, nutrients and pests, although the existence of a complex of interactions between them, particularly between nutrients and water, should be recognized.

Water

This is the first limiting factor in most dry arable situations. From a technical perspective, the priorities are to catch and infiltrate rain where it falls and to maximize the proportion of water that is transpired by a productive crop, minimizing the losses from soil evaporation and weed transpiration. Questions of tillage, fertilization and early crop establishment are relevant here: it was demonstrated in the early 1980s that net increases of around 75% in water-use efficiency (kg dry matter ha^{-1} mm^{-1} evapotranspiration) could be achieved from fertilizing rain-fed barley in northern Syria (Cooper *et al.* 1987; Shepherd *et al.* 1987), and such considerations may influence choice of rotation. However, the major rotational issue in respect of water and water-use efficiency concerns fallowing.

One widely believed advantage of fallows, particularly of clean fallows, is the storage in the soil of part of the fallow-season rainfall to benefit the crop grown the following year. Part of that rainfall is rapidly lost, by evaporation and (except in clean fallows) by transpiration by weeds; but, provided the soil is deep, the rest may be stored. In fact, the amount of water stored is often overestimated. Especially where summers are long and hot and where the soil cracks to depth, evaporative losses are high, and no plant-available water is retained above 45 cm depth (or deeper in many cases). The widely held perception that fallowing is a practice of particular importance for the driest areas is not supported by the facts. From experience in Cyprus, Papastylianou (1991) observed that, if the fallow-year rainfall is less than 200 mm, its penetration is only shallow and no water is stored for the subsequent year. Over five years at Breda, Syria (mean annual rainfall, 270 mm) the proportion of the previous winter's rainfall stored at the end of the summer was always less than 10% (Harris *et al.* 1991b).

Subsoil water is used efficiently by the crop, often promoting (like supplemental irrigation) a greater efficiency of use of the incident rainfall, but at Breda a barley-barley sequence had greater water-use efficiency than a fallow-barley sequence. Storage of fallow-year water was greater (8-37%) at Tel Hadya (mean rainfall, 330 mm), but even there it was only when a severe drought followed an exceptionally wet season that the fallow rotation was most water-efficient. Unfortunately, it is in the nature of things that, with decreasing mean annual rainfall, the probability of achieving substantial long-term storage decreases as the need for it, to improve and stabilize the subsequent season's crop yield, increases; in low-altitude, hot-summer environments it may not be the best strategy for optimum water-use efficiency. Under the shorter, milder summers of higher altitudes, the case may be different, as Turkish work suggests (Karaca *et al.* 1991).

Nutrients

Most arable soils in the barley-livestock zone of West Asia are deficient in available phosphate and nitrogen. In 75 on-farm barley fertilizer trials across northern Syria, grain and/or straw responded positively and significantly to applied nitrogen and/or phosphate on 74 occasions (Jones and Wahbi 1992). Responses to phosphate were most frequent at the driest sites (Table 1), the major mechanism being the enhancement of the rate of establishment of crop cover and hence of water-use efficiency (as noted above). For this nutrient, there appears to be little alternative but to apply fertilizer, and little interaction effect on yield between phosphate fertilization (rate, timing in crop sequence) and rotation has been noted.

Nitrogen is a different story. The nitrogen removed from the field in the harvested barley amounts, very approximately, to 20 and 5 kg N/t of grain and straw, respectively. This is more than is normally replaced by natural processes like atmospheric deposition and non-symbiotic fixation, and responses to fertilizer nitrogen are frequent, even under the driest conditions (Table 1). However, biological fixation appears to offer an alternative to fertilizers. There are a number of forage legume species adapted to the barley-zone environment and appropriate to the predominantly animal-oriented farming systems.

Table 1. Percentage distribution of significant (5%) positive responses by barley to N fertilizer in 75 on-farm trials in northern Syria, as affected by rainfall and crop sequences (from Jones and Wahbi 1992).

		Grain		Straw	
Factor	No. sites	N	P	N	P
Rainfall (mm)					
< 225	24	21	88	50	96
225-300	29	52	52	76	79
> 300	22	73	41	86	59
Previous crop					
Fallow	54	44	65	65	81
Barley	21	57	86	86	71

Nevertheless, although legumes are generally assumed to improve soil fertility by adding nitrogen, hard evidence for dry West Asian conditions is scarce. It is fairly clear that a barley crop following a forage legume usually yields more and takes up more N/ha than barley following barley. For example, barley yields in Cyprus showed a strong interaction between rotation and N-fertilizer regime (Table 2): barley in a barley-vetch (*Vicia dasycarpa*) rotation receiving no N yielded as much grain as barley in barley-fallow or barley-barley rotation receiving 60 kg N/ha. Papastylianou and Samios (1987) reported that rotations including vetch yielded 44-60 kg N/ha more than was added in fertilizer, while for barley following barley the annual N balance between output and input was only 5-6 kg N/ha.

It should be emphasized that such results do not necessarily imply any long-term improvement in fertility where legumes are included. In the Cyprus trials, soil total-N content was similar in the different rotations at the end of a 7-year period (Papastylianou and Samios 1987). A subsequent trial at one of the same sites, comparing sequences of barley with vetch (*V. sativa*) or oats (*Avena sativa*) and utilizing an ^{15}N enrichment technique, indicated that biologically fixed nitrogen from the vetch contributed little to the soil available-N pool or to the nitrogen in barley. Most of the increased uptake of nitrogen by barley following vetch (rather than oats) was attributable to a greater availability of soil N arising from the lower uptake of soil N by the preceding vetch than by the oats (Danso and Papastylianou 1992). There are no reasons to suppose the situation of barley-vetch *vis-à-vis* barley-barley rotations is substantially different. Broadly, the presence of a legume crop allows the partial recovery of the soil's native available-N status, as happens under fallow, whereas a cereal crop, having no alternative supply, does not.

Table 2. Effects of rotation and N fertilizer on mean barley grain yields (t/ha) in Cyprus: 6-year means over two sites in Cyprus (from Papastylianou and Jones 1988).

Applied N (kg/ha)	Rotation		
	Barley-vetch	Barley-fallow	Barley-barley
0	1.86	1.51	0.95
60	1.7	1.9	1.7

All differences significant at $P < 0.05$.

Pests

Rotational effects on pest incidence in dry barley-growing areas are poorly documented. Fallows almost certainly limit the build-up of pests and pathogens, but rotation with non-cereal crops may be equally effective against organisms specific to barley. Generally, fallows and rotations control relatively immobile pests whose larvae are found in the soil or on crop residues. Populations of *Porphyrophora tritici*, a root-sucking pest of barley and wheat in parts of Syria and Turkey, can be kept low by rotating the cereal crop with bare fallow or a non-susceptible species (Rashwani 1981). Wheat ground beetle (*Zabrus tenebroides*) also can be a serious problem where cereal follows cereal in a mild, wet winter and the residues of the first crop are left on the soil.

In ICARDA long-term trials, the appearance of barley in unfertilized, continuous barley plots suggests serious root problems, but attempts a few years ago to identify specific pathogens were unsuccessful. Barley grown continuously with moderately heavy N and P fertilization remains apparently healthy, but so does unfertilized barley following fallow or a forage legume.

Barley Rotation Trials at Tel Hadya and Breda

Trials were initiated in the 1982/83 season. Data from the 6th to 10th seasons (1987-1992) are used here to compare four rotations: barley-lathyrus (*Lathyrus sativus*) [B-L], barley-vetch (*Vicia sativa*) [B-V], barley-fallow [B-F] and barley-barley [B-B].

Both phases of each rotation are grown each year under both fertilized and unfertilized conditions. The fertilizer treatment is an N and P addition to the phase 1 barley crop only. Comparisons are made in terms of barley yields, total rotation output of crop dry matter (DM), total rotation output of crop nitrogen, and barley quality (N%). These give different perspectives of the relative values of the four rotations.

Barley yields varied greatly according to season, especially at Breda. Mean annual values of total DM were 4.06-6.65 t/ha at Tel Hadya and 1.65-6.90 t/ha at Breda. Highest barley yields were almost always obtained following fallow, and frequently (but not invariably) barley yields following vetch or lathyrus were higher than those following barley. These trends (Table 3) were largely independent of site and fertilizer regime.

Table 3. Five-year yield totals (%) from phase 1 barley crops in four different rotations.

	Tel Hadya		Breda	
Preceding crop	Grain	Straw	Grain	Straw
With fertilizer (N + P)				
Lathyrus	80	82	81	95
Vetch	84	83	84	96
Fallow	100	100	100	100
Barley	69	66	64	67
Without fertilizer				
Lathyrus	75	75	82	86
Vetch	78	80	84	89
Fallow	100	100	100	100
Barley	46	47	55	66

However, these yield trends are from a single-year viewpoint. On a whole-rotation basis, greatest output came from the barley-only rotations, B-B and B-F. That from

B-B rotation was high because all the cropped area produced barley every year, but comparison of the annual grain yield means (Table 4) shows that any advantage over B-F rotation was small and the annual variability tended to be greater. If a high value is placed on growing as much barley as possible, then it makes sense to grow it exclusively, in either B-F or B-B rotations, which produce, very approximately, 20-30% more grain; but, given the inevitably higher production costs that a doubled area entails (and the greater difficulty of harvesting larger areas of poorer crop) these results demonstrate no advantage to B-B over B-F rotation.

Table 4. Five-year mean barley grain yields (t/ha) from four rotations on a whole-rotation basis, with coefficients of variation as indices of annual variability.

	Tel Hadya		Breda	
Rotation†	Mean	CV (%)	Mean	CV (%)
With fertilizer (N + P)				
B-L	2.24	30	1.49	79
B-V	2.33	33	1.55	78
B-F	2.78	20	1.83	53
B-B	3.09	32	1.89	58
Without fertilizer				
B-L	1.68	27	1.00	86
B-V	1.75	26	1.02	79
B-F	2.23	17	1.21	76
B-B	2.03	26	1.32	80

† B = barley, F = fallow, L = lathyrus, V = vetch.

Total rotation dry matter production was often greatest in barley-legume rotations, although this was not consistent in all years at both sites. Five-year totals imply that rotations with legumes outyielded barley-only rotations (Table 5), but all the differences between the two could be said to have arisen in 1987/88, which was an unusually wet season. There is insufficient quantitative difference between the rotations in a normal year to convince a farmer that he should plant legumes.

Table 5. Effect of rotation on total crop dry matter production (t/ha)†, 5-year totals.

	Tel Hadya			Breda		
Rotation‡	Total	Mean	Diff.§	Total	Mean	Diff.
With fertilizer (N + P)						
B-L	22.8			16.7		
B-V	21.3	22.1		16.5	16.6	
			4.0			3.8
B-F	17.4			11.9		
B-B	18.8	18.1		13.7	12.8	
Without fertilizer						
B-L	16.7			10.8		
B-V	15.9	16.3		10.1	10.5	
			3.9			1.9
B-F	12.8			7.6		
B-B	11.9	12.4		9.5	8.6	

† Total dry matter is the sum of barley grain and straw and legume grain and straw, as appropriate.
‡ B = barley, F = fallow, L = lathyrus, V = vetch.
§ Difference between means of rotations.

Total rotation crop nitrogen output shows large differences among rotations, unfortunately invisible to farmers. Over 4 years, the presence of a legume in the rotation was worth about 35 kg N/ha per annum at Tel Hadya (Table 6). At Breda, the figure was close to 30 kg N/ha per annum but only in the fertilized situation, probably because the dryness exacerbates the effects of the natural soil deficiency in phosphate there. In the unfertilized situation, the mean annual excess of crop N in barley-legume rotations was 17 kg N/ha.

Table 6. Effect of rotation on net total crop nitrogen output (kg N/ha)†, 4-year totals.

	Tel Hadya			Breda		
Rotation‡	Total	Mean	Diff.§	Total	Mean	Diff.
With fertilizer (N + P)						
B-L	224.1			177.0		
B-V	172.1	198.1		161.5	169.3	
			148.5			116.6
B-F	54.1			57.6		
B-B	45.0	49.6		47.7	52.7	
Without fertilizer						
B-L	235.8			147.1		
B-V	195.0	215.4		119.9	133.5	
			128.5			68.9
B-F	92.2			62.8		
B-B	81.5	86.9		66.4	64.6	

† Total N in barley grain and straw and legume grain and straw, as appropriate, but with 4-year fertilizer inputs subtracted (80 kg N/ha at Tel Hadya, 40 kg N/ha at Breda).
‡ B = barley, F = fallow, L = lathyrus, V = vetch.
§ Difference between means of rotations.

Barley quality. The extra nitrogen output of the barley-legume rotations was not located solely in the harvested legume crops. There was a general tendency for the nitrogen content (%) of the barley grain and straw from B-L and B-V rotations to be higher than that from the barley-only rotations, especially the B-B rotation (Table 7). Improvement in N content relative to B-B values amounted to 15 and 13% for grain and 4 and 17% for straw, for Tel Hadya and Breda, respectively.

Table 7. Effect of rotation on percent protein content (N% x 6.25) of barley grain and straw (5-year mean values).

Rotation	Tel Hadya		Breda	
	Grain	Straw	Grain	Straw
With fertilizer (N + P)				
B-L	11.7	3.2	13.2	4.5
B-V	12.1	3.4	13.1	4.5
B-F	11.0	3.0	12.3	3.9
B-B	10.0	2.9	10.6	3.4
Without fertilizer				
B-L	10.1	2.6	12.0	4.6
B-V	10.5	2.7	11.6	4.2
B-F	9.9	2.7	12.2	4.2
B-B	9.3	2.8	11.4	4.2

New Approaches

It might be concluded from the preceding summary of results that there are real advantages in barley-legume rotations over barley-only rotations, but that those advantage exist largely and most consistently in two factors that are not evident to farmers: higher total N output per rotation, and higher percentage N content of the barley component.

They are therefore unlikely to encourage the adoption of forage legumes into barley rotations by farmers. What is needed is more visible evidence of greater output where legumes are included, e.g., greater legume bulk and/or higher barley yields following legumes (that is, equal to barley yields following fallow).

For the last two seasons, the barley rotation trials at Tel Hadya and Breda have included two new rotations, one involving another promising forage legume, narbon vetch (*Vicia narbonensis*) harvested mature, the other growing common vetch (*V. sativa*) harvested early by simulated green grazing. It is hoped that the narbon vetch will be more productive than the other two legumes used (without prejudice to the subsequent barley crop). The green grazing treatment, which can be a profitable mode of utilization (lamb fattening, enhanced milk production), has been shown in other trials to affect the soil in a similar way to a bare fallow, leaving more available water and/or available nitrogen than a forage legume grown to maturity.

Results to date show that narbon vetch produced significantly more dry matter at both sites in both years (Table 8). The advantage amounted to about 30% at both sites in 1990/91, and 57 and 47% at Tel Hadya and Breda, respectively, in 1991/92. However, it is important to check whether this increased productivity had any adverse effect on the following barley crop. So far, this can be done only for the 1991/92 season, when the barley grain yield after narbon vetch was slightly lower than that after the other two mature-harvested legumes at Tel Hadya and slightly higher at Breda, in neither case significantly so (Table 9). At the same time, barley after "green-grazed" common vetch produced grain yields comparable with those from the B-F rotation, 25 and 13% higher than yields after mature common vetch (Tel Hadya and Breda, respectively).

Table 8. Two-season comparison of total mature dry matter production (t/ha) of narbon vetch (*Vicia narbonensis*) with lathyrus and common vetch.

Legume	Tel Hadya		Breda	
	90/91	91/92	90/91	91/92
	***	***	***	***
Lathyrus sativus	2.16	2.14	1.62	2.23
Vicia sativus	2.17	2.09	1.45	2.07
Vicia narbonensis	2.86	3.32	1.97	3.16
SEM	±0.063	±0.123	±0.045	±0.044

*** P≤0.01.

Again for the 1991/92 season only, values of the rotational output of crop nitrogen show only small differences among the four barley-legume rotations (Table 10). The narbon vetch-based rotation was marginally the most productive of nitrogen. Green grazing of common vetch had little effect on rotational nitrogen output but caused a greater proportion of that nitrogen to be found in the barley (79 versus 60% at Tel Hadya, and 65 versus 53% at Breda).

Table 9. Effect of preceding crop on barley grain yields (t/ha)† in 1991/92.

Preceding crop	Tel Hadya	Breda
	*	ns
Lathyrus (mature)	2.46	1.05
Common vetch (mature)	2.49	1.08
Narbon vetch (mature)	2.40	1.14
Common vetch (green)	3.11	1.22
Fallow	3.04	1.28
SEM	0.191	0.065

† Values are means of N-P and zero fertilizer treatments. The fertilizer effect was significant at both sites, but there was no interaction with preceding crop treatment.

Table 10. Effect of different legume-based rotations and fertilizer on total crop nitrogen output (kg/ha)† in 1991/92.

	Tel Hadya		Breda		
Legume in rotation	N-P	0	N-P	0	Mean
Lathyrus (mature)	65.9	35.4	52.3	31.8	46.4
Common vetch (mature)	58.1	32.6	48.7	27.3	41.7
Narbon vetch (mature)	60.8	37.4	58.2	34.9	47.8
Common vetch (green)	63.2	37.4	45.4	27.2	43.3

† Total N in barley grain and straw and legume grain, straw or clipped green material, as appropriate.

These results give some support to the hope that visible, quantitative increases can be achieved in yields of barley-legume rotations through the introduction of more vigorous legume material and/or by utilizing the legume at an earlier stage of growth.

Conclusions

The farming systems of West Asia are undergoing rapid change. A major feature of that change is an intensification of land use, particularly arable land use. Systems in which crops are grown only biannually, with fallows in the alternate years, are rapidly being superceded by annual cropping. This need not be regretted, but the loss of the buffer that in some respect the fallow provided requires a more informed, more planned approach to crop production, if increased output is to be maintained indefinitely.

A major feature of a more planned approach is crop rotation. To many farmers continuous cereal production currently appears to be the only (or at least the most profitable) option, and with luck and a fairly liberal use of fertilizer, the main dangers of pest build-up and fertility decline may possibly be averted for quite a long time. But such a system is unlikely to be stable and productive on a permanent basis. Nor is it likely to be the most high yielding. Results from trials at ICARDA and elsewhere show that rotations of barley with forage legumes equal or surpass continuous barley in biomass production and are greatly superior in terms of biomass quality.

Unfortunately, the quality aspect is still largely unappreciated by the farmer, who looks mainly for biomass quantity and perhaps sees legumes as crops more sensitive to drought and cold than barley. To overcome these perceptions and to help farmers build stable, productive rotations based on barley and legumes, several parallel research and extension efforts are required, including:

1. The identification, selection and improvement of forage legumes adapted to dry areas; valuable traits would be more rapid winter growth and high biomass production.
2. Demonstration to farmers of the different modes of forage legume utilization, and the differential influence of these modes on subsequent barley yields.
3. Demonstration to farmers of the higher feed value of the legume biomass.
4. The development of a structure for providing cheap forage-legume seed and for marketing legume forage products at a premium price.

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Effect of Forage Legumes on Barley Seed Yield and Lamb Fattening on Pasture Legumes under Rain-fed Conditions in Jordan

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Abstract

With the current high prices for livestock and livestock products, forage legumes are increasingly attractive to farmers in Jordan. Therefore, the need to increase forage production to meet the growing livestock population in the Mediterranean region necessitates the evaluation of forage legume-cereal crop rotations to maximize herbage yield and to improve land profitability. Barley was sown after forage legumes (*Vicia sativa* and *Medicago* spp.) and after fallow. In both years the entries were sown in November and their primary growths sampled periodically during growth. At Ramtha, rainfall has exceeded 250 mm in only 4 years, which is considered the absolute bare minimum for annual forage production. Dry matter of herbage yield, seed yield and lamb production were recorded. In both seasons, barley sown after fallow attained the highest seed yield and there was limited variation in the maximum dry matter yield of forage legume species. In general, the maximum production of barley seed yield [325 kg/du (3250 kg/ha)] and dry matter herbage yield of grazing forage legume [380 kg/du (3800 kg/ha)] were attained in 1988 when the highest annual rainfall (311 mm) was received. Throughout, the highest net return over 6 years [8.8 JD/du (88 JD/ha)] was given by a barley/grazing forage legume rotation.

Introduction

In Jordan, cereals are usually grown continuously or in rotation with fallow or food legumes. In times of high prices for livestock products, forage legumes, which may be fed to livestock in the form of straw, grain or grazed pasture, become an increasingly attractive alternative to fallow.

This forage is most efficiently utilized by livestock, in particular young rapidly growing lambs (Anonymous 1989). Where machinery is available, forage also can be used to produce high-quality hay (Osman and Nersoyan 1986).

In those parts of Jordan where annual rainfall is less than 300 mm, there are small areas of annual medic (*Medicago* spp.) whereas in higher rainfall regions there are slightly larger areas of common vetch (*Vicia sativa*) and bitter vetch (*V. ervilia*). Several other species have been tried, most notably the forage legume narbon vetch (*V. narbonensis*) and woolly-pod vetch (*V. villosa* ssp. *dasycarpa*). Where rainfall exceeds 300 mm the most promising of these species is thought to be common vetch (Tow 1987). In such areas, these forage legumes could replace fallow in such a way that a ley farming system could be established (Ababneh 1983). Aside from high feed production, the legumes in the ley farming system would have a tremendous impact on cereal production through symbiotic nitrogen fixation. Annual medics and vetch are considered to be the most promising legumes for such a system (Hancock 1990).

At present, cereal/livestock farmers in Jordan are not maximizing their profits or productivity for two main reasons:

1. They do not grow their own forage to feed their livestock.
2. The fallow year of the cereal/fallow rotation is a wasted year of productivity.

Therefore, a 10-year cereal/forage legume rotation trial was designed in 1985 and conducted at Ramtha Agricultural Research Station through the Jordan/Australia Dry Land Farming Project. The objectives of this study were to introduce vetches or medics as forage legumes to replace fallow, to provide livestock feed to encourage farmers to adopt an integrated cereal/livestock farming system to meet the local consumption in terms of livestock products such as red meat and/or milk, and to improve land use in Jordan.

Materials and Methods

The experiment included the following six treatments with three replicates using the Complete Randomized Design: grazing forage - barley (GB); hay-making forage - barley (HB); fallow - barley (FB); barley - fallow (BF); barley - hay-making forage (BH); barley - grazing forage (BG).

The experiment was sown on 28 December 1985. The crop phase was barley and the pasture phase a mixture of snail medic (*Medicago scutellata* cv. Sava), annual medic (*M. rigidula*) and common vetch (*V. sativa*).

All crop species (barley, vetch and medic) were sown at 7, 10 and 3 kg/du (70, 100 and 30 kg/ha) respectively in 70 × 230 m plots and fertilized with 10 kg/du

(100 kg/ha) of Diammonium Phosphate (DAP). In spring, volunteer cereals were sprayed with fusilade. At the flowering stage four treatments of BG, BH, GB and HB were fenced to be grazed by introducing 48 lambs (12 lambs/plot). Herbage yield, seed yield and weight of each lamb before and after grazing period were recorded.

Results and Discussion

The most productive treatment for seed production was barley-fallow (BF), with a very limited variability in herbage yield between forage legume species used in this trial. However, the economic summary rotation trial over 6 years (1985-1991) showed that the most profitable farming system (8.8 JD/du; 88 JD/ha) is barley-grazing forage (BG).

Each farming system consisted of two treatments which were both replicated three times. For example, fallow and barley were included each year and comprised six plots. The figures presented are the average of each rotation and its reverse for each year.

In view of the huge diversity of climatic conditions in rain-fed areas of Jordan, few species have been used as forage legumes. However, a large area of Jordan is affected by frost and most of the South Australian medics currently being studied are frost sensitive (Radwan *et al.* 1978). Vetches and chicklings are more frost tolerant and could be used instead of medics; vetches are classified as moderately frost tolerant (Lakhanova 1985).

The Ramtha Trial has now completed seven full seasons which has allowed the evaluation of three complete cycles of the 2-year rotation. Some trends are now appearing but it is essential to continue this trial for another 3 years to ensure the farming rotations are stable and sustainable. As can be seen in Table 1 the range of economic return varies proportionally to the average annual rainfall.

The grazing forage (medic)-barley (GB) rotation continues to be the most profitable. In the seasons of above-average rainfall (1986/87, 1987/88 and 1989/90) when dense herbage mass (Fig. 1) was obtained, good economic gains were made from lamb fattening. During these seasons, total red meat production (total liveweight gain, kg) ranged from 17 to 32 kg/du (170-320 kg/ha) when stocked at 3-4 lambs/du (30-40/ha) of grazing medic. In the other three seasons, lamb fattening was not possible and gave negative gains for the forage. Barley yields were 23% lower than for the barley-fallow rotation; this is to be expected in a low-rainfall environment when annual rainfall is 200 mm. Assisting this depression in barley yield is the infestation of "wild barley" which has proved difficult to control in the non-fallow treatments with the resources and management currently available on the station.

Table 1. Economic summary of a rotation trial at Ramtha station for 6 years, 1985-1991.

	Net return (JD/du)†			
Season	Rainfall (mm)	Barley-grazing (medic)	Barley-hay (*V. sativa*)	Barley-fallow
1985/86	165	−2.42	−2.43	−1.82
1986/87	297	13.43	12.79	6.13
1987/88	311	10.11	3.79	9.05
1988/89	148	−0.40	−0.50	0.04
1989/90	248	31.32	13.20	13.06
1990/91	168	0.76	0.24	5.17
Average	223	8.80	4.52	5.27

Source: JADF Annual Report (1990).
† JD/du × 10 = JD/ha.

The barley-fallow (BF) rotation continues to give the highest annual seed yield in average followed by grazing forage treatment in most cases as shown in Table 2, but when this is combined with the cost of maintaining a fallow the Annual Gross Margin is 40% lower than that of the grazing forage-barley (GB) rotation. This rotation is the easiest to manage with the owner only needing to spend 3 days in the field (for seeding, spraying and harvesting) and therefore continues to appeal to those absentee landowners who have jobs in major cities of Jordan.

The hay forage-barley (HB) rotation has a Gross Margin similar to that of the barley-fallow (BF) rotation but requires more management. Therefore, it can be said that the use of hay forage or seed and *tibn* collection is not an economical or feasible replacement for the barley-fallow rotation in the Ramtha area (Table 1). However, the herbage yields of *V. sativa* cv. Beekia do indicate that this forage would be equal to that of the medic for lamb-fattening purposes (Fig. 1).

Table 2. Barley seed yield (kg/du)† at Ramtha station (rotation trial).

Season	Rainfall (mm)	B-F‡	B-V	B-M
1986/87	297	246	235	250
1987/88	311	325	160	235
1988/89	148	74	50	30
1989/90	248	190	130	142
1990/91	168	127	65	80
1991/92	380	256	183	196
Average	258	203	137	155

† kg/du × 10 = kg/ha.
‡ B-F = Barley-fallow; B-V = Barley-vetch; B-M = Barley-medic.

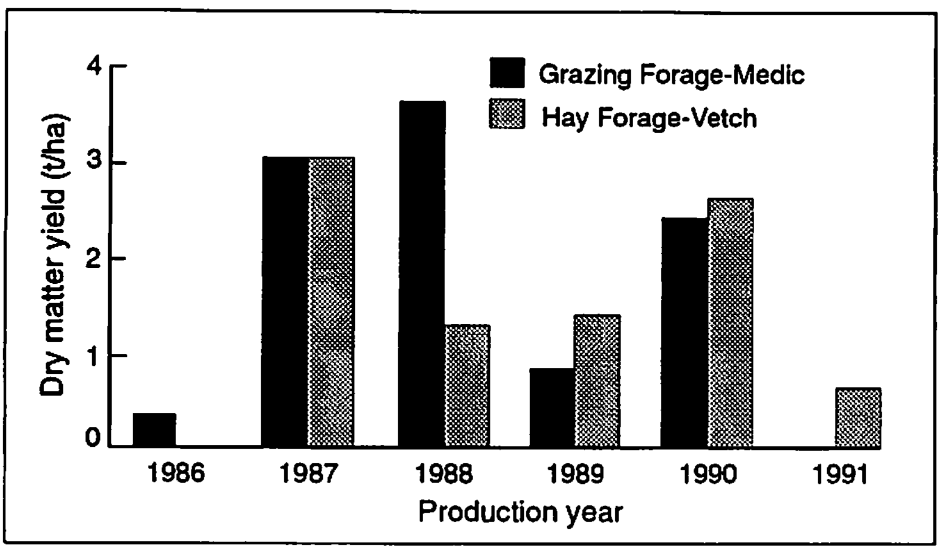

Fig. 1. Herbage production from grazing and hay forage; herbage yield in 1988 had 90% vetch as dry matter.

Conclusions and Recommendations

The grazing forage (medic)-barley rotation after 6 years of continual evaluation continues to be 40% more profitable than the traditional barley-fallow rotation.

This experiment has provided valuable basic data on the feeding value of several legume species for grazing, thus providing an economic assessment of livestock production from these plants.

The high feeding value of vetch has given a new slant to thinking about forage production in Jordan. Because common vetch is well known in Jordan and seed is readily available, it is possible to recommend lamb fattening on vetch. Vetch crops have been grown in Jordan for many years, mostly for seed production, which is used for production of concentrate feed for livestock. Forage legumes are an excellent crop to grow for grazing sheep, goats and cattle for the production of meat and milk.

Acknowledgements

The authors sincerely thank the Mashreq project for following up this trial, and Mrs Sa'eda Arabiat for typing the original manuscript.

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Discussion

A.R. Al-Rawi
You mentioned that in 1990 the red meat produced per dunum on grazing legume was 32 kg. Does this figure represent red meat or liveweight?

M. Ababneh and F.T. Awawdeh
Yes, the 32 kg represents live body weight. Thus to calculate return, liveweight should be multiplied by 0.45 to obtain meat produced.

M. Abu Zant
Could you elaborate on the time when grazing was started and terminated? Did the sheep graze after pod formation?

M. Ababneh
Grazing started at 50% flowering. No, sheep did not graze after pod formation.

The Search for Dual-purpose Barley

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Abstract

In the central irrigated plains of Iraq, green fodder is in short supply in late autumn and early winter. Sheep and cattle owners usually rely on barley for their green forage supply, but the varieties grown (California Mariout, Numar and Arivat) do not tolerate two rounds of clipping. They supply green fodder but lose their grain yield because they are early grain producers of spring growth habit. A project was initiated in 1985 with the objective of recommending a dual-purpose barley variety that serves the needs of sheep and/or cattle owners for green fodder supply and still maintains a high grain production when the stand is left for grain yield after two consecutive rounds of clipping. Three experiments were established: Experiment I during the 1985/86 and 1986/87 seasons, Experiment II in the 1987/88 season and Experiment III in 1991/92 and 1992/93 seasons. The research team identified lines 99 and 265 as agronomically superior to the old recommended varieties of barley because they could tolerate two consecutive rounds of clipping at the pre-stem elongation stage. Line 99 averaged 11.28 t/ha of green forage after two consecutive clippings and produced an average of 4.76 t/ha of grain when the clipped stand was left for grain production. Line 265 averaged 17.58 t/ha of green forage and 5.58 t/ha of grain for the same treatment. Both lines are facultative and of semiprostrate growth habit with a mid to late heading date which makes them adapted to the long growing season of the central plains of Iraq.

Introduction

The use of winter small-grain crops, mainly wheat and barley and to some extent oats and rye, is a common practice. However, the popularity of such practice varies from country to country and from region to region within a country. The most important factor that impedes or curtails such a practice is the amount of grain recovered when the stand is left for grain production after early grazing or clipping.

Hubbard and Harper (1949), in a comprehensive study of 24 varieties of wheat, oats, rye, barley and some mixtures of these cereals, reported a loss in grain yield that ranged between 50 and 80% under moderate (10 cm stubble height) to severe clipping (5 cm stubble height), respectively. Wasko (1947) found that grazing these same crops resulted in grain reductions between 23.2 and 48% after a single and two consecutive clippings, respectively. He also reported that genotypes differ in their tolerance to clipping practices. Poysa (1985) in a study on wheat, rye and triticale reported a loss in grain yield of 6% in wheat and 28% in rye. Triticale showed an increase of 0.5 t/ha after forage was removed in early stem elongation stages for these crops.

Bishnoi (1980) found that grain yield after clipping was inconsistent for wheat and triticale although clipping treatment markedly reduced grain yield of rye. Thakur and Shands (1954) in a study on seven varieties of wheat, barley and oats reported grain yield reductions of 14 and 48% after a single and double clipping, respectively. Sprague (1954) reported up to 50% increase in grain yield after grazing in only two climatically favorable growing conditions, whereas losses were incurred due to unfavorable growing conditions for wheat, rye and oats. Day *et al.* (1968) in a study on Harlan, a spring-type variety of barley, concluded that clipping barley twice during the growing season gave a comparable yield to "no-clipping" treatment. Muldoon (1985) in a study on wheat, barley, oats, rye and triticale found that after a single-clipping treatment all species fared as well as the no-clipping treatment in their respective grain yield. However, grain yield for such entries declined drastically after the second and the following clipping treatments in wheat and rye and to a lesser degree in barley, oats and rye. The reduction in grain yield in barley came as a result of a reduction in number of seeds/spike whereas the reduction in wheat grain yield resulted from the reduction in all yield components.

In Iraq, barley is a major small-grain crop that is under production in the central and southern irrigated plains of the country. The central plains, in particular, are characterized by seasonal climatic conditions (Table 1) that are conducive to an almost continuous and uninterrupted growth and development of the crop (Nicollos and May 1964; Cottrell *et al.* 1982; Cottrell and Dale 1986).

The farmers of the central plains, mostly livestock and sheep owners, in the past used the old landraces of barley, which successfully lend themselves to hand-clipping practices or direct grazing during the early crop development (pre-stem elongation) stages in order to provide part of their green forage needs from late December to the end of January. In these two months there is a shortage of green fodder. The stand is then left for grain production. These landraces have proven themselves to be fodder barleys and amenable to clipping and grazing practices (Al-Rawi and Al-Shamma 1991). These landraces of barley were replaced by the spring-type, short-season, grain-producing varieties of barley such as Arivat, California Mariout and Numar. Under field conditions, these varieties do not lend themselves to direct grazing or clipping as the old landraces do.

Table 1. Average monthly day/night temperatures (°C) at Baghdad, Iraq during 1985/86 and 1986/87 seasons.

	1985		1986		1987	
Month†	Day	Night	Day	Night	Day	Night
January	17.4	6.0	17.3	4.7	18.15	6.3
February	16.4	3.7	17.9	6.9	21.42	7.0
March	21.6	7.4	22.6	9.9	20.98	9.6
April	30.0	15.6	28.7	16.0	28.97	13.7
May	37.1	24.6	35.1	18.4	34.91	19.9
June	41.1	23.6	39.2	23.4	40.42	24.7
October	29.3	14.4	33.8	19.5	25.16	18.9
November	23.9	12.9	20.1	9.5	23.76	14.6
December	15.7	4.0	16.5	3.3	16.1	7.6

† Growing season months.

The economic importance of clipping or grazing practices of small-grain crops is recognized, as is the existence of various degrees of tolerance to repeated clipping or direct grazing (two consecutive clippings) among the cultivars of the winter small-grain species (Crowder 1954; Thakur and Shands 1954; Gardner and Rogers 1956; Morey 1961; Dumphy *et al.* 1982). A project was initiated in the 1985/86 season for the purpose of identifying and/or recommending a suitable cultivar of barley exclusively for green forage production during the early development stages with no or little concomitant loss in grain-yielding potential when the stand is left for grain production after clipping or grazing. To fulfil the objective of this project a program of germplasm introduction and collection was started. Suppliers of the materials were ICARDA (mainly pedigreed lines initially designated as dual-purpose barley lines) and CIMMYT (mainly F_2s of winter × spring barleys).

Three studies were undertaken; the first lasted from 1985 to 1987, the second study (an M.Sc. thesis) was finished in 1988, and the third study covered the 1991/92 season.

All studies were conducted at the Fudilia Experiment Station, Baghdad, Iraq. The soil is silty clay, pH = 7.9 with EC of soil extract measured at 3.2 mmhos.

Experiment I: 1985/86 and 1986/87

The experiment was run as a split-split plot arrangement in a complete randomized block design replicated three times. Barley varieties and lines served as main treatment. Seeding rates of 120 and 140 kg/ha were subtreatments and clipping frequencies (no clipping, single clipping and double clipping) were the sub-subplot treatments. Clipping treatments were performed when stand (on extended leaf basis) reached between 32 and 36 cm in height, similar to what was recommended by Perry and Chapman (1974). Stubble at clipping was maintained at about 6 cm above the soil line. Plots were seeded in 11 Nov 1985 and 7 Nov 1986 in the first and second seasons, respectively. Fertilizer in the form of N-P-K, 27-27-0 (rate 625 kg/ha for 1985/86 season) and 18-18-18 (rate 775 kg/ha for 1986/87 season) was used in this experiment. The fertilizer was split into two halves; the first half was applied at seeding date whereas the second half was either applied in full at early tillering stage for the no-clipping treatment, or after the clipping for the single-clipping treatment, or again split into two parts and each part applied after every round of clipping for the double-clipping treatment. The sub-subplot size (the experimental unit) was 0.6 m x 4 m with 30 cm row spacing. Clipping height was stabilized through the use of a 4 m long by 6 cm wide plank held firmly and vertically next to rows to be clipped. An ordinary hand sickle was used for clipping treatments.

Nine varieties and lines of barley were used in this study: Numar, California Mariout, line 108, line 119, line 96, line 99 (6-row types) and Clipper, line 95 and line 104 (2-row types). However, we will limit our discussion to results obtained on the 6-row types because of their popularity in the central plains of Iraq.

Results and Discussion

Statistical analysis followed by tests of significance ($P < 0.05$) revealed that seeding rates and genotype $\times$ seeding rates interaction were not effective in influencing the green forage yield and grain yield. These results confirmed the findings of Kirby and Faris (1970), who reported that higher seeding rates have hampered tiller bud development and survival in barley, and were consistent with the findings of Bishnoi (1980) and Justus and Thurman (1955), who found that increasing seeding rates of wheat, rye, oats and triticale did not significantly increase forage returns in either clipping treatments or hay yield.

Data of green forage yield of the no-clipping (clipped for hay), single-clipping and double-clipping treatments are presented in Table 2. The no-clipping treatment significantly outyielded the single-clipping and double-clipping treatments for all entries. From a phenological point of view such results are not unexpected.

However, there were no significant differences between green forage yields of the single-clipping and double-clipping treatments for all entries at the different seeding rates in both seasons, although the double-clipping treatment outyielded the single-clipping treatment in forage yield. Average grain yields for all entries in both seasons are presented in Table 3. Clipping treatments significantly affected grain yield in both seasons. In the 1985/86 season the single-clipping treatment resulted in an increase in average grain yield over the no-clipping and the double-clipping treatments for both seeding rates and for all entries. However, the differences were significant only for Numar and line 99 at the higher seeding rate. Moreover, lines 96 and 99 did not experience a drastic decline in grain yield after the double-clipping treatment whereas the other lines were not as tolerant of the double-clipping treatment. In the 1986/87 season, on a per-entry basis there were no significant differences among clipping treatments. However, lines 96 and 99 outperformed all others at the two clipping treatments at the two seeding rates.

The decline in grain yield when the stand was left for grain production after the double-clipping treatment in the 1986/87 season was not as sharp as that in the 1985/86 season for the same treatment. Such discrepancies could have been due to the quality of fertilizer. Reduced rates of nitrogen fertilization do not necessarily reduce grain yield in foliage clipping treatments of small grains.

Experiment II: 1987/88 Season

In another experiment, six genotypes of barley were used to study the effect of genotype, number of clipping treatments and stubble height at clipping on green forage production, grain yield and morphological yield components: number of tillers/unit area, average number of seeds/spike and 1000-seed weight. The variety Numar and lines 96, 99, 108 and 265 were used in this study along with line 95 (not reported here because it is a 2-row line).

Again a split-split plot arrangement of treatments in a complete randomized block design with three replications was employed. Genotypes were assigned to main plots. Clipping treatments (no clipping, single clipping and double clipping) were assigned to the subplots. Stubble heights (3 cm or 6 cm above soil line) were entered as the sub-subplot. The size (experimental unit) was 0.6 × 4 m. Seeding rate was 120 kg/ha.

All plots were seeded on 2-3 Nov 1987 in rows spaced 30 cm apart. Fertilizer in the form of N-P-K, 27-27-0 was applied at seeding at a rate of 320 kg/ha, then 240 kg/ha at early tillering for unclipped plots, but applied at a rate of 100 kg/ha after each round of clipping. Clipping treatments were performed when stands (on extended leaf basis) reached between 32 and 36 cm in height. Stubble was

Table 2. Effect of different seeding rates and clipping frequencies on green forage yield (t/ha) of 6-row barley for two seasons at Fudilia, Baghdad, Iraq.

Genotype	1985/86						1986/87					
	120 kg/ha			140 kg/ha			120 kg/ha			140 kg/ha		
	None	Single	Double	None	Single	Double	None	Single	Double	None	Single	Double
California Mariout	68.0	4.3	16.4	70.5	5.8	14.4	42.0	3.0	8.8	39.4	3.8	8.0
Numar	69.0	5.5	14.0	68.9	5.4	12.6	49.7	3.1	8.7	46.8	3.6	9.0
119	55.6	4.1	10.0	61.2	5.3	11.9	34.8	3.2	9.3	37.2	3.7	11.0
108	48.2	3.5	11.4	46.8	4.2	13.0	32.5	2.9	7.4	34.1	4.1	10.8
96	48.6	4.3	10.1	51.8	3.0	9.6	36.6	3.4	6.4	36.2	4.4	7.9
99	45.7	4.6	10.3	50.4	4.6	9.7	37.8	3.1	7.9	41.3	3.9	8.2

LSD 5% sub-sub treatment = 7.966; LSD 5% for sub-sub treatments = 6.969.

Table 3. Effect of different seeding rates and clipping frequencies on grain yield (t/ha) of 6-row barley in two seasons at Fudilia, Baghdad, Iraq.

	1985/86						1986/87					
	120 kg/ha			140 kg/ha			120 kg/ha			140 kg/ha		
Genotype	None	Single	Double	None	Single	Double	None	Single	Double	None	Single	Double
California Mariout	2.9	3.5	1.4	2.5	4.1	2.6	4.2	3.7	2.5	3.13	3.73	3.57
Numar	3.0	3.0	2.1	3.0	3.1	1.6	4.3	5.1	3.5	5.09	4.21	3.71
119	2.4	3.0	2.6	2.0	2.9	1.5	3.5	3.4	3.4	3.33	3.36	2.99
108	2.4	3.2	2.5	2.6	3.7	2.1	3.4	3.8	3.2	3.17	3.70	3.34
96	4.3	3.7	3.1	4.4	4.0	3.5	5.1	5.1	4.3	4.12	4.77	4.30
99	3.7	3.7	3.2	3.3	4.6	3.0	4.3	5.4	4.2	4.38	5.16	4.02

maintained at 3 and 6 cm above the soil line through the use of planks (4 m long by 3 cm or 6 cm wide) held firmly next to the rows to be clipped.

Results and Discussion

Data on average yield of green forage are presented in Table 4. Genotypes included in this study differed significantly in their overall performance in green forage production; Numar and line 265 exceeded all others.

Table 4. Effect of genotype, clipping frequency and stubble height on green forage yield of 6-row barley in 1987/88 at Fudilia, Baghdad, Iraq.

Genotype	Clipping					Average yield (t/ha)
		Single		Double		
	None	3 cm	6 cm	3 cm	6 cm	
108	32.8	8.6	5.8	15.6	15.6	18.5
Numar	54.3	7.9	6.9	14.2	14.8	25.5
96	38.4	8.3	5.9	16.0	12.0	19.8
99	40.1	9.2	7.0	16.7	11.9	20.8
265	46.1	9.9	7.7	18.2	15.5	23.9
Average			7.7		15.1	

LSD 5% for genotypes = 2.65; LSD 5% for clipping treatments = 1.37; LSD 5% for stubble height = 0.31.

The double-clipping treatment significantly outyielded the single-clipping treatment. Lower stubble height significantly contributed to higher green forage yield for all entries in the single-clipping treatment. However, for the double-clipping treatment Numar showed a significant reduction in green forage yield at 3 cm stubble height whereas line 108 gave similar yields of green forage in the double-clipping treatment for both stubble heights. Lines 96, 99 and 265 showed a significant increase in green forage yield when clipped twice at the lower stubble height. Results of regrowth of Numar and line 108 are supported by results obtained by Wilson and McGuire (1961) who concluded that a higher leaf area index (LAI) is not required to realize higher green forage yield. They suggested that 2 or 4 inch (5 and 10 cm) stubble heights are sufficient for regrowth. Lawrence (1973) concluded that dry matter yield over two seasons in a study on intermediate wheat grass was highest when clipping was done at 3.8 cm above the soil line. Laude and

Fox (1982) defined close clipping as that process through which foliar removal is carried out at or below 5 cm stubble height.

From the preceding discussion it is safe to conclude that lines 96, 99 and 265 do behave like some of their weedy relatives in their tolerance of close clipping, whereas other erect, early spring-type barley varieties and lines such as Numar and line 108 need to be clipped at a higher stubble height to maintain higher green forage production in the double-clipping treatment.

Data on average grain yield for the different genotypes after clipping treatments at different stubble heights are presented in Table 5. Again, genotypes included in this study differed in their overall performance of grain production potential. Line 99 significantly outyielded all other entries, followed by line 265. Other varieties and lines showed significant reduction in their overall grain production potential.

Table 5. Effect of genotype, clipping frequency and stubble height on grain yield of 6-row barley in 1987/88 at Fudilia, Baghdad, Iraq.

	Clipping					
		Single		Double		Average yield (t/ha)
Genotype	None	3 cm	6 cm	3 cm	6 cm	
108	4.8	5.6	4.1	4.6	4.2	4.7
Numar	8.2	5.4	6.9	3.3	3.7	5.5
96	6.7	4.6	4.0	3.7	4.8	4.8
99	6.8	7.2	5.2	6.7	5.4	6.2
265	7.8	5.6	5.7	5.1	5.9	6.0
Average			5.4		4.7	

LSD 5% for genotypes = 0.930; LSD 5% for clipping treatments = 0.60; LSD 5% for stubble height = 0.980.

Of all lines, line 99 showed significant tolerance for close clipping, yielding 7.2 t/ha in the single-clipping treatment and 6.7 t/ha in the double-clipping treatment at 3 cm stubble height. Numar, on the other hand, showed a marked reduction in grain yield in the double-clipping treatment with 3 cm stubble height. Other entries showed stubble (line 265) or varied responses to both clipping treatments and/or clipping heights. Some of these results are similar to those obtained by Winter and Thompson (1987) who found that grazing wheat at 1.25 to 1.75 inches (3 and 4.5 cm) did not affect grain yield.

Experiment III: 1991/92

In Experiment III, four barley lines (101, 116, 267 and 270) were used in a split-plot arrangement of treatments in a complete randomized block design. These lines previously were identified as top lines after small-plot testing of tolerance to single- and double-clipping practices in 1987/88 and 1988/89 seasons. The four lines are characterized by semi-prostrate growth habit and have a midseason heading date. Lines 99 and 265 were included in this experiment.

The six lines were entered as main treatments and thus were assigned to main plots. Clipping treatments, namely no clipping, single clipping and double clipping, were assigned to subplots. Subplot size was 0.6 × 4 m, consisting of two rows spaced 30 cm apart. Fertilizer in the form of N-P-K 18-18-18 was applied at a rate of 600 kg/ha. Urea was applied at a rate of 200 kg/ha after each round of clipping. The no-clipping plots received the same amount of urea. Seeding rate was maintained at 140 kg/ha; sowing date was 22 Nov 1991.

Clipping was done when the stand was 32-36 cm in height for single- and double-clipping treatments. Stubble height was maintained at about 6 cm above the soil line through the use of a 4 m long by 6 cm wide plank held firmly next to the rows to be clipped. Clipping was done with an ordinary sickle. Border rows were clipped at the same height to eliminate unfair competition and shading effects.

Results and Discussion

Data on green forage yield for the single-clipping and double-clipping treatments along with mean entry performance are presented in Table 6. Although there were significant differences between lines 116 and 99, all other lines were similar in their overall performances. There also was a significant difference between the single-clipping and double-clipping treatments, both averaged for overall genotypes. These results testify to the clemency of the prevailing climatic conditions from December through January, which contributed to almost uninterrupted growth and development. Within entries there was a significant difference between the single- and double-clipping treatments for all entries. The double-clipping treatments averaged between 14.32 t/ha (line 99) and 21.07 t/ha, which exceeded the results in Experiments I and II. Urea application must have played a major role in increasing green forage productivity.

Data on grain yield are presented in Table 7. There were no statistical differences between mean line performances. These results were expected because lines 101, 116, 267 and 270 were under some kind of selection for two seasons. However, line 99 gave the highest grain yield, followed by line 265 and line 116.

Table 6. Effect of genotypes and clipping frequencies on green forage yield (t/ha) of 6-row barley in 1991/92 at Fudilia, Baghdad, Iraq.

Genotype	Clipping		Average yield (t/ha)
	Single	Double	
270	16.2	15.8	11.0
99	5.1	14.3	9.7
267	6.5	19.5	13.0
116	7.7	21.1	14.4
265	7.5	17.7	12.6
101	8.1	18.8	13.4

LSD 5% among genotypes = 4.134; LSD 5% between clippings = 1.387; LSD 5% between clippings within genotypes = 3.396.

Table 7. Effect of genotypes and clipping frequencies on grain yield (t/ha) of 6-row barley in 1991/92 at Fudilia, Baghdad, Iraq.

Genotype	Clipping			Average yield (t/ha)
	None	Single	Double	
270	6.2	6.4	4.7	5.5
99	4.8	6.5	6.4	6.4
267	4.7	6.0	5.5	5.7
116	4.3	6.6	5.8	6.2
265	5.0	6.8	5.8	6.3
101	5.5	7.2	4.6	5.9

LSD 5% among genotypes = 1.716; LSD 5% between clippings = 1.062; LSD 5% between clippings within genotypes = 2.602.

Grain yield averaged over all entries for the single-clipping treatment significantly outyielded the no-clipping and double-clipping treatments. On a per-entry basis, however, all lines maintained higher yield after the single-clipping treatment. In fact, the increment in grain yield for the single-clipping treatment over the no-clipping treatment ranged from about 2% for line 270 to 53.5% for line 116. The increment in other lines fell within this range. On the other hand, all entries experienced reductions in their grain yield after the double-clipping treatment except for line 99 which yielded around 6.4 t/ha.

Conclusions

The maintenance of higher grain yield after either the single- or the double-clipping treatments in some lines of barley was a function of number of seeds/spike and 1000-seed weight. This was true for Experiments I and II. However, grain yield after clipping in Experiment III was a function of the three morphological yield components: number of seeds/spikes, 1000-seed weight and number of fertile tillers/unit area. This could have been due to the addition of urea at a rate of 200 kg/ha after each round of clipping. The efficiency in grain production after foliage removal in some lines of barley such as lines 99 and 265 is probably related to the abundance of the reserved photosynthates in the crowns and roots of the clipped plants. This may have come as a result of removing the photosynthetically inert lower leaves which are of a parasitic nature (Davidson and Donald 1958) or removing smaller inefficient leaves (Gabrielson 1948; Klendenning and Gorham 1950). Moreover, Sosebee and Weibe (1971) and Fischer (1975) have suggested that the photosynthetic tissue that develops after clipping (in our studies it took 14 to 17 days to fully develop after the first round of clipping) is more effective at photosynthesis than the older tissue when there is enough light penetration.

Bokhari and Singh (1974) reported that total nonstructural carbohydrates in the shoots, crown and roots of western wheatgrass (*Agropyron smithii*) was highest at 24/13°C day-night temperature and regrowth was better at or slightly above 13/7°C day-night temperatures. Since all genotypes of barley in this study were subjected to temperatures similar to those, it is suggested that differences in tolerance to clipping among these barley lines are due to differences in their genetic makeup. Such tolerance could be explained by the nature of depletion of the reserved carbohydrates and the ability of certain genotypes to replenish such reserves after clipping. Perry and Chapman (1974) and Everson (1966) found that rapid depletion of carbohydrates reserves in basin wild rye (*Elymus cinerus*) explains its lack of tolerance to continuous grazing whereas tolerance to intensive clipping in wheat grass (*A. smithic*) is related to maintenance of higher total nonstructural carbohydrates in plants.

On the basis of data presented and discussed here, it is concluded that barley line 99 followed by line 265 is tolerant to double clipping or grazing. Preliminary results obtained through researcher-managed on-farm trials testify to the ability of line 99 to tolerate two consecutive grazings at the pre-stem elongation stage as this line suffered no subsequent loss in grain yield after grazing.

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Discussion

T. Treacher
I would like information as to whether the varieties had actually been grazed in farmers' trials.

B. Al-Rawi
Yes, in fact line 99 has been distributed to 38 farmers in Radwanieh Agriculture district. The fields were grazed by sheep and cattle once or twice at pre-stem elongation stage. Then the stand was left for grain production.

A. Hadjichristodoulou
In Iraq you increase grain yield of barley by 1-2 clippings. In the other WANA countries we get reduction in grain yield. You mention two reasons for this: (1) heavy nitrogen fertilizer and (2) availability of irrigation. You also mentioned that the climate of Iraq is favorable. Can you elaborate on this point?

B. Al-Rawi
Yes, usually small grains do thrive under 6/14-17 °C night/day temperatures. In the central plains of Iraq, such temperatures do occur from December to the end of February on a regular basis. This contributes to an almost continuous growth and development of the crop. Also daylight duration falls between 8 and 9 hours

of sunshine throughout the growing season. Such light duration does help in the development of the reproductive organ of small grains, barley in particular.

B. Jamal
Does cutting the irrigated barley have an effect on the protein content?

B. Al-Rawi
In fact we did not conduct any protein analysis.

M. Ababneh
What is the effect of cutting on seed yield, and what is the period between first and second cut?

B. Al-Rawi
We don't consider time, instead we consider plant height which should be between 32 and 36 cm at cutting. As for grain production, cutting resulted in more grain yield, especially after one cut as you could see from the tables.

S. Ceccarelli
Do you have any evidence of different effects on disease development?

B. Al-Rawi
No, in fact the powdery mildew was completely eliminated by grazing.

ربحا صافيا فاق بشكل واضح ما حققه إستعمال أسلوب المزارع التقليدي . لذا لا بد من التوسع في إجراء المشاهدات من أجل الوصول إلى أكبر عدد من المزارعين ، حيث تعتبر المشاهدات وسيلة إرشادية ناجحة لاطلاع أكبر عدد من المزارعين على النتائج الحقلية التي يتم الحصول عليها ، وذلك لتشجيعهم على تبني هذه التقنيات ، الامر الذي سؤدي إلى رفع إنتاجية المزارع بشكل خاص والانتاج الوطني بشكل عام .

ويلاحظ أن كفاءة إستعمال الامطار بلغت أعلاها في شمال الاردن ، وذلك تحت ظروف المشاهدات وظروف المزارع على حد سواء ، حيث زادت الكفاءة تحت ظروف المشاهدات بنسبة ٦٦٪ عنها في الوسط ، وبنسبة ٨٣٪ عنها في الجنوب . ويمكن عزو هذا التفوق إلى أن التربة في هذه المناطق هي في العادة أفضل ، وأكثر عمقا ، ومعتدلة الميول ، وذات خصوبة أعلى . بالاضافة إلى أن الخبرة في الزراعة قد تكون أقدم .

إن النتائج التي تم استعراضها تشير بوضوح إلى أهمية اتباع حزمة العمليات الكاملة الموصى بها في زراعة الشعير ، نظرا لمساهمتها في رفع إنتاجية الحب بشكل كبير ، وصل في بعض الاحيان إلى أكثر من ضعفي الانتاجية التي حصل عليها المزارع باتباع أساليبه التقليدية في الزراعة . وإن اتباع حزمة العمليات يحتاج إلى توفر المدخلات اللازمة والاساسية في هذه الحزمة والتي تشتمل على المحاريث الحفارة ، والبذارة ، والسماد ، ومبيدات الاعشاب ، بالاضافة إلى الصنف المحسن من البذار . هذا وإن جميع هذه المدخلات متوفرة لدى محطات تأجير الآلات التابعة للمنظمة التعاونية الاردنية والموجودة في شمال ووسط وجنوب الاردن . لذا كان توجه المشروع في نشر مشاهدات الحزمة الكاملة مركزا على المناطق التي تتوفر فيها هذه المحطات وهذه المدخلات ، بحيث يمكن للمزارع الحصول عليها إذا ما رغب في ذلك ، وذلك بغية تحقيق تبني هذه التقنيات بالسرعة المطلوبة .

وتجدر الاشارة هنا إلى أن هناك تحولا إيجابيا واضحا في توجهات المزارعين لتبني هذه التقنيات ، ويمكن ملاحظة ذلك من نتائج المسح الذي نفذ في الاردن والذي تعرض له البحث الذي قدمه محمود عقله وآخرون في هذا الكتاب . وقد يتساءل البعض وماذا عن المردود الاقتصادي حول إستعمال حزمة العمليات المتكاملة في إنتاج الشعير ؟ فهل الزيادة في الانتاج تؤدي إلى زيادة أربحية المزارع ؟ وتشير دراسات أولية قام بإعدادها خبيرين كان قد تم استقدامهما من قبل مشروع المشرق لاجراء تحليل حول اقتصاديات تقنيات المشروع ، تشير تلك الدراسات إلى أن حزمة العمليات الكاملة في إنتاج الشعير قد حققت

جدول رقم (٥): المساحة ، الانتاجية من الحب (كغم / هكتار) في حقول المشاهدات وفي حقول المزارعين والفجوة الانتاجية ، وكفاءة إستعمال الامطار في مواقع مختارة خلال المواسم الثلاث والمناطق المختلفة وتحت نوعي المشاهدات .

	المساحة (هكتار)	إنتاجية المشاهدة (كغم/ هـ)	إنتاجية المزارع (كغم/هـ)	الفجوة الانتاجية (كغم/هـ)	كفاءة إستعمال الامطار (RUE)* كغم / هكتار المشاهدات	المزارع
المواسم الزراعية						
١٩٨٩ /٩٠	٣٫٦	١٣٦٥	٩٨٠	٣٨٥	٤٫٤٧	٣٫٥
١٩٩٠ /٩١	٩٫٠	١٣٥٥	٩٣٠	٤٢٥	٤٫٢٨	٣٫٣
١٩٩١/ ٩٢	٩٫٥	٢٣٤٠	١٤٥٠	٨٩٠	٥٫٢٠	٣٫٣
المناطق						
شمال الاردن	٧٫٠	٨١٨	٥٤٣	٢٧٥	٣٫٦٦	٢٫٣٧
وسط الاردن	٧٫٨	٥٠٢	١٩٢	٣١٠	٢٫٢٠	٠٫٧
جنوب الاردن	٨٫٢	٦٥١	٤٤٠	٢١١	٢٫٠٠	١٫٤٠
نوع المشاهدة						
المنفردة	٤٫٠	٧٨٤	٥١٩	٢٦٥	٢٫٠٠	١٫٩٦
المجمعة	١٤٫٥	٥١٢	٢٥٧	٢٥٥	٢٫٢٠	١٫٧٠

* RUE = Rain Use Efficiency.

المصدر : تقارير مشروع المشرق للمواسم ١٩٨٩/٩٠ ، ١٩٩٠/٩١ و ١٩٩١/٩٢
المركز الوطني للبحوث الزراعية ونقل التكنولوجيا - عمان .

ولم تختلف النتائج المتحصل عليها في الموسمين التاليين عن نتائج الموسم الاول وإنما اختلفت في حجم الزيادة ، ففي الحقول المنفردة تراوحت الزيادة ما بين ٤٤٪ في جنوب الاردن في موسم ١٩٩١/٩٢ و١٨٠٪ في الوسط في موسم ١٩٩٠/٩١.
أما في الحقول المجمعة والتي شملت مجموعة من المزارعين تراوحت أعدادهم بين ٣و٦ مزارعين في الحقل الواحد ، فقد تراوحت الزيادة بين ٢٤٪ في موسم ١٩٩١/٩٢ إلى ٢٣٠ ٪ في الموسم الذي سبقه وذلك في وسط الاردن . ويلاحظ أن الانتاجية كانت بشكل عام أعلى خلال موسم ١٩٩١/٩٢ وذلك نتيجة لتساقط كميات أعلى من الامطار مقارنة بالموسمين الآخرين .

وعند مقارنة بعض النتائج المتحصل عليها في مواقع محددة تم رصد كميات أمطارها (جدول رقم ٥) . يمكن أن نلاحظ بأن الفجوة الانتاجية ما بين الانتاج المتحصل عليه من المشاهدات والانتاج المتحصل عليه باستعمال أسلوب المزارع كانت متباينة بشكل واضح ما بين المواسم . مع تسجيل أعلى رقم (٨٩٠ كغم/هـ) في الموسم ١٩٩١/٩٢ ، بسبب ارتفاع معدل أمطاره بالنسبة إلى الموسمين الآخرين ، ولم يكن هنالك إختلافات واضحة بين المناطق أو بين أسلوب تنفيذ المشاهدات سواء كانت منفردة أم مجمعة .

أما فيما يتعلق بكفاءة إستعمال الامطار المتساقطة والتي حسبت على أساس إنتاج كغم حب لكل ملم من المطر (جدول رقم ٥) ، فيمكن أن نلاحظ بوضوح البون الشاسع ما بين كفاءة الاستعمال في المشاهدات وكفاءتها بإتباع أسلوب المزارع في زراعة الشعير . فقد تراوحت الزيادة في الكفاءة بين ١و٢ كغم/ ملم، وكانت الزيادة منتظمة في المواسم الثلاثة وفي مختلف المناطق وتحت نوعي المشاهدات. ويمكن أن يعزى السبب في ذلك إلى توفر الظروف الافضل للنبات بحيث إستطاع تحقيق الاستفادة القصوى من الامطار، مما مكنه من استعمال المياه بكفاءة أكبر ودون منافسة . هذا بالاضافة إلى إستعمال الصنف المحسن الذي يفترض أن يكون ذا إنتاجية أعلى وذا كفاءة أكبر في إستعمال الموارد المتاحة .

جدول رقم (٤): إنتاجية الشعير من الحب (كغم / هكتار) نتيجة لاستعمال حزمة العمليات الكاملة الموصى بها (في المشاهدات) مقارنة بإنتاجية الشعير في حقول المزارعين (خارج المشاهدات) عند زراعته في حقول المزارعين في مناطق الاردن المختلفة خلال المواسم ١٩٨٩/٩٠ ، ١٩٩٠/٩١ و ١٩٩١/٩٢ .

الموسم الزراعي والمعاملة	الحقول المنفردة						الحقول المجمعة					
	شمال		وسط		جنوب		شمال		وسط		جنوب	
	الانتاجية	الزيادة (٪)	الانتاجية	الزيادة (٪)	الانتاجية	الزيادة (٪)	الانتاجية	الزيادة (٪)	الانتاجية	الزيادة (٪)	الانتاجية	الزيادة (٪)
١٩٨٩/١٩٩٠												
المشاهدة	١٤٤٠		٤٤٧		١٠٨٦		-		-		-	
		٢٧٥		-		١٧٨		-				
حقل المزارع	٣٨٣		رعي		٣٩٠		-		-		-	
١٩٩٠/١٩٩١												
المشاهدة	١١٠٠		٧٨٧		٧١٠		١٠٥٠		٩٦٠		٧١٥	
		٦٤		١٨٠		٦٩		٩٠		٢٣١		٨١
حقل المزارع	٦٦٧		٢٨٠		٤٢٠		٥٥٠		٢٩٠		٣٩٥	
١٩٩١/١٩٩٢												
المشاهدة	٢٦٣٠		٢٢٠٠		٢٢٨٣		٢٢٥٥		٢٠٨٠		٢٦٦٧	
		٦٢		٨٦		٤٤		٤١		٢٤		٨١
حقل المزارع	١٦٢٥		١١٨٠		١٥٨٧		١٥٩٥		١٦٧٠		١٤٧٣	

المصدر : تقارير مشروع المشرق للمواسم ١٩٨٩/٩٠ ، ١٩٩٠/٩١ ، ١٩٩١/٩٢ . المركز الوطني للبحوث الزراعية ونقل التكنولوجيا - عمان .

جدول رقم (٣) . كميات الامطار السنوية (ملم) المتساقطة في بعض مواقع مشروع المشرق خلال المواسم ١٩٨٩-١٩٩٢.

المواقع		١٩٨٩/٩٠	١٩٩٠/٩١	١٩٩١/٩٢
شمال	رمثا	٢٥٧ر٤	١٥٥ر٥	٢٨٠ر٠
	رحاب	-	١٧١ر٨	٢٧٧ر٥
وسط	مشقر	٣١٤ر٠	٢٧٤ر٨	٧٠٩ر٢
	ذيبان	-	٢٨٦ر٧	٣٦٥ر٥
جنوب	ربه	٣١٩ر٢	٤٠٤ر١	٥٠١ر٠
	غوير	-	٣٢٢ر٦	٣٧٤ر١

المصدر : تقارير مشروع المشرق للسنوات ١٩٨٩-١٩٩٢ . المركز الوطني للبحوث الزراعية ونقل التكنولوجيا - عمان

الظروف المناخية السائدة خلال مواسم تنفيذ المشاهدات

يتصف المناخ في الاردن بمناخ حوض البحر الابيض المتوسط الذي يتميز بالشتاء البارد الرطب والصيف الحار الجاف مع تمايز لفصلي الربيع والخريف. وهناك إختلاف وتباين كبير للهطولات المطرية بين سنة وأخرى وبين موقع وآخر . تميز الموسم الاول (١٩٨٩/٩٠) بتباين واضح في الامطار حيث كانت الامطار أعلى في الوسط والجنوب منها في الشمال . أما الموسم الثاني (١٩٩٠/٩١) فقد تميز بالجفاف، وكانت الهطولات المطرية أقل من المعدل السنوي العام، خاصة في الشمال والوسط . كما تميز الموسم بتأخر الهطولات المطرية وإنحباسها في نهايته . خاصة في المنطقة الجنوبية . رغم تلقيها كميات عالية جدا من الامطار في نهاية الموسم . أما الموسم ١٩٩١/٩٢ فقد تميز بهطول عال من الامطار ورافق ذلك تدني في درجات الحرارة وتساقط الثلوج . ويوضح الجدول رقم ٣ معدل الامطار للمواسم الثلاثة في بعض المناطق التي نفذت فيها المشاهدات .

النتائج والمناقشة

كما ذكرنا سابقا . كان هدف تنفيذ المشاهدات في حقول المزارعين وبالتعاون معهم هو أن يشاهد المزارع بنفسه أهمية إستعمال حزمة العمليات الكاملة الموصى بها لانتاج الشعير . وأثر هذه الحزمة على زيادة إنتاجية الشعير مقارنة بالانتاجية التي يتحصل عليها عند إتباع أسلوبه التقليدي في الزراعة .

يوضح الجدول رقم (٤) إنتاجية الشعير من الحب عند إستعمال حزمة العمليات الكاملة مقارنة بالانتاجية المتحصل عليها عند إتباع الاسلوب التقليدي للمزارع ، وذلك في مناطق الاردن المختلفة وخلال المواسم الثلاثة المدروسة . ويمكن ملاحظة الزيادة الكبيرة التي تحققت نتيجة إستعمال الحزمة المتكاملة . حيث بلغت في الموسم الاول (١٩٨٩/٩٠) ٢٧٥٪ في الشمال و ١٧٨٪ في الجنوب . أما في الوسط فلم يتمكن المزارع من حصاد محصوله فترك الاغنام ترعاها . بينما حقق إنتاجا مقبولا يعادل ٤٤٧ كغم / هكتار عند إستعمال الحزمة الكاملة للعمليات الزراعية .

جدول رقم (٢) . عدد المشاهدات ومساحتها وعدد المزارعين المشاركين المشمولة في حزمة العمليات الكاملة لانتاج الشعير والتي نفذت في حقول المزارعين في المواسم ١٩٨٩ -١٩٩٢ في مناطق الاردن المختلفة .

الموسم الزراعي	المنطقة	عددالمشاهدات منفرده	مجمعة	المساحة الكلية (هكتار)	عدد المزارعين المشاركين
١٩٨٩/٩٠	شمال	٦	-	٢٠ر١	٦
	وسط	٦	-	٢٢ر٣	٦
	جنوب	٥	-	١٩ر٥	٥
المجموع		١٧	-	١٧ر٩	١٧
١٩٩٠/٩١	شمال	٣	٣	٥٨ر٦	٢٠
	وسط	٣	٣	٤٧ر٧	١٤
	جنوب	٢	٢	٣٧ر٩	١٣
المجموع		٨	٨	١٤٤ر٢	٤٧
١٩٩١/٩٢	شمال	٤	٤	٥٧ر٠	٢٢
	وسط	٤	٢	٧٣ر٤	١٥
	جنوب	٣	٣	٦٨ر٧	١٥
المجموع		١١	١١	١٩٩ر١	٥٢
المجموع الكلي		٣٦	١٨	٤١٥ر٢	١١٦

حزمة عمليات إنتاج الشعير الموصى بها:

اشتملت حزمة العمليات التي نفذت على ما يلي :

تحضير الارض بإستعمال المحاريث الحفارة ، الزراعة بالبذارة قبل سقوط الامطار (عفيرا) ، إستعمال أحد الاصناف المحسنة المعتمدة (وهي رم ، ودير علا ١٠٦ ، واكساد ١٧٦) وبمعدل بذار٨٠ كغم/ هكتار ، إضافة السماد بمعدل ١٠٠ كغم/هـ من سماد ثنائي فوسفات الامونيوم (DAP) حيث يحوي على N 18% و P_2O_5 46% عند الزراعة ، ثم إضافة دفعة ثانية بمعدل ٣٠ كغم من اليوريا عند الاشطاء إذا كانت الرطوبة في التربة عالية ومناسبة ، ومكافحة الاعشاب عريضة الاوراق إن وجدت بكميات تستدعي المكافحة بأحد مشتقات 2,4-D .

مواقع تنفيذ المشاهدات

تم تنفيذ ٥٤ مشاهدة في مختلف مناطق المملكة خلال المواسم الثلاثة ، ١٩٨٩/٩٠، ١٩٩٠/٩١ ، و١٩٩١/٩٢ (الجدول رقم ٢) ، بحيث اشتملت على ٣٦ مشاهدة منفردة و ١٨ مشاهدة مجمعة .

وقد بلغت مساحة المشاهدة الاجمالية ٢ر٤١٥ هكتار ، وشملت ١١٦ مزارعا . ووزعت هذه المشاهدات على مختلف مناطق المملكة المستهدفة من المشروع ، بحيث بلغت ٢٠ مشاهدة في شمال المملكة اشتملت مساحة مقدارها ٧ر١٢٥ هكتار و٤٨ مزارعا . أما في وسط المملكة (جنوب العاصمة ، مأدبا ، ذيبان)،فقد تم تنفيذ ١٩ مشاهدة على مساحة ٤ر١٥٢ هكتار شارك فيها ٣٥ مزارعا، و١٥ مشاهدة في الجنوب وبمساحة ١ر١٣٦ هكتارا شارك فيها ٣٣ مزارعا .

تم حصاد المشاهدات بإستعمال الحاصدة المتكاملة ، وتم قياس الانتاج الكلي من الحب ، ثم تم حساب الانتاجية للهكتار . حصدت المشاهدات خلال شهري أيار وحزيران وذلك حسب المواقع والمواسم الزراعية .

في محافظة إربد شمال الاردن . فيما بلغت إنتاجية الشعير لدى المزارعين ٦٨٠ كغم/ هـ أي بزيادة مقدارها ٢٤٥٪ . كذلك بلغت إنتاجية الهكتار في منطقة مأدبا في وسط الاردن ١١٣٠ كغم لمعدل مساحة قدرها ١٠٧٫٥ هكتارا مقارنة بإنتاجية ٦٨٠ كغم / هـ تحققت لدى المزارعين في نفس العام .

وبهدف تعميم هذه التقنيات على المزارعين لتشجيعهم على تبنيها ، قام مشروع المشرق خلال المواسم الزراعية ١٩٨٩/٩٠ ، ١٩٩٠و/٩١ . ١٩٩١و/٩٢ بتنفيذ مشاهدات موسعة في حقول المزارعين وبمشاركتهم . طبقت فيها حزمة التقنيات الموصى بها من قبل البرنامج الوطني الاردني ، وتم مقارنة النتائج بالنتائج التي تحصل عليها المزارع عند إتباع أسلوبه التقليدي في زراعة محصول الشعير .

المواد وطريقة العمل

تم تنفيذ نوعين من المشاهدات بإتباع حزمة العمليات الكاملة وهي :-

المشاهدات في الحقول المنفردة

وهنا طبقت حزمة العمليات الكاملة بالتعاون مع مزارع واحد . وتم إختيار الحقل بعد مراعاة المواصفات الخاصة لخدمة الغايات الارشادية في ذلك الحقل ، والتي تشتمل على أن يكون الحقل قريبا من الطرق العامة ، وممثلا لحقول المزارعين ، ووسط تجمع زراعة الشعير .

المشاهدات في الحقول المجمعة

حيث نفذت المشاهدات في مجموعة من حقول المزارعين المتجاورين بعد التشاور معهم وموافقتهم ، بحيث يتم تجهيز الارض بشكل مشترك وكذلك تتم إجراء كافة العمليات الزراعية على القطع المشاركة بإعتبارها وحدة واحدة ، ويتناسب نصيب المزارع من الناتج مع مساحة أرضه . بدأ تطبيق هذا النوع من المشاهدات في الموسم ١٩٩٠/٩١ .

توصلت الدراسات التي نفذت من قبل وزارة الزراعة وكلية الزراعة في الجامعة الاردنية خلال عقد السبعينات إلى مجموعة من التقنيات والتوصيات حول زراعة القمح والشعير في الاردن . شملت توصيات حول إستعمال المحاريث المناسبة، وطريقة الزراعة ، وموعد الزراعة ، والصنف المحسن ، ومعدلات السماد، ومعدلات البذار ، والمكافحة الكيمياوية للأعشاب ، ولقد تم إختبار مجموعة التقنيات هذه في حقول المزارعين ضمن مشروع مشترك نفذ في الفترة ١٩٧٩-١٩٨٦ ، بالتعاون ما بين كل من وزارة الزراعة ، وكلية الزراعة في الجامعة الاردنية والمركز الدولي للبحوث الزراعية في المناطق الجافة (إيكاردا) . وفي نهاية المشروع المشترك تم إقتراح مجموعة العمليات الكاملة لزراعة وإنتاج القمح والشعير ، وإشتملت العمليات الموصى بها بالنسبة لزراعة محصول الشعير على ما يلي :

١- إعداد وتجهيز الارض بالمحاريث الحفارة .
٢- الزراعة بالبذارة قبل سقوط الامطار (عفيرا).
٣- إستعمال معدل بذار ٨٠ كغم/ هكتار .
٤- إستعمال الاصناف المحسنة المعتمدة من الشعير والتي تشمل أصناف رم، ودير علا ١٠٦ ، و اكساد ١٧٦ .
٥- التسميد بإضافة ١٠٠ كغم/هـ من سماد ثنائي فوسفات الامونيوم (DAP) (N 18% P_2O_5 46%) عند الزراعة ، ثم إضافة دفعة ثانية من اليوريا بمعدل ٣٠ كغم/ هـ عند الاشطاء إذا كانت ظروف المطر ملائمة.
٦- مقاومة الاعشاب عريضة الاوراق عند الضرورة وذلك عن طريق الرش بالمبيد العشبي الموصى به .

وقد أشارت النتائج إلى أن تطبيق التقنيات الموصى بها كان له أثر كبير في رفع الانتاجية . فحيث تم تطبيق هذه التقنيات في مشروع إكثار البذار الذي تنفذه المنظمة التعاونية بإشراف فني من وزارة الزراعة في موسم ١٩٨٦/٨٧ تشير الارقام إلى أن إنتاجية الهكتار قد بلغت ٢٣٧٠ كغم لمساحة ١٣١٫٥ هكتار

جدول رقم (١) . مساحة وإنتاج الشعير وكمية الاستهلاك والمستوردات السنوية ومعدل الاكتفاء الذاتي في الاردن (١٩٧٣ - ١٩٩١) .

السنة	المساحة (الف هكتار)	الانتاج الكلي (الف طن)	الانتاجية (كغم/هكتار)	الاستيرادالسنوي (ألف طن)	الاستهلاك السنوي (ألف طن)	معدل الاكتفاء (٪)
١٩٧٣	٢ر٥٣	٩ر٥	١١٠	-	-	-
١٩٧٤	٩ر٦٤	٢ر٤٠	٦٢٠	-	-	-
١٩٧٥	٢ر٦٩	٨ر١١	١٩٠	٥ر٢	٣ر٤	٢٧٤
١٩٧٦	٦ر٥٣	٢ر١٣	٢٥٠	٧ر١٤	٩ر٢٧	٤٧
١٩٧٧	٣ر٤٦	٠ر١٢	٢٦٠	٦٨	٨٠	١٥
٩٧٨	٤ر٥٢	٦ر١٥	٢٩٠	٤ر٢٣	٠ر٣٩	٠ر٤٠
١٩٧٩	٥ر٤٤	٨ر٤	١١٠	٤ر٤٤	٢ر٤٩	٧ر٩
١٩٨٠	٣ر٥١	١ر٤٨	٧٤٠	٥ر٢٠	٦ر٥٨	٦٥
١٩٨١	٤ر٤٧	٢ر١٩	٤٠٠	٣ر٩	٢٩	٦٦
١٩٨٢	٧ر٤٨	٧ر١٩	٤٠٠	٣ر٦٩	٨٩	٢٢
١٩٨٣	٠ر٤٥٠	٠ر٤٣	٩٥٠	٤ر١٧	٤ر٦٠	٧١
١٩٨٤		٥٠	١١٨	٢٣	٨ر٧٩	٨ر٢٧
١٩٨٥	٩ر٣٩	٧ر١٩	٤٩٠	٩ر٧٤	٦ر٩٤	٨ر٢٠
١٩٨٦	٢ر١٨	٥ر١٤	٨٠٠	٥ر١٤٣	١٥٨	٢ر٩
١٩٨٧	١ر٦٠	٠ر٤١	٦٨٠	٨ر١١٤	٨ر١٥٥	٣ر٢٦
١٩٨٨	٤ر٦٣	٠ر٥٠	٧٩٠	٠ر٩٨	١٤٨	٧ر٣٣
١٩٨٩	٢ر٤٤	٨ر٢٨	٦٥٠	٧ر٢١٧	٥ر٢٤٦	٧ر١١
١٩٩٠	٤ر٣٤	٤ر٣٦	١٠٦٠	٥ر٢٠٩	٩ر٢٤٥	٨ر١٤
١٩٩١	٦ر٢٢	٨ر٢٦	١١٩٠	٩ر٢٥٢	٧ر٢٧٩	٦ر٩
المعدل السنوي	١٩ر٤٧٥	٨ر٢٣	٥٠٠	٩ر٩١	٧ر١١٥	٤ر٢٢

المصدر : وزارة الزراعة / مديرية الاقتصاد الزراعي/ قسم الاحصاء الزراعي - عمان .

وبلغت الزيادة في الموسم ١٩٩١/٩٢ في الحقول المنفردة ٦٤٪ والمجمعة ٦ر٤٨٪ .

أظهر المحصول المزروع في المشاهدة كفاءة أعلى في إستعمال مياه الامطار الساقطة من المحصول المزروع بأسلوب المزارع حيث بلغت كفاءة إستعمال مياه الامطار (كغم من الحب لكل ملم مطر) ٤٧ر٤ في المشاهدة مقارنة بـ ٥ر٣ في حقل المزارع في الموسم الاول و ٢٨ر٤ مقارنة ب ٢ر٢ في الموسم الثاني ، وإرتفعت في الموسم الثالث إلى ٢٠ر٥ كغم/ ملم تحت ظروف المشاهدة مقارنة بـ ٢ر٢ في حقل المزارع. وكانت الكفاءة أعلاها في شمال الاردن منها في كل من الوسط والجنوب ، كما كانت أعلى في محصول المشاهدات المنفردة منها في محصول المشاهدات المجمعة .

مقدمة

تتركز زراعة الشعير في الاردن في المنطقة الحدية التي تتراوح أمطارها السنوية ما بين ٢٠٠ - ٣٠٠ ملم ، والتي تشكل ٦٣٪ من المساحة الكلية للمملكة الاردنية الهاشمية . ويعتبر محصول الشعير من المحاصيل الهامة في الاردن ، حيث يستعمل في تغذية الاغنام وحيوانات المزرعة الاخرى إما على شكل حبوب أو تبن.

بلغ معدل مساحة الاراضي التي استغلت في زراعة الشعير على مدى العقدين الماضيين ٥ر. ٪ من المساحة الكلية للمملكة ، وهي تمثل ٢ر١٠٪ من المساحة المستغلة سنويا ، وبمعدل سنوي بلغ ٤٧٥ ألف دونم (جدول رقم ١) . هذا وتشير الاحصاءات في الاردن (جدول رقم ١) إلى أن معدل الانتاج الوطني من الشعير هو ٢٤ ألف طن (معدل الفترة الواقعة ما بين أعوام ١٩٧٣- ١٩٩١) ، بينما بلغ معدل الاستهلاك السنوي لنفس الفترة ٧ر١١٥ ألف طن ، وذلك بنسبة إكتفاء ذاتي بلغت ٤ر٢٢٪ ، بحيث تتم تغطية النقص عن طريق الاستيراد بالعملة الصعبة . وتشير الارقام إلى أن إنتاجية المحصول على المستوى الوطني تراوحت ما بين ١١٠٠ و١١٩٠ كغم / هـ وبتذبذب كبير ناتج بشكل رئيسي عن تباين كميات الامطار الساقطة وتوزيعها خلال مواسم الزراعة .

تقنيات حزمة العمليات الكاملة لانتاج الشعير
في الاردن

قاسم ممدوح
المركز الوطني للبحوث الزراعية ونقل التكنولوجيا / عمان - الاردن
و
نصري حداد
المركز الدولي للبحوث الزراعية في المناطق الجافة (إيكاردا)
عمان - الاردن

الخلاصة

نفذت مجموعة من المشاهدات في حقول المزارعين وبمشاركتهم لمقارنة إنتاجية الشعير عند إتباع حزمة العمليات الكاملة الموصى بها مع انتاجية المزارع عند إتباعه أسلوبه التقليدي في الزراعة . شملت حزمة العمليات الكاملة تحضير الارض بإستعمال المحاريث الحفارة ، الزراعة بالبذارة قبل سقوط الامطار ، إستعمال الصنف المحسن ، إضافة السماد وإستعمال مبيدات الاعشاب . تم تنفيذ ما مجموعه ٥٤ مشاهدة منها ٣٦ مشاهدة في حقول منفردة و١٨ مشاهدة في حقول مجمعة، وبلغ عدد المزارعين المشاركين في المشاهدات ١١٦ مزارعا . غطت المشاهدات ٢ر٤١٥ هكتار في مناطق زراعة الشعير في شمال ووسط وجنوب الاردن ونفذت خلال المواسم ١٩٨٩/٩٠ ، ١٩٩٠/٩١ و ١٩٩١/٩٢ .

أظهرت النتائج بشكل واضح تفوق إنتاجية المشاهدات المنفذة بإتباع حزمة العمليات الكاملة على الانتاجية المتحصل عليها بإتباع أسلوب المزارع في الزراعة ، فلقد تراوحت الزيادة من ٢٤٪ في حدها الادنى إلى ٢٧٥٪ في حدها الاقصى . وكان معدل الزيادة في موسم ١٩٨٩/٩٠ ٥ر٢٢٦ ٪ للحقول المنفردة ، وفي موسم ١٩٩٠/٩١ كان معدل الزيادة ٣ر١٠٤ ٪ للحقول المنفردة و١٢٤٪ للحقول المجمعة.

The Effect of Full-package Production Technology on Barley Production in Jordan

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Abstract

Demonstrations were conducted on farmers' fields with their participation to compare the effect on barley yield of using full-package barley production technology and farmers' conventional practices. The full package consisted of seed-bed preparation with a chisel plow, early planting with a seed drill before the rain, an improved cultivar, fertilizer and weed control with herbicides. A total of 54 demonstrations covered an area of 415.2 ha in north, central and south Jordan during the 1989/90, 1990/91 and 1991/92 seasons. The full package resulted in a substantial barley yield increase over yield obtained with traditional practices, ranging from 24 to 275%. The average increase achieved during 1989/90 was 116.5%. In 1990/91, the average increase was 104.3% for individual field demonstrations and 134% for consolidated fields, whereas the average yield increase in 1991/92 was 64% in individual fields and 48.6% in consolidated fields. Rainfall use efficiency (RUE), expressed as kg grain/1 mm rain, was greater in the demonstrations than in the farmers' field conditions. RUE values were 4.47 vs. 3.5% in 1989/90, 4.28 vs. 2.30% in 1990/91 and 5.3 vs. 3.3% in 1991/92. Moreover, the RUE was highest in north Jordan than in central and south Jordan, and was greater in individual field demonstrations than in consolidated fields.

لاخرى وهذا معناه أن للبيئة تأثير على الانتاجية .

٢- التربة في محافظة حماة تختلف عن التربة في محافظة الرقة ، ولذلك فهناك فروق في الانتاجية.

٣- تمت الزراعة في موعد واحد هو النصف الثاني من تشرين الثاني .

٤- إعتبارا من هذا الموسم أدخلنا مقارنة معدلات البذار بإستخدام باذرة الخطوط (كشيشان) مقارنة مع الباذرة الهارو . وفي محافظة حماه تم مقارنة إستخدام الالة مع النثر اليدوي بمعدلات بذار مختلفة .

بهاء الدين الراوي

هل تم دراسة تأثير معدل البذار والسماد على مكونات الغلة ؟

ياسين سويدان

أعتقد أن هذا الامر مهم ولم يتم دراسته إلا أننا بصدد دراسته في المستقبل .

ياسين سويدان

هنالك إستجابة للشعير للتسميد وتكون هذه الاستجابة أكبر كلما زاد معدل البذار ، ويعود ذلك لانه كلما زاد عدد النباتات في وحدة المساحة كلما زادت المنافسة بين النباتات لامتصاص العناصر الغذائية من التربة وبالتالي تكون الاستجابة أكبر .

محمد عباينه

إن معدلات البذار المستعملة كانت متباعدة عن بعضها البعض .

ياسين سويدان

أولا : في مراكز البحوث وتحت إدارة الباحثين يمكن إقامة أبحاث لدراسة كافة الاحتمالات ولكن ليس من المفيد أن تدرس هذه القضايا في حقول المزارعين .

ثانيا: الباحث لديه مسبقا بعض المؤشرات وبإمكانه إستبعاد المعدلات المنخفضة كثيرا والعالية جدا وعليه تم إختيار هذه المعدلات الثلاث فقط .

أحمد الراوي

١- كيف يمكن دراسة معدلات البذار بمعزل عن ظروف التربة ونوع التربة ؟ حيث أن ظروف التربة مثل تكوين القشرة الارضية والملوحة لها تأثير على نسبة ألانبات ؟

٢- ما هو تأثير موعد الزراعة (قبل المطر أو بعد المطر) على معدل البذار المستعمل ؟

٣- ما هي نسبة المستخدمين لالات البذار ؟ لماذا لم يدخل في المعاملة مقارنة النثر وهي الطريقة الشائعة ؟

ياسين سويدان

١- لاحظت أثناء العرض بأننا ركزنا على أن الانتاجية تختلف من بيئة

- يمكن أن تجري دراسات من قبل الباحثين في مراكز البحوث لتحديد أفضل معدل بذار لكل صنف ويمكن دراسة كافة مكونات الغلة وعلاقتها بمعدل البذار .

ميشيل ميشيل

هل المزارعين المتعاونين مع مشروع المشرق يستخدمون معدل البذار الموصى به من قبل المشروع أم لا؟

ياسين سويدان

ستتم الاجابة على هذا السؤال من قبل الباحثين الذين سيستعرضون دراسة الحصر الاقتصادي والاجتماعي فلديهم الاجابة .

حسن النابلسي

ما هو تفسيرك لاختيار المزارعين في سوريا لكميات بذار عالية ، في حين أن المزارعين في الاردن توصلوا إلى نسب بذار أقل كثيرا ؟

ياسين سويدان

الاعتقاد السائد لدى مزارعي محافظة حماه (المنطقة الوسطى من سوريا) أن زيادة معدلات البذار تؤدي الى التخلص من الاعشاب نتيجة التغطية الكاملة للتربة من قبل الشعير ، ولكن إستطعنا أن نقنع المزارع بأنه يمكن التخلص من الاعشاب بإستخدام مبيدات الاعشاب . ووجدنا أن جنوب سورية يستخدمون معدلات بذار منخفضة ويعتقدون بأن النبات يستطيع أن يكّون اشطاءا أكثر ونحن موافقون معهم .

حسن النابلسي

ما دامت الاستجابة للسماد كانت أكثر عند إستعمال كمية بذار أكثر ، لماذا لم تجرى التجربة بإستعمال كميات سماد أكبر من السماد عند إستعمال معدلات أكبر من البذار (١٥٠ كغم / هـ) ؟

مناقشه

تأثير معدلات البذار
على إنتاجية الشعير

ياسين سويدان ، محمد وليد الطويل وغازي الاسدي
(مديرية البحوث العلمية الزراعية)
دوما - سوريا

عدنان العذاري

هل أخذ بنظر الاعتبار التغايرات في الاصناف وإختلاف عدد البذور في الكفم بين الاصناف في دراسة كمية البذار ؟

ياسين سويدان

الدراسة تمت على الصنف المحلي فقط .

حسين صالح

١- هل هناك توصية باللاستمرار بالتسميد ؟
٢- هل هناك علاقة بين معدل البذار والصنف وخاصة أن هناك أصناف كثيرة محسنة ؟ هل حددت المواقع حسب الاصناف ؟ هل حدد معدل البذار من خلال الكثافة النباتية وعدد الاشطاء؟

ياسين سويدان

١- طبعا هناك توصيات دائمة بضرورة إستخدام الاسمدة في المناطق الجافة

٢- العمل والبحث تم على الصنف المحلي فقط .
- تم تنفيذ البحث في ٣٢ موقعا في مناطق الاستقرار الثانية والثالثة .

ومن هنا نستنتج ما يلي :

١- إن إاتخدام معدل البذار ١٠٠ كغ/هـ هو الافضل من الناحية الانتاجية والاقتصادية لانه يعطي أعلى غلة من الشعير . ومن المؤكد أن استخدام هذا المعدل يؤدي إلى تحقيق عائد إقتصادي أعلى ويوفر الجهود لدى مؤسسة إكثار البذار ، بالاضافة إلى توفيره مبالغ طائلة تنفق على المبالغة في إضافة البذار للزراعة .

٢- للتسميد أهمية كبيرة في زيادة إنتاجية الشعير .

٣- كلما زاد معدل البذار زادت درجة الاستجابة للتسميد نتيجة للمنافسة على امتصاص العناصر من التربة .

المراجـــــــع

١. المكتب المركزي للاحصاء - رئاسة مجلس الوزراء في سورية 1990. تقرير عن تطور مساحة وإنتاج الحبوب والبقول الجافة ، دمشق - سورية صفحة 108-109.

٢. المهندس الزراعي العربي - العدد /2 ، صفحة 62-71 .

٣. التقرير السنوي الفني الثاني لمشروع المشرق للشعير والاعلاف والاغنام للموسم 1990/1991.

٤. التقرير السنوي الفني الثالث لمشروع المشرق للشعير والاعلاف والاغنام للموسم 1991/1992

جدول رقم (٥) . تاثير معدلات البذار والسماد على إنتاجية الشعير في كافة المواقع والسنوات ومناطق الاستقرار الثانية والثالثة في محافظتي حماه والرقة.

معدل البذار (كغم/هكتار)	المعاملات	متوسط الانتاج (كغم/هكتار)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ مع تسميد)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ بدون تسميد)
٧٠	مع تسميد	١٤٥٧	٤-	-
	بدون تسميد	١١٨٠	-	١-
١٠٠	مع تسميد	١٥١١	-	-
	بدون تسميد	١١٩٢	-	-
١٥٠	مع تسميد	١٤٧٨	١+	-
	بدون تسميد	١١١٠	-	٧-

أقل فرق معنوي لمتوسط الانتاجية

على مستوى ٥٪ = ٢٦٥ .

معامل الاختلاف (٪) = ٩ر١١ .

جدول رقم (٤) . تاثير معدلات البذار والسماد على إنتاجية الشعير من الحب (كغم/ هكتار) عند زراعته في مشاهدات في حقول المزارعين في منطقة الاستقرار الثالثة في محافظتي حماه والرقة خلال مواسم ١٩٨٩/١٩٩٠ و ١٩٩٠/١٩٩١ و ١١٩١/١٩٩٢.

معدل البذار (كغم/هكتار)	المعاملات	متوسط الانتاج (كغم/هكتار)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ مع تسميد)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ بدون تسميد)
٧٠	مع تسميد	١٠٦٨	٤-	-
	بدون تسميد	٩٢٥	-	١+
١٠٠	مع تسميد	١١٠٧	-	-
	بدون تسميد	١٨٩	-	-
١٥٠	مع تسميد	١١١٧	١+	-
	بدون تسميد	٨٢٧	-	١٠-

أقل فرق معنوي لمتوسط الانتاجية

على مستوى ٥٪ = ١٨٢ .

معامل الاختلاف (٪) = ٩٫٨ .

جدول رقم (٣) . تحليل العائد الاقتصادي الناتج عن استعمال معدلات البذار المختلفة في مناطق الاستقرار الثانية والثالثة .

معدل البذار (كغم/ هـ)	المعاملات	منطقة الاستقرار الثانية: العائدالصافي ليره سورية	منطقة الاستقرار الثانية: الاربحية مقارنة مع معدل البذار (١٠٠كغم/هـ)	منطقة الاستقرار الثالثة: العائدالصافي ليره سورية	منطقة الاستقرار الثالثة: الاربحية مقارنة مع معدل البذار (١٠٠كغم/هـ)	التحليل التجميعي: العائدالصافي ليره سورية	التحليل التجميعي: الاربحية مقارنة مع معدل البذار (١٠٠كغم/هـ)
٧٠	مع تسميد	٩٨٩١	٦٧٧-	٦٧٢٠	٥١+	٩٤٤٣	٥٤-
	بدون تسميد	٧٩٠٣	٦٨-	٥٧١٩	٣٧٣+	٧٥٠٤	٢٤٠+
١٠٠	مع تسميد	١٠٥٦٨	-	٦٦٦٩	-	٩٤٩٧	-
	بدون تسميد	٧٩٧١	-	٥٣٤٦	-	٧٢٦٤	-
١٥٠	مع تسميد	٩٥٥٩	١٠٠٩-	٦١٩٩	٤٧٠٠-	٨٧٢٦	٧٧١-
	بدون تسميد	٦٨٦٤	١١٠٧-	٤١٧٦	١١٧٠٠-	٦١٥٠	١١٤-

سعر كيلو الشعير في سنة ١٩٩١ كان ٧ ليرات سورية للبيع و ١٠٫٨٠ ليرة سورية للشراء.

في القطع غير المسمدة .

أما بالنسبة لمعدل البذار ١٥٠ كغم/هـ فقد أظهر التحليل تساوي الانتاجية تقريباً في القطع المسمدة وتفوقها بمقدار ١٠٪ في القطع غير المسمدة .

بينما أظهر التحليل الاقتصادي في الجدول رقم (٣) باستخدام الميزانية الجزئية البسيطة وبأسعار موسم ١٩٩١ السابقة بأن هناك خسارة باستخدام معدل البذار ١٠٠ كغم/هـ بمقدار ٥١ ل.س/هـ مقارنة باستخدام معدل البذار ٧٠ كغم/هـ في معاملة التسميد، وخسارة بمقدار ٢٧٢ ل.س/هـ في معاملة عدم التسميد، في حين أن هناك ربحاً باستخدام معدل البذار١٠٠ كغم/هـ بمقدار ٤٧٠ ل.س/هـ في معاملة التسميد قدره ١١٧٠ ل.س/هـ في معاملة عدم التسميد مقارنة باستخدام معدل البذار ١٥٠ كغم/هـ .

ثالثاً:- النتائج المجمعة لكافة المواقع والسنوات ومناطق الاستقرار الثانية والثالثة

وأظهرت النتائج في جدول رقم (٥) تفوق معدل البذار ١٠٠ كغم/هـ على كلا معدلي البذار ٧٠ و ١٥٠ كغم/ هـ وبمقدار ٢ - ٤٪ في معاملة التسميد و١ - ٧٪ في معاملة عدم التسميد على الترتيب . ولكن لم تكن الفروق معنوية بين معدلات البذار ، مما يؤكد بأن معدل البذار لا يلعب دوراً في زيادة الانتاجية لمحصول الشعير . في حين كانت الفروق معنوية بين معاملات التسميد وعدم التسميد ضمن معدل البذار الواحد، مما يظهر أهمية التسميد واستجابة محصول الشعير له في تحقيق إنتاجية جيدة .

كما أظهر التحليل الاقتصادي التجميعي (جدول رقم ٣) أربحية استخدام معدل البذار ١٠٠ كغم/هـ مقارنة مع معدل البذار ٧٠ كغم/هـ و ١٥٠ كغم/هـ وبمقدار ٥٤ - ٧٧١ ل.س/ هـ على الترتيب في معاملة التسميد، وخسارة بمقدار ٢٤٠ ل.س / هـ في معاملة عدم التسميد مقارنة مع معدل البذار ٧٠ كغم/هـ وأربحية بمقدار ١١١٤ ل.س /هـ مقارنة باستخدام معدل البذار ١٥٠ كغم/ هـ . مما يؤكد أيضا أهمية استخدام معدل البذار ١٠٠ كغم/هـ.

جدول رقم (٢) . تاثير معدلات البذار والسماد على إنتاجية الشعير من الحب (كغم/ هكتار) عند زراعته في مشاهدات في حقول المزارعين في مناطق الاستقرار الثانية من محافظتي حماه والرقة خلال المواسم الزراعية ١٩٨٩/١٩٩٠ و١٩٩٠/١٩٩١ و ١١٩١/١٩٩٢ .

معدل البذار (كغم/هكتار)	المعاملات	متوسط الانتاج (كغم/هكتار)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ مع تسميد)	الزيادة عن معدل البذار١٠٠كغ/هـ (٪ دون تسميد)
٧٠	مع تسميد	١٥٢١	-٩	-
	دون تسميد	١٢٣٧	-	-٤
١٠٠	مع تسميد	١٦٦٤	-	-
	دون تسميد	١٢٩٣	-	-
١٥٠	مع تسميد	١٥٩٧	-٤	-
	دون تسميد	١٢١٢	-	-٦

أقل فرق معنوي لمتوسط الانتاجية

على مستوى ٥٪ = ٢٤٢ .

معامل الاختلاف ٪ = ٣ر١١ .

وأظهرت الدراسة خلال المواسم الثلاثة النتائج التالية :

النتائج والمناقشة

أولا :- النتائج في مناطق الاستقرار الثانية

أظهر التلحليل الاحصائي في الجدول رقم (٢) وتحت معاملة التسميد تفوق معدل البذار١٠٠كغم/هـ على معدل البذار٧٠ كغم/هـ بمقدار ٩٪ ، وعلى المعدل ١٥٠ كغم/هـ بمقدار ٤٪ . أما عند تطبيق معاملة عدم التسميد فقد بلغ مقدار تفوق معدل البذار ١٠٠ كغم / هـ على معدل البذار ٧٠ كغم / هـ حوالي ٤٪ ، وعلى المعدل ١٥٠ كغم/ هـ حوالي ٦٪ . ولم تكن الفروق معنوية بين معدلات البذار لكل معاملة على حدة ، أي لم يكن لمعدلات البذار تأثير واضح على الانتاجية ولكن كانت الفروق معنوية جداً بين معاملات التسميد وعدمه ، مما يظهر أهمية التسميد ودرجة استجابة الشعير له والتأكيد على زيادة انتاجية الشعير بإستخدام معدل البذار ١٠٠ كغم/هـ مع التسميد .

وأظهر التلحليل الاقتصادي في جدول رقم (٣) باستخدام الميزانية الجزئية البسيطة وبأسعار موسم ١٩٩١ على أساس سعر مبيع الكغم الواحد بـ ٧ ليرات سورية وسعر الشراء للكغم الواحد بـ ١٠٫٨٠ ليرة سورية ، بأن هناك أربحية في استخدام معدل البذار ١٠٠ كغم / هـ بمقدار ٦٧٧ ل.س/ هـ في معاملة التسميد و ٦٨ ليرة سورية/هـ في معاملة عدم التسميد ، وذلك مقارنة باستخدام معدل البذار ٧٠ كغم/هـ . كما أظهر التحليل أربحية بمقدار ١٠٠٩ ل.س/هـ في معاملة التسميد و ١١٠٧ ل.س/هـ في معاملة عدم التسميد مقارنة باستخدام معدل البذار ١٥٠ كغم/هـ ، مما يظهر ضرورة استخدام معدل البذار ١٠٠ كغم/هـ سواء في معاملة التسميد أو عدمه وبالتالي تحقيق أربحية اقتصادية وإنتاجية تزيد من دخل المزارع وتوفّر في كميات البذار المستخدمة .

ثانيا:- النتائج في مناطق الاستقرار الثالثة

وأظهرت النتائج في جدول رقم (٤) تفوق معدل البذار ١٠٠ كغم/هـ على معدل البذار ٧٠ كغم/هـ وبمقدار ٤٪ بالنسبة للقطع المسمدة وتساوي الانتاجية تقريباً

الظروف المناخية خلال مواسم الدراسة

كان التباين المناخي واضحا ومختلفاخلال مواسم الدراسة حيث تميز الموسم الاول (١٩٨٩/١٩٩٠) بالجفاف وطول فترة البرودة وحدوث الصقيع ، خاصة في محافظة حماه (١٤-١٦ آذار ١٩٩٠) إذ كان له تاثير سلبي على نمو النباتات وبالتالي هلاك المحصول ومن ثم إلغاء التجارب في تلك المحافظة ·

وفي الموسم الثاني (١٩٩٠/١٩٩١) تاخر الهطول المطري حتى نهاية كانون الثاني ١٩٩٠ وتكرر حدوث الصقيع حتى نهاية شباط ، مما أدى إلى عدم نمو البادرات بشكل جيد· أعقب ذلك رياح مغبرة في محافظة الرقة خلال شهر نيسان كان لها تاثير سلبي على النمو وتكوين السنابل ، ولم تعط الفرصة للنباتات للوصول إلى مرحلة النضج ، لذلك لم تحصد التجارب في محافظة الرقة باستثناء موقع كطار في منطقة الاستقرار ثانية .

وفي محافظة حماه كان الوضع في بداية الموسم مشابها، إلا أن تحسن الاحوال الجوية فيما بعد وهطول الامطار وتوزيعها بشكل مناسب أتاح فرصة أفضل لنمو النباتات حيث تم حصاد كافة المواقع .

واتسم الموسم الثالث (١٩٩١/١٩٩٢) بظروف مناخية مختلفة تماماً حيث هطلت الامطار بشكل مبكر وبدأ الانبات مبكراً، إلا أن استمرار الهطولات المطرية والمرافقة لدرجات البرودة المستمرة كان له تأثير سلبي على نمو البادرات وعدم استرساء النبات واستطالته ، وبقيت النباتات قصيرة (٥-٧ سم) حتى نهاية شهر شباط ، تلى ذلك وخلال شهري آذار ونيسان فترة انقطاع مطري (جفاف) باستثناء هطولات قليلة (آثار) ، مما كان له تأثير سلبي على مكونات الغلة . وكان لهطول الامطار خلال شهر أيار تأثير فعّال وإيجابي في تحسن حالة النمو وتكوين السنابل وامتلاء الحبوب ، وعليه تم حصاد معظم المواقع في محافظتي حماه والرقة .

جدول رقم (١) . مواقع تنفيذ مشاهدات أفضل معدل بذار من الشعير في محافظتي حماه والرقة للمواسم الثلاثة .

مناطق الاستقرار المحافظة والمواسم	إستقرار ثانية	إستقرار ثالثة
١- في محافظة حماه		
١٩٨٩/١٩٩٠	الكبارية - السعن القبلي	عكش
١٩٩٠/١٩٩١	السعن القبلي-السبيل-عين خزام كوكب - صوران - الشعته	تل التوت - فريتان
١٩٩١/١٩٩٢	معردس - تل الذرة - السليمة (بين جبال) السليمة (بركان)	تل التوت - بري شرقي
٢- في محافظة الرقة		
١٩٨٩/١٩٩٠	كطار	بير صران
١٩٩٠/١٩٩١	لويبدة - كطار - الجميلية	العيوج - بير صران شراكراك - بير عاصي
١٩٩١/١٩٩٢	الجميلية - حمان التركمان- السكرية	شركراك - بير صران خنيز فوقاني

تهدف هذه الدراسة الى اختبار معدلات البذار المثلى لزراعة الشعير في حقول المزارعين في مناطق زراعة الشعير في شمال وشمال شرق سوريا ، ومقارنة تلك المعدلات ، بتلك التي يستعملها المزارع .

المواد وطرق البحث

أجريت هذه الدراسة في حقول المزارعين وفي مواقع متعددة في محافظتي حماة والرقة ، وهي المحافظات الاكثر استخداما لمعدلات البذار العالية من الشعير . نفذت الدراسة في المواسم الثلاثة ١٩٨٩/١٩٩٠ و١٩٩٠/١٩٩١ و ١٩٩١/١٩٩٢ حيث تم استخدام ثلاثة معدلات من البذار :٧٠ و ١٠٠ و ١٥٠ كغ/هـ .

تم استخدام صنفي الشعير العربيين المحليين ، العربي الابيض في محافظة حماه والعربي الاسود في محافظة الرقة .

نفذت المشاهدات في مناطق الاستقرار الثانية والتي تتلقى سنويا ٢٥٠-٣٥٠ملم من الامطار ومناطق الاستقرار الثالثة (٢٥٠ ملم سنويا) ، ويبين الجدول رقم (١) مواقع المشاهدات . بلغت مساحة الحقل الواحد ٢ دونم في الموسمين الاول والثاني و ٣٠ دونم في الموسم الثالث . استخدمت البذارة المتوفرة لدى المزارعين في الزراعة . وتمت إضافة السماد إلى نصف مساحة كل معاملة وذلك حسب المعدلات التالية :

٥٠ كغ/هـ من سماد اليوريا (٤٦٪ من الآزوت) كدفعة أولى لمناطق الاستقرار الثانية أو

٢٥ كغ/هـ من سماد اليوريا (٤٦٪ من الآزوت) كدفعة أولى لمناطق الاستقرار الثالثة .

ثم أضيف ٧٥ كغ/هـ من نترات الامونيوم (٣٠٪ آزوت) كدفعة ثانية في مرحلة الاشطاء .

أما السماد الفوسفاتي فقد أضيف عند الزراعة بمعدل ١٠٠ كغ/هـ سوبرفوسفات (٤٦٪ خامس أوكسيد الفوسفور P_2O_5) .

كما أظهر التحليل الاقتصادي لمعاملة التسميد بأن أربحية إستخدام معدل البذار ١٠٠ كغم/ هـ قد بلغت في معاملة التسميد ٥٤ ل . س/هـ وهي أعلى من الاربحية التي تم الحصول عليها عند استخدام معدل البذار ٧٠ كغم /هـ ، كما بلغت ٧٧١ ل.س /هـ عند استخدام نفس معدل البذار وهي أعلى من معدل البذار ١٥٠ كغم / هـ .

وتحت معاملة بدون تسميد بلغت أربحية استعمال معدل البذار ١٠٠ كغم / هـ ١١١٤ ل.س/هـ وهي أعلى من الاربحية المتحصل عليها عند استخدام معدل البذار ١٥٠ كغم /هـ .

المقدمة

يعتبر الشعير *(Hordeum vulgare)* أحد الموارد العلفية الرئيسية ، فهو يحتل المركز الاول من حيث المساحة المزروعة في سورية ، والثاني بعد القمح من حيث الاهمية الاقتصادية (المكتب المركزي للاحصاء ١٩٩٠) ، وتنجح زراعته في نفس البيئات الملائمة لزراعة القمح ، إلا أنه أكثر تحملا لظروف الجفاف والامطار الاقل والمناطق الاقل خصوبة .

أكدت تجارب المركز العربي لدراسات المناطق الجافة والاراضي القاحلة (أكساد) في كل من سوريا والاردن والمغرب والجزائر أن معدل البذار ١٠٠ كغ/هـ هو المعدل الامثل للحصول على إنتاج عالي الغلة من الشعير، ولم تكن الفروق معنوية في الانتاجية عند استخدام معدلات منخفضة مثل ٦٠ كغ/هـ أو ٩٠ كغ/هـ (المهندس الزراعي العربي - العدد الثاني)

وأشارت نتائج الحصر والمسح الاقتصادي والاجتماعي لمشروع المشرق للموسمين ١٩٩٠/١٩٩١ و ١٩٩١/١٩٩٢ (تقارير مشروع المشرق) بأن المزارعين يميلون إلى استخدام معدلات بذار عالية وبمدى يتراوح بين ١٢٠ و٣٣٠ كغم/ هـ لمحصولي القمح والشعير .

تأثير معدلات البذارعلى إنتاجية الشعير

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الملخص

تهدف الدراسة الى معرفة أنسب معدل بذار لمحصول الشعير في مناطق الزراعة البعلية ذات معدلات هطول مطري يتراوح بين ٢٥٠ و ٣٥٠ ملم سنويا . نفذت الدراسة في حقول المزارعين وفي مواقع متعددة في محافظتي حماه والرقة خلال المواسم الزراعية الثلاث ١٩٨٩-١٩٩٢ في مشاهدات لاختبار ثلاثة معدلات بذار للشعير المحلي (عربي أبيض في حماه وعربي أسود في الرقة) هي ١٠٠ و ١٥٠ و٢٠٠ كغ/هـ خلال الموسم الاول و٧٠ و١٠٠ و ١٥٠ كغ/هـ للموسمين الثاني والثالث .

بدأت الزراعة خلال النصف الثاني من تشرين الثاني من كل عام بإستخدام البذارة الآلية المتوفرة لدى المزارع وبمساحة ٣-٦ دونم لكل موقع . نفذت معدلات البذار تحت معاملتين الاولى بدون سماد والثانية بإضافة السماد.

أظهرت الدراسة في التحليل الاحصائي المركب لكافة المواقع والسنوات ومناطق الاستقرار الثانية والثالثة بأن إنتاجية الشعير كانت الاعلى بإستخدام معدل البذار ١٠٠ كغم/ هـ وأن مقدار الزيادة تراوح من بين ٢ و ٤ ٪ في معاملة التسميد وبين ١ إلى ٧ ٪ في معاملة عدم التسميد بالمقارنة مع كلا معدلي البذار٧٠ كغم/ هـ و١٥٠ كغم/ هـ . على الترتيب . ولكن لم تكن الفروق معنوية بين معدلات البذار في المعاملة الواحدة ، مما يؤكد بأن معدل البذار لا يلعب دورا في زيادة الانتاجية لمحصول الشعير وإنما كانت الفروق معنوية جدا في معاملة التسميد وبدونه ضمن معدل البذار الواحد مما يظهر أهمية التسميد .

Effect of Seed Rates on Barley Productivity

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Abstract

Multiple-location on-farm trials were conducted in Hama and Raqqa provinces over three seasons (1990-1992) to identify the best seed rate for barley in the rain-fed area (250-350 mm annual rainfall). Three levels of seed rates of local barley varieties (Arabi Abiad at Hama and Arabi Aswad at Raqqa) were investigated. The rates used were 100, 150 and 200 kg/ha during the first season and 70, 100 and 150 kg/ha in the second and third seasons. Planting was done during the second half of November in all years, using a seed drill available to farmers in the targeted areas. The site area was 3-6 dunum (0.3-0.6 ha). Seed was planted under two fertilizer treatments: no fertilization (−F) and with fertilization (+F). Fertilizer was added at planting at a rate of 50 and 25 kg/ha of urea (46% N) to sites in Zones 2 (250-350 mm) and 3 (250 mm) respectively. Ammonium nitrate (30%) was added at tillering to both sites at the rate of 75 kg/ha. Phosphate (46% P_2O_5) was added to all sites at the rate of 100 kg/ha before planting. Barley planted at the rate of 100 kg/ha gave a greater yield than barley at the rates of 70 or 150 kg/ha under the fertilized and the unfertilized treatments. The yield increase ranged from 2 to 4% with fertilizer and −1 to 7% without fertilizer for both seasons. However, the differences among seed rates within the fertilizer treatment were not significant. The economic analysis indicates that using a seed rate of 100 kg/ha increased the net revenue by 54-771 SL/ha over seed rates of 70 and 150 kg/ha with +F treatment, and 114 SL/ha over the 70 and 150 kg/ha with −F treatment. The results suggest that the highest and most economical barley yield can be obtained with a seed rate of 100 kg/ha.

Barley Improvement

Interaction Between National and International Breeding Programs

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Abstract

The importance of specific adaptation to maximize yield and yield stability of barley in stress conditions suggests that repeated cycles of selection in a few sites have a high probability of reducing the frequency of genotypes specifically adapted to environmental and/or agronomic conditions not represented at those sites. A wider and earlier devolution of the selection work done by International Agricultural Research Centers (IARCs) to breeders of developing countries will reduce this danger by making use of positive genotype × environment interactions. It also will reduce the danger of narrowing the genetic diversity within a crop. This will be an efficient way of finalizing training activities and of establishing self-reliant breeding programs in less developed countries, which is one of the most important mandates of an IARC.

Introduction

Distribution of germplasm and training are the most important types of interaction between national and international crop improvement programs. Distribution of germplasm from international to national breeding programs takes place mostly through a system known as "International Nurseries."

International nurseries consist of different types of breeding material which are distributed to the national programs of different countries to be tested under a wide range of conditions. In the case of self-pollinated crops the breeding material distributed through the international nurseries has various degrees of homozygosity. However, most breeding material is made up of fixed or nearly fixed lines. Taking as an example the Cereal Improvement Program at ICARDA, the frequency of segregating populations distributed in the international nurseries during the last 5 years ranges from one-third to one-fifth of all the material distributed. The fixed or nearly fixed lines usually have been selected for 5-6 years in a number of environments.

There are three ways in which the environment and the selection strategy used during the testing and selection phase will determine some general characteristics of the lines eventually reaching the national programs.

First, most of the testing and selection is usually done under favorable conditions (Hildebrand 1990; Simmonds 1991) because it is believed that these are the ideal conditions for the full expression of genetic differences. That genetic differences under those conditions, which have little in common with those of the farmers, may be irrelevant (except for disease resistance) to the real farming world seems to have escaped the attention of most international breeders.

Second, the selection and testing environments represent a much smaller subset of environments than the range of environments where the lines will be tested by national breeding programs. Even when some of the environments used for selection are stress environments, it is unlikely that they represent all different types of stress environments. Thus genotype × environment interaction is bound to play an important role.

Third, the selection strategy most commonly used to decide which lines are the best in a set of environments is to use mean yields. Lines with high average yields are frequently those with a high yield in the best environments, and these will find their way to national breeding programs at the expense of those performing extremely well only in poor environments.

The effectiveness of the process has been increased by training a large number of scientists from developing countries on both principles (selection strategy and environment of selection). Thus all the ingredients to make international breeding successful at the national level are in place. By making sure that national breeding programs evaluate lines in the international nurseries under conditions as similar as possible to those used by the international programs the probability that some of the lines will be successful is greatly increased. At the adoption level farmers who can afford to grow the lines under the same conditions (defined as "progressive" farmers) will benefit from them. Those who can not afford it (the "illiterate" or "conservative" or "traditional" farmers) will stay with what they had before (if still available on the seed market).

It is now recognized, and it is not surprising, that this combination of breeding and training has been highly successful when the environments where the crop was eventually grown were favorable or could be profitably modified to become favorable, and much less successful for unfavorable environments (Bramel-Cox *et al.* 1991; Simmonds and Talbot 1992).

This paper has two objectives. First, to discuss the theoretical background of selection in environments which differ from the target environment, and second, to illustrate an example of a different type of interaction between national and international breeding programs.

Direct versus Indirect Selection

From a theoretical standpoint, the efficiency of germplasm distribution through the international nurseries can be treated as a case of the more general issue of the relationship between selection environment and testing environment (Rosielle and Hamblin 1981; Ceccarelli 1989; Simmonds 1991). In even more general terms and with reference to yield, this is a case of indirect selection. Selection is indirect when the breeder aims to improve a primary character by selecting for one or more secondary characters. A secondary character can be the same as the primary character, but measured in a different environment (Falconer 1981). From a genetic standpoint selection is always indirect in that the breeder selects for genotypic values or for the economic value through the phenotypic values (Gallais 1983).

With specific reference to selection in stress and non-stress environments, Rosielle and Hamblin (1981) showed that selection for tolerance to stress will generally result in reduced yield in non-stress environments and in reduced mean yield in stress and non-stress environments. More recently Simmonds (1991), using a numerical simulation concluded that (1) selection for low-yielding conditions has to be conducted under low-yielding conditions, (2) that using selection environments with intermediate yield levels is ineffective, and (3) that alternating selection cycles in low- and high-yielding environments is equally ineffective. Similarly Smith *et al.* (1990) concluded that it is essential to carry out selection under low-input conditions if significant gains in productivity under such conditions are to be achieved. Experimental evidence indicates that the selection environment affects how selections respond to changing environments (Hildebrand 1990; Ceccarelli and Grando 1991a).

The relative efficiency of indirect versus direct selection can be predicted by the magnitude of the heritability and of the genetic correlation coefficient. If A is the trait to be improved in environment X by selecting in environment Y, then (Falconer 1981):

$$CR_X/R_X = r_G \, h_Y / h_X$$

where CR_X is the correlated response in environment X when selection is done in environment Y, R_X is the direct response when selection is done in environment Y, r_G is the genetic correlation coefficient between A_X and A_Y, h_Y and h_X are the square roots of heritabilities of A in the two environments.

It is obvious from the formula that when $h_Y = h_X$, the maximum value of CR_X/R_X is 1 when $r_G = 1$. Therefore, when heritabilities are the same, direct selection will always be more effective because the genetic correlation coefficient will always be somewhat less than one. When h_Y is twice as large as h_X, r_G must be greater than 0.5 before CR_X becomes greater than R_X (Table 1).

Table 1. Values of CR_X/R_X as functions of the genetic correlation coefficient (r_G) and the ratio between the square roots of heritabilities in high-yielding (h_Y) and low-yielding (h_X) environments (modified from Ceccarelli *et al.* 1992).

	h_Y/h_X									
r_G	1	2	3	4	5	6	7	8	9	10
0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0.2	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.3	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
0.4	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
0.5	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
0.6	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0
0.7	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0
0.8	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
0.9	0.9	1.8	2.7	3.2	4.5	5.4	6.3	7.2	8.1	9.0
1.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0

With low genetic correlation coefficients (0.1 - 0.2), h_Y must be at least 10 to 5 times higher than h_X for CR_X to become higher than R_X. Estimates of r_G, h_Y and h_X therefore can clarify further whether selection in non-stress environments will be effective for genotypes that will be grown in stress environments. This is a problem of strategic importance to breeders in both national and international programs.

Experimental Evidence

During the last seven cropping seasons we compared the performance of barley genotypes in low- and high-yielding conditions. A summary of the comparisons is shown in Table 2 (Ceccarelli *et al.* 1992).

The upper part of the table shows the grain yield of the best 5% of the lines selected in low-yielding (stress) conditions (LY) and the grain yield of the best 5% of the lines selected in high-yielding (non-stress) conditions (HY) when grown in LY conditions. In 1988 one of the sites used as a low-yielding environment (Bouider) had a relatively high average yield because rainfall was more than twice the average of the other cropping seasons. However, we have kept this site in the low-yielding group because it was still the lowest testing site used in 1988. The bottom part of Table 2 shows the grain yield of the same lines in the HY sites.

Table 2. Grain yield (kg/ha) in low-yielding sites (LY, upper part) and high-yielding sites (HY, lower part) of the top 5% of the barley lines selected for grain yield either in LY or HY sites (modified from Ceccarelli *et al.* 1992).

	Testing site			Top-yielding lines selected under	
Year	Site†	Rainfall	Mean yield‡	LY	HY
1985	BR	178	743±17	1284±59	779±79
1986	BO	180	1138±34	1935±26	1340±79
1987	BR	164	673±9	1019±19	654±66
1988	BO	382	2910±38	4199±48	3383±132
1989	BO	184	687±16	1287±18	658±52
1990	BR	183	471±10	794±17	429±46
1991	BO	207	1050±22	1693±24	953±110
1985	TH	373	3489±29	3339±114	4210±49
1986	TH	316	4007±35	4139±78	4970±70
1987	TH	343	2668±23	2739±113	3613±35
1988	TH	499	4420±45	4672±173	6100±67
1989	AT	214	5824±60	4874±315	7814±107
1990	TR	317	3346±26	3066±118	4122±27
1991	TR	559	4740±54	4705±253	6073±65

† BR = Breda, BO = Bouider, TH = Tel Hadya, AT = Athalassa, TR = Terbol.
‡ ± standard error.

In LY conditions (mean yields ranging from 471 to 2910 kg/ha) the lines which had the highest yields in high-yielding conditions yielded between 429 and 3383 kg/ha. On the average they yielded about 37% less than the corresponding lines which were selected as high yielding in stress conditions (yields ranging from 794 to 4199 kg/ha). In HY conditions (mean yields ranging from 2668 to 5824 kg/ha) the lines which were high yielding under stress conditions yielded between 2739 and 4874 kg/ha. On the average they yielded 24% less than the lines which were selected as high yielding in non-stress environments (yields ranging from 3613 to 7814 kg/ha). These data indicate that indirect selection (selection in the absence of stress to improve yield in the presence of stress) is unlikely to be more effective than direct selection (selection in the presence of stress). The analysis of the selection history of the most successful lines in low-yielding environments in three cycles of yield testing (Ceccarelli and Grando 1991b) indicates that selection of breeding lines unrelated to local landraces conducted in high-yielding environments was 28 times less efficient than selection of locally adapted germplasm conducted in low-yielding environments. Similar comparisons made with different types of germplasm indicate that when selection was conducted in low-yielding environments, lines derived from local landraces outyielded non-landrace material (Table 3). Likewise in high-yielding environments the non-landrace material outyields the landrace material. The data of Table 3 suggest that repeated cycles of selection in a given type of environment would progressively reduce the frequency of breeding lines which might be specifically adapted to other environments.

This is shown by the generally lower yields of the landraces when evaluated only in high-yielding conditions. The utilization of landraces in breeding programs for developing countries is often discouraged on the grounds of their low yield potential and disease susceptibility. There is no doubt that this is often true when all selection is conducted under high-input conditions or outside the adaptation area of the landraces. But when this type of germplasm is evaluated in the conditions in which it has evolved and is still grown by farmers, conclusions are very different (van Leur *et al.* 1989). Therefore using the wrong selection environment may result in germplasm being discarded which otherwise could prove to be very useful. The argument of the disease susceptibility of landraces has been discussed elsewhere (van Leur *et al.* 1989) and it was shown that pureline selections within landraces may reveal unsuspected sources of disease resistance.

Estimates of genetic correlation coefficients (Table 4) have been obtained from yield trials conducted in 1987, 1989, 1990 and 1991 in sites with highly contrasting site means (Ceccarelli *et al.* 1992).

Table 3. Grain yield (kg/ha) under stress (YS) and non-stress (YNS) of barley breeding material classified according to germplasm type.

		YS‡		YNS§	
Type of germplasm	N†	Yield	Range	Yield	Range
Non-landraces	155	488	0-893	3901	2310-4981
Landraces¶	77	788	486-1076	3413	2398-4610
Best check#		717		4147	

† Number of entries.
‡ Average of Bouider 1989 and Breda 1990.
§ Average of Tel Hadya 1988, Tel Hadya 1989, Terbol 1990.
¶ Pure lines obtained by pure line selection within landraces.
# Harmal for YS, Rihane-03 for YNS.

Table 4. Range of genetic correlation coefficients between yield measured in a low-yielding and high-yielding site and ratio between correlated and direct response to selection (CR/R) in a total of 58 trials conducted in four cropping seasons (modified from Ceccarelli *et al.* 1992).

Year	Negative	0-0.2	0.2-0.4	0.4-0.6	0.6-0.8	0.8-1.0	CR/R > 1
1986/87	6	1	4	2	2	2	1
1988/89	13	2					0
1989/90	5	7	2				0
1990/91	3	4	2	2		1	0
Total	27	14	8	4	2	2	1

There were 17 trials in 1986/87, 15 in 1988/89, 14 in 1989/90 and 12 in 1990/91. Each trial had two replications and 25 genotypes. Among the 58 estimates of r_G, 27 were negative. Among the 31 positive values only 8 were higher than 0.4 and six of those were associated with average yields in the highest yielding sites ranging between 1812 and 3180 kg/ha. These values are at or around the value where in barley a crossover between genotypes with specific adaptation to different environments often occurs (Fig. 1). In only one case was a positive r_G associated with a relative magnitude of point estimates of heritabilities in the two environments such that the CR_X/R_X ratio was greater than 1 (= 2.1). In this case the trial had the smallest difference found among all 58 trials between YS (618 kg/ha) and YNS (1812 kg/ha). Both these values are below the crossover point in Figure 1.

These results indicate that selection in high-yielding environments will produce at best no correlated response, and at worse a negative correlated response in low-yielding environments.

The experimental data generated by the barley breeding program at ICARDA suggest that when lines are tested across a sufficiently wide range of environments, a crossover type of genotype by environment interaction is a common occurrence (Fig. 1). Indeed, this has been found to be the case in a number of crops (Simmonds 1981; Hildebrand 1984; Ceccarelli 1989; Smith *et al.* 1990).

A close examination of Figure 1 reveals four interesting points. The first is that the definition of stress environments plays a key role in discussing breeding strategies. If we define "stress environment" as an environment with average yield slightly above the crossover point, then genotype A can be defined as "widely adapted" to all environments above that point. However, if we define "stress environment" as an environment with average yield below the crossover point, the "wide adaptation" of genotype A has its lower limit at the crossover point. The second point relates to the type of comparisons which are made in the analysis illustrated (Fig. 1). In this analysis the regression line of a typical genotype selected in an optimum environment (A) is usually compared either with the mean of all the genotypes in the experiment (and it is unclear what this comparison tells) or with a local check. Very seldom is genotype A compared with a genotype selected under a level of stress below the crossover point (such as genotype B) because of the general assumption discussed in the introduction. The third point is that the presence of a crossover type of genotype × environment interaction and the possibility of detecting genotypes specifically adapted to conditions below the crossover point have been deliberately neglected by training scientists to conduct selection and testing above the crossover point. The fourth point is whether the current type of interaction between national and international breeding programs is the best way to exploit that specific adaptation which is required to maximize yields in macroenvironments such as those below the crossover point in Figure 1.

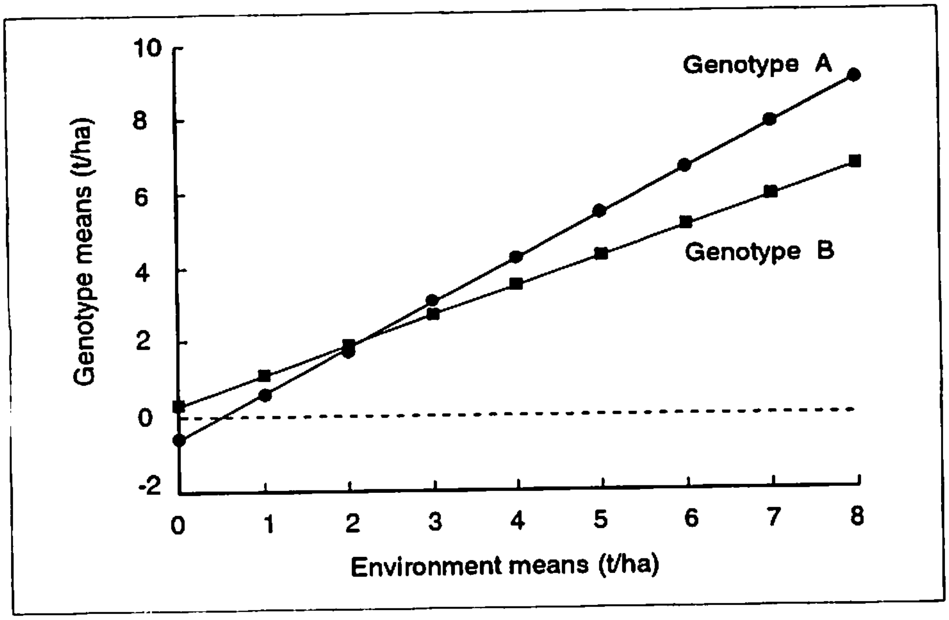

Fig. 1. Crossover type of genotype by environment interaction: A and B are genotypes selected in high- and low-yielding environments, respectively.

National and International Breeding Programs

International breeding programs, such as those conducted at International Agricultural Research Centers, have the declared objective of assisting national programs in increasing agricultural production by developing superior cultivars. The interaction between national and international breeding programs has been largely a one-way, "top-down" (Simmonds and Talbot 1992) process where the international programs develop the germplasm and the national programs test it and eventually release it as a variety.

The importance of specific adaptation and of the selection environment, especially for barley breeding in low-yielding environments, and the increased expertise and competence in national breeding programs, call for a different type of interaction between national and international breeding programs. The first step is to replace fixed or semi-fixed lines with segregating populations or less advanced genetic material. An earlier distribution of breeding material will reduce the probability of discarding material that is useful in different environments (either climatically or agronomically) because of its relatively poor performance in some of the sites used by the international breeding program. An example of the magnitude of the problem is given in Table 5. In 1991/92, 288 6-row barley lines were evaluated in the Magreb countries (Libya, Tunisia, Algeria, Morocco) and in preliminary yield trials grown at three ICARDA sites (Tel Hadya, Breda and Bouider). In the Magreb countries selection was visual whereas at ICARDA selection was for yield potential, yield under stress, early and late heading. Forty-nine of the 103 entries (47.6%) selected at ICARDA were included in the 154 Magreb selections. Of the lines selected in the Magreb, 68.2% (105/154) were discarded at ICARDA and of the lines selected at ICARDA, 52.4% (54/103) were discarded in the Magreb.

Table 5. Suitability of northern Syria for selection of barley germplasm for Magreb countries.

Selected in†	N	%
Syria	103	35.8
Magreb	154	53.5
Syria and Magreb	49	47.6
Syria, discarded in Magreb	54	52.4
Magreb, discarded in Syria	105	68.2

† Initial population size = 288 lines.

This large proportion of wrongly selected and wrongly discarded lines occurred in a single cycle of selection when all the entries were 6-row (North African farmers grow only 6-row barleys) and by using contrasting selection criteria. This is a strong indication that at each cycle of selection there is a high probability of discarding lines potentially useful in other areas. To fully exploit specific adaptation and thus make use of positive genotype × environment interaction we are gradually implementing a replacement of the traditional international nurseries with progressively less advanced material (Table 6).

When fully implemented, national programs in a given geographical area (North Africa is used as an example in Table 6) will receive from ICARDA's barley breeding program only F_2 segregating populations. Ideally the F_2 will be derived from crosses between parents identified by national breeding programs on the basis of specific adaptation to the environments and needs of their countries. Selection between populations will be done in different agroecological environments within each country under a type of management as close as possible to that of farmers' fields. Lines selected from the superior F_2 populations will be advanced, without futher selection, at ICARDA headquarters and then yield tested in different locations within each country.

Table 6. Development of barley germplasm with specific adaptation.

Year	New nurseries†				Old nurseries‡		
1990/91					BYT	BON	BSP
1991/92	SN92				BYT	BON	BSP
1992/93	PY93	SN93		F_2	BYT		
1993/94	AY94	PY93	SN94	F_3-F_4			
1994/95	NARS	AY95	PY95	SN95			

† Nurseries specific for countries in a given area: SN = special nursery (first year testing), PY = preliminary yield trials (second year testing), AY = advanced yield trials (third year testing), NARS (national yield testing system).
‡ Traditional International Nurseries (same for all countries): BYT = regional yield trial, BON = observation nursery, BSP = regional segregating populations.

Further to the exploitation of specific adaptation this process is expected to have two other important advantages. Until now one objective, if not the most important one, of international breeding programs has been the release of varieties. This can be deduced from the importance given to the data concerning the number of varieties released and the area grown to released varieties which are published in the Annual Reports of International Centers. Enhancing the research capabilities of National Agricultural Research Systems (NARS), improving their efficiency by developing, testing and disseminating methodologies, and ultimately building up breeding programs capable of developing the most appropriate germplasm for their own countries are at least as important. A change in the type of germplasm distributed to NARS through the international nurseries may be one step to achieve this objective. The second advantage is related to genetic diversity. Exploiting specific adaptation implies that the number of varieties of a given crop grown at any moment will be large. The benefits of maintaining genetic diversity within a crop over large areas have been extensively discussed in the literature and do not need to be further justified.

The role of an international breeding program in this scenario will be first to ensure continuity against the rapid turnover of staff in national institutions, second to provide the necessary assistance in specific areas of germplasm development, and third to assess the relevance of methodological and technological innovations to increase efficiency of selection.

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Breeding Barley for Drylands

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Abstract

Breeding programs for dryland conditions such as those of the West Asia and North Africa region encounter specific problems such as the unpredictable fluctuation in annual climatic conditions, which causes significant variation in grain yield (genotype × year interaction). This variation in amounts and distribution of precipitation accounts for up to 99% of the variation in grain yield. Unpredictable GY interaction affects the efficiency of selection when based on grain yield alone. An analytical procedure is described which uses important adaptive traits for selection in (1) segregating populations and nurseries where reliable yield data are not recorded and (2) yield trials where the value of yield data in individual years is influenced by GY interaction and therefore of low value. The major traits recommended in efficient selection for consistency of performance are high tillering capacity, stability of number of tillers/m^2, optimum earliness for each region, plant height of 100 cm (under favorable conditions), stability of height, relatively large grains, high total biological yield, long awns, disease resistance and early growth vigor. It is necessary to include as many as possible of the above traits in one genotype to secure its success under unpredictable, variable conditions.

Introduction

This paper reviews the work on breeding barley for dry areas. It focuses on aspects of breeding of spring types of *Hordeum vulgare* ssp. *vulgare*, grown in winter in the West Asia and North Africa (WANA) region, in the dry southern Mediterranean countries and other parts of the world with similar climatic conditions. Special emphasis is given to the dryland environment, its role in the adaptation of barley, its effects on modifying adaptive traits, and on the use of yield components and other traits in order to increase yield and consistency of performance of barley.

The Dryland Environment

The dryland environment in the WANA region is characterized by:

1. Low annual precipitation, causing moisture stress during at least some period of the growing season.
2. Significant within-year variation in annual precipitation at a given site.
3. Significant variation in the distribution of precipitation within a given season.

The first effective rains, adequate for seed germination and seedling growth, generally do not come at a fixed period, but at any time during October-December (Photiades and Hadjichristodoulou 1984). The crop matures during April-May, depending on the area and season. Winters are mild in the coastal areas with average minimum temperatures of 5-10°C, but lower temperatures are common as the distance increases from the coast.

Annual precipitation in the barley areas is very low, generally 150-350 mm. The effects of precipitation on grain yield of barley, wheat, forage barley, forage oats and forage vetch were studied in detail by Hadjichristodoulou (1976, 1977, 1978, 1982). Variation in precipitation among other environmental factors explained most of the variation in grain yield. The correlation coefficient between grain yield and annual precipitation was 0.20-0.85, depending on the variety and crop, but the multiple correlation coefficient computed from the variation in precipitation during the growing season was significantly higher, up to 0.99. The most critical periods of precipitation positively affecting grain yield were during sowing and grain filling. In southern Australia, Cornish (1950) reported that 70-80% of the variation in grain yield of wheat during 1896-1941 was due to inter-annual variation in rainfall. Other studies reviewed by Hadjichristodoulou (1982) report that annual precipitation and its distribution explained up to 79% in grain yield of dryland wheat and barley.

Choice of Crop for Drylands

Selection of the best crop for drylands is necessary for a successful breeding program. Farmers and scientists consider barley as the crop most adapted in the drylands. In Cyprus, as in the past (Anonymous 1937), barley is still considered a safer crop than wheat under dryland conditions. In 27 trials conducted in Cyprus during 1968-73, the mean grain yield of Athenais was 3.2 t/ha, 98% higher than that of the indigenous durum wheat variety Kyperounda and 75% higher than the improved bread wheat variety Pitic 62 (Hadjichristodoulou 1974a). Precipitation at the experimental sites ranged from 201 to 908 mm. Barley was consistently the highest-yielding crop in 26 of the trials. In other studies, barley outyielded durum wheat, bread wheat, and triticale under low-yielding environments, but it gave lower yield under high-yielding environments (Josephides 1993).

Barghouti and Hadjichristodoulou (1979) reported that in areas receiving 200-400 mm precipitation barley produces 7-9 kg of grain ha^{-1} mm^{-1} precipitation compared with 1-6 kg produced by wheat. The situation is reversed at higher amounts of precipitation. In the 66 trials conducted during 1982-91 in Syria by ICARDA in Zone B (320 mm average rainfall) in which the best barley, durum and bread wheat varieties were compared, the mean yield of barley was 2.3 t/ha, 31% higher than that of durum wheat and 29% of aestivum wheat (Michel *et al.* 1992).

As for consistency of performance, the average yield of barley was higher than that of wheat in all nine seasons, and significantly so ($P = 0.01$) in seven seasons. Out of the 66 trials, the yield of barley was only slightly lower than that of bread wheat in five trials and of durum wheat in eight trials, while in the remaining trials barley had a yield advantage over both wheat species. It is evident that breeding efforts must be concentrated on barley, in order to increase yield and improve consistency of performance in drylands.

Breeding Barley for Marginal Lands

As mentioned, the annual precipitation at one site may vary considerably. At Athalassa, near Nicosia, the range of precipitation during the lifetime of our Institute, 1963-92, was 56-433 mm. It is common for yields, even of barley, to be extremely low when precipitation is below 200 mm. The economics of such a crop depend on the cost of production in different areas, but usually it is not economic to grow barley for grain in these marginal lands. Nothing can be done in areas of unpredictable low rainfall, but in areas where precipitation is frequently below 200 mm, breeding barley for grain may not be successful. In such areas other farming systems with barley must be investigated. One such system is the use of barley as a self-reseeding pasture crop. In this system, the cost of production is significantly lower, as no reseeding or cultivations are necessary. Barley genotypes suitable for permanent pastures have been developed in Cyprus by crossing *H. vulgare* with *H. spontaneum* and *H. agriocrithon* (Hadjichristodoulou 1988a, 1990a).

GE Interaction, a Cause of Slow Progress in Breeding

Several factors have been considered responsible for the slow progress or absence of progress in breeding under dryland conditions compared with breeding under improved conditions: (1) yields are very low in drylands and improved genotypes cannot show their yield potential, (2) low inputs in human resources or funds, because the expected gains are not considered significant, and (3) the slow progress is caused by the GE. Although the first two causes cannot be ignored, it seems that the major causes for failures or slow progress in breeding programs are the negative implications of GE interaction.

The importance of GE interaction has been discussed widely (Allard and Bradshaw 1964; Hill 1975). After citing GE interaction as one of the factors limiting the further improvement of maize, Sprague (1963) expressed the view that "one is plagued by the rather disturbing feeling that each genotype may have its own characteristic environmental response. Whether this is true, it appears that the problem of GE interaction has received much less attention than its importance may justify." Today, the breeder has adequate information to aid in developing consistently high-yielding genotypes over a wide range of environments.

The GE interaction is partitioned into GL, GY and GLY interaction where G stands for genotype, E is environment, L is Location and Y is year. Thus to eliminate the location effect in the GE interaction, breeding must aim for specific adaptation at each location (Allard and Bradshaw 1964; Allard and Hansche 1964; Eberhart and Russell 1966; Brennan *et al.* 1981). This is relatively easy to achieve, if the fluctuation in climatic conditions with year is not significant. In such a case breeding will aim at developing genotypes adapted to the specific location. The magnitude of the area represented by each location will depend on the acreage represented by similar soil, climatic and other environmental conditions.

This explains why, because of specific adaptation, material selected in one season is discarded the following season, and potentially promising material for the same season is discarded. In the course of this process, no progress is achieved in selection under dryland conditions.

These adverse effects of GE interactions on the evaluation of genetic material, especially in dry areas, are well known to breeders and have been discussed recently by Brennan *et al.* (1981) and Fox *et al.* (1985).

The Dryland Barley Variety

A successful dryland variety must give high yield under a wide range of environmental conditions that are mainly caused by the variation in the amount and distribution of precipitation. The term stability is frequently used to describe such varieties. Although many scientists explain stability correctly, there is still confusion on the use of this term. Eberhart and Russell (1966) pointed out that the term "stability" often has been used to mean a variety that performs relatively the same over a wide range of environments (V6 or V4 in Fig. 1). Becker and Leon (1988) introduced the term "static concept of stability" to describe varieties not responding to improved conditions, and stated that this stability is usually associated with relatively poor yield levels. Several studies with grain and forage cereals in Cyprus and other countries show that varieties responding to improved environmental conditions (not "stable" in yield) tend to have high mean yield (Hadjichristodoulou 1988b). The term "consistency of high performance" seems to better describe the varieties giving high grain yield under a wide range of environmental conditions (V1 in Fig. 1). Becker and Leon (1988) agreed that the dynamic concept describes varieties with a predictable response to environments. Such varieties have high mean yield, regression coefficient b = 1.0 and S2di (deviations from regression) near zero. The term stability, in statistical terms meaning low or zero variance, describes correctly traits other than grain yield, e.g., plant height, tiller number and 1000-grain weight.

The Analytical Breeding Procedure

As pointed out, selection based only on yield perhaps will not make progress in breeding programs because of significant GE interactions. Plant physiologists and breeders have been involved in research on the identification of traits that could be used in selection for moisture stress conditions (review by Hadjichristodoulou 1974b). Acevedo *et al.* (1991) studied the association of traits with grain yield under low-rainfall environments and concluded that earliness, many ears/m^2, large grains and prostrate vigorous seedling growth are important traits for selection. Specific traits also were identified for 2-row and 6-row varieties. However, very limited work has been reported on breeding for consistency of performance, which is of primary importance in drylands. Marshall (1987) and Ceccarelli (1988, 1989) described problems encountered in using analytical procedures (use of morphological and physiological traits for indirect selection) and the empirical method (early, multilocation yield testing).

A procedure was proposed by Hadjichristodoulou (1987a, 1992) for breeding for consistency of performance in drylands. The method requires long-term studies on optimum values and stability or plasticity of adaptive traits. Once these values are determined, they can be used for selection in segregating populations, nurseries or yield trials in a given environment, with increased probability for selecting consistently high-yielding genotypes.

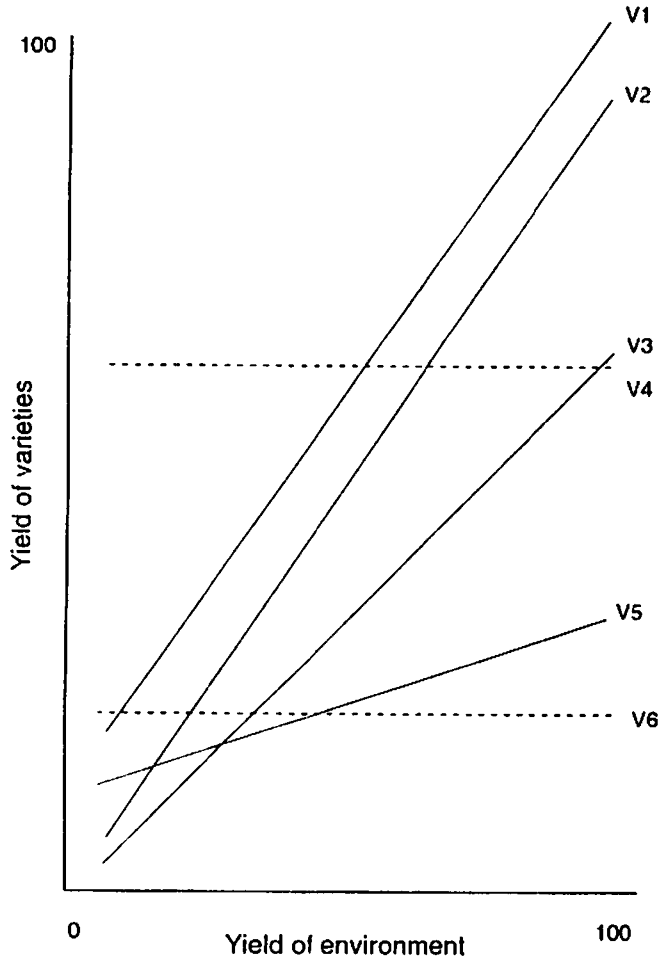

Fig. 1. Theoretical regression lines for the yield of selected types of varieties over several environments. The regression coefficients (b) are b>1.0 (V_1,V_2), b=1.0 (V_3), b<1.0 (V_5) and b=0 (V_4, V_6).

Adaptive Traits for Consistency of Performance

The results of long-term studies conducted in Cyprus on establishing values of adaptive traits in order to breed barley for consistency of performance under dryland conditions were reported by Hadjichristodoulou (1985, 1987a, 1987b, 1987c, 1988b, 1989, 1990b, 1990c, 1991a, 1991b, 1992). The findings are applicable to the Cyprus environments, but similar procedures are studied in other environments. Recommended traits for selection in drylands are described below.

Tillering Capacity

Variation in stand establishment is one of the major causes of unpredictable variation in grain yield in dry areas as described by Hadjichristodoulou (1985, 1987a, 1987c). This is caused by the variation in number of tillers/m^2. High numbers of tillers per unit area and stability of number of tillers/m^2 (or plasticity of number of tillers/plant) were related to high yield and consistency of performance. The advantage of plasticity of tillering per plant was shown by Hadjichristodoulou (1985) to be expressed under unfavorable conditions, where the low-yielding varieties produced 46-51 tillers/m^2, much fewer than the 82-150 tillers produced by the high-yielding varieties.

Earliness

Earliness, recorded as days to heading, is an important trait for dry areas. The studies in Cyprus showed that heading date of the high-yielding genotypes varies with year, but always falls within an optimum range, relative to standard varieties; in barley, from the same heading as Kantara to 5-8 days earlier; in durum wheat, 1 day after and 4 days before the heading of Karpasia (Hadjichristodoulou 1985, 1987d). Optimum ranges may vary with region. Late-heading genotypes were more stable in heading date, and this is attributed to the higher temperatures prevailing late in spring, when late genotypes reach heading stage.

Plant Height

Plant height is also a major source of variation in grain yield caused by the unpredictable amounts of precipitation and its distribution, as described by Hadjichristodoulou (1987a, 1987c, 1987d, 1991b). Studies have shown that for dry areas genotypes having optimum height around 100 cm associated with stability of height give high yield in both high-rainfall (causing lodging) and low-rainfall years. This height is reached under favorable conditions and it is reduced by stress conditions, but not to the point of causing increased weed competition and difficulties in mechanical harvesting. The role of height in storing assimilates and transferring to the grain in dry seasons has been shown by several authors (review by Hadjichristodoulou 1991a, 1991b).

Grain Size

Grain size, recorded as 1000-grain weight, was among the most stable traits. Consistently high-yielding genotypes had average stability, and the correlation coefficient of 1000-grain weight with grain yield was positive or nonsignificant (Hadjichristodoulou 1990b). In the case of six-row barley, 1000-grain weight was positively correlated with grain yield. Thus, selection for large-seeded genotypes is expected to have a positive effect on yield, especially in the case of 6-row barley. This can be done visually at all stages of material evaluation.

Total Biological Yield

Total biological yield (TBY) and straw yield were positively correlated with grain yield (Hadjichristodoulou 1991a). The role of TBY in drylands seems to be connected with storage of assimilates during the vegetative period (winter) and their translocation to the grain during the moisture stress period. Also Harvest Index (HI) was positively associated with grain yield. Thus, TBY and HI are useful selection criteria for drylands.

Other Traits

The variation in yield caused by unpredictable variations in the environment may be reduced by selecting for certain physiological or morphological traits other than the above. There is adequate information for using the following traits in breeding for consistency of performance under dryland conditions.

Disease resistance

Severity of most diseases is one of the major sources of variation in yield, especially in wet seasons but also for other diseases in dry seasons (root rots, nematodes). As discussed by Hadjichristodoulou (1987a, 1987c) in more detail, selection for resistance or tolerance eliminates these causes of variation in yield.

Awn length

The relatively high temperatures during the grain-filling period are among the usual causes of variation in yields under dryland conditions. Experimental evidence, without exception, points out the usefulness of long awns in such conditions, as their photosynthetic ability is affected by drought and heat less than that of leaves (Grundbacher 1963; Evans *et al.* 1972; Ferguson 1978; Blum 1985). Under relatively humid conditions the effect of awns on yield was variable, but not negative. Perhaps it is not by coincidence that all the varieties grown in the dry areas of the WANA region are awned. It can be concluded that long awns have a positive effect in dry-hot seasons, and not negative in wet-cool seasons, thus contributing toward consistently high yields of barley or wheat under all conditions.

Early growth vigor
The available information was reviewed by Hadjichristodoulou (1987a) and, although limited, suggests that early growth vigor may be advantageous to winter cereals in drylands. Barley, a more productive crop than wheat under low-rainfall conditions, produced more biomass at early stages. Recently, Acevedo *et al.* (1991) reported that prostrate habit, vigorous seedling growth and good ground cover are important traits for dry environments. Thus, early fast growth may be considered in selecting genotypes for the dry areas.

Population structure
Consistency of performance can be achieved by exploiting individual buffering (single genotype, homogeneous population), by population buffering (mixture of genotypes) or high levels of heterozygosity in the population (Allard and Jain 1962; Allard and Bradshaw 1964; Allard and Hansche 1964; Marshall and Brown 1973). The most successful varieties of barley in the region, grown for many years, appear to be nonhomogeneous populations (Ceccarelli *et al.* 1991). Athenais, an improved variety introduced from Greece around 1950, has gradually replaced all other barley land varieties (mixtures of genotypes) in Cyprus. By pureline selection in Athenais, it was shown that it was not a genetically homogeneous population. All the available information tends to suggest that, although individual buffering should be exploited, one should not aim for complete genetic uniformity of varieties when breeding for consistency of performance in areas of unpredictable seasonal variation in climatic conditions. Similar conclusions were reached by Ceccarelli *et al.* (1991).

Choice of Adaptive Traits

It has been demonstrated that optimum values and stability of the traits described above play an important role in consistency of high performance in drylands. Therefore, it is desirable that all the above traits, and of course other traits, must be considered in selecting for consistency of performance. However, the magnitude of the contribution of each adaptive trait depends on the environmental conditions prevailing at the particular site. For example, the effect of stability of tiller number may become insignificant if the conditions favor optimum stand establishment at all times. For the same reasons, disease resistance may not play an important role under conditions of low disease incidence. Too-early genotypes may not be at a disadvantage in seasons of early onset of the spring and summer drought, and too-late genotypes in seasons of late rains, but genotypes with optimum heading date will give satisfactory yields in all conditions.

By multiple regression analysis Ceccarelli *et al.* (1991) concluded that different combinations of traits are expected to produce the same effect in terms of final yield. However, the most significant effects on grain yield in 2-row barley was shown by heading date and 1000-grain weight and the least significant by growth vigor, plant height and growth habit. The multiple correlation coefficient (R) was 0.29-0.84 in four seasons (P = 0.01).

Unpublished data from trials conducted in Cyprus show that in one trial R was 0.98 when plant height, straw yield and HI were used as independent variables. No improvement was made by adding heading date, 1000-grain weight and volume weight. In another trial R was 0.79, when heading date and straw yield were used as independent variables and increased to 0.98 by adding all variables used in the first trial.

To conclude, although different sets of adaptive traits may play a major role in the yield of barley in a given environment, for consistency of performance over many seasons in drylands it is necessary to combine in the same genotype as many as possible of the adaptive traits which have been found important at a given area. In this way, the genotype will have built-in adaptive mechanisms for success under different conditions.

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Discussion

A. Al-Shamma
Tillering is of low heritability so how can we select in the early generation? Also, tillering could be correlated with plant height and grain size; how could that work?

A. Hadjichristodoulou
Although the heritability of tillering is low, it is possible to select for high tillering in F_2-F_6. An example of this is the reported data by the Jordan scientists that the Cyprus cross CYB-19 has very high tillering capacity. As regards negatively correlated tillering capacity and tallness, my experience is that by simultaneous selection for both traits it is possible to make progress. It should be mentioned that in selecting for tallness, a breeder must select for optimum height, not maximum height. For Cyprus conditions, optimum plant height is around 100 cm (expressed under favorable growing conditions). For feeding barley, it is not necessary to aim at very high 1000-grain size (as in the case of malting barley). The breeder must

not exercise heavy selection pressure for 1000-grain weight, provided that yield is high and 1000-grain weight is satisfactory.

W. Tawil

1. Why, in your opinion, did up-to-date plant breeders not succeed in developing new varieties of barley which exceeded the locals in very dry areas (200-250 mm annual rainfall)?

2. Do you think that the current genetic materials are enough to achieve success in obtaining superior new barley varieties?

A. Hadjichristodoulou

1. The reasons for slow or no progress in breeding barley for the very dry areas are caused by the genotype × environment interaction and the type of germplasm used in crosses. To achieve progress one must first use locally adapted landraces or wild ssp. *spontaneum* and material which has been tested in these areas and has shown good adaptability. Avoid using as parents varieties not tested in these areas. Second, for selection strategy, the analytical procedure described in the paper must be used from F_2-F_6 to variety trials in order to increase the chances for selecting consistently high-yielding genotypes and to avoid the negative effects of G × E interaction.

2. The current genetic material available in the very dry areas has survived after many years and possesses all the necessary genes for adaptation to these conditions. Crosses must be made between the best of these land varieties and also the old barley, if available in the region; material from other dry areas and new varieties developed in similar dry areas must be tested and if adapted to the area, they may also be crossed. But above all, the employment of the correct selection strategy, developed in the drylands, is absolutely necessary for progress to selection (analytical procedure). Otherwise, selection will be inefficient, because of G × E interaction.

B. Al-Rawi

1. Why don't we entertain the idea advanced by Smith of Oklahoma State University as regards to modified bulk breeding for the semi-arid zones?

2. What is your opinion on using variety mixtures for consistency or performance?

A. Hadjichristodoulou

1. The traditional pedigree, the bulk breeding methods and all modifications can be employed. However, for our dry areas with the very high genotype × environment interactions, if one relies only on yield, progress will be very small. The use of stability of adaptive traits may increase the chances for selecting consistently high-yielding genotypes.

2. It is well established by several researchers that certain mixtures express higher stability or better consistency of performance than pure varieties. However, it is also known that consistency of performance can be achieved by individual buffering, for example by selected homozygous pure varieties. There are examples in the literature for this. In Cyprus we have such a successful variety (Athenais). Furthermore, in countries where breeders' rights apply and where organized seed production services are available, precise description of the varieties is necessary. Thus only homozygous-pure varieties can be released. However, for the variable dryland areas of the WANA Region, I feel that breeders should not aim at absolute variety purity and homozygosity, in order to safeguard high performance under all conditions. It is known that most successful local varieties in the region are mixtures of genotypes and the level of heterogeneity varies with variety.

Developmental Stability of Adaptive Traits of Barley

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Abstract

Stability of nine traits of 50 barley (*Hordeum vulgare* L.) varieties was studied in 20 environments under rain-fed conditions in Cyprus. Stability was computed as variance of log-transformed data ($s^2\log_x$). Significant differences in stability among varieties were found in all nine traits studied. Stability of traits was correlated in 14 of the 36 possible pairs of traits. Stability of 1000-grain weight was not correlated with stability of any of the eight traits, but stability of grain yield was correlated with stability of six of the eight traits. Plant height, 1000-grain weight, heading date and harvest index were the most stable traits and yields of grain and straw the least stable traits. Stability of grain yield (low $s^2\log_x$) was not associated with high grain yield. Consistently high-yielding varieties had high regression coefficient (b), above 1.0. Grain yield also was negatively correlated with $s^2\log_x$ of harvest index and number of grains per spike. Early, high-yielding varieties had high plasticity for heading date (high $s^2\log_x$). The information on stability of traits can be used in breeding against genotype × environment interactions in arid environments.

Introduction

The effect of the environment on genotype and the implications of genotype × environment interactions (GE) in plant breeding are well known (Allard and Bradshaw 1964; Gullord and Aastveit 1987; Rognli 1987; Hadjichristodoulou 1987a, 1988). Breeding for specific adaptation to identified regions eliminates the genotype × location interaction. The remaining portion of GE, the genotype × year interaction, is unpredictable and can be dealt with only by breeding.

For a long time the term "stability" was used to characterize a genotype which always shows a constant yield over environments, but as Becker (1981) stated, such genotypes do not respond to improved growing conditions favoring increased yield. Therefore, breeders now look for genotypes with relatively higher performance than other varieties in the various environments. Westcott (1987), Adegoke and

Frey (1987) and Hadjichristodoulou (1988) reported that in general high-yielding varieties have regression coefficient b higher than 1.0; thus they exhibit higher variation in performance than low-yielding varieties, which have b around 0.5. The term "consistency of performance" (Allard and Bradshaw 1964) describes the desirable genotype better than the term "stability" of performance.

The effect of environment on barley genotype is expressed on measurable yield (grain, forage, etc.) but also on traits such as yield components (spike number/m^2 or per plant, number of grains/spike and 1000-grain weight), plant height, earliness and harvest index. The term "developmental stability" is used to indicate low variance of a trait in response to changes in the environment, and "developmental flexibility" or plasticity to indicate the ability of genotypes to modify their phenotype in response to changes in the environment (review by Aastveit and Aastveit 1984). Although there is some information published on a few traits (Aastveit and Aastveit 1984; Hadjichristodoulou 1985, 1987c, 1990b) there is no information allowing comparison of stability among varieties and also among traits.

The present report examines the stability or plasticity of nine adaptive traits of barley in response to environmental changes in semi-arid areas, and discusses the interdependence of stability of traits and their effects on agronomic performance.

Materials and Methods

Stability of traits was studied in a trial of 50 varieties, sown in 6-row plots, 5 m long, of which only 4 m were harvested for grain yield (4.2/m^2). The varieties were sown in 20 environments (10 sites × 2 seed rates, 30 and 120 kg/ha). Data were recorded on grain yield, straw yield, plant height (distance from the ground up to the end of the spike, excluding awns), heading date (number of days from 1 March to the date when 50% of the spikes emerged completely from the flag leaf) and other traits. Total biological yield was computed as the sum of grain plus straw. Spike number/m^2 and harvest index (ratio of grain over total biological yield) were recorded in 18 of the 20 environments. Number of grains/spike were computed from data on yield, spike number and 1000-grain weight in 16 environments. Lodging was recorded as percentage of plot lodged at maturity.

Sowing was done in November 1987 and harvesting in May 1988. Precipitation during the growing season was variable, both in amount (316-500 mm) and distribution within the season. The rainiest months were December and January. Nitrogen was applied at 56 kg/ha and phosphorus at 14 kg/ha.

Stability of traits was computed as the variance of log-transformed data ($s^2 \log_x$). Logarithmic transformations were used in order to correct for scale-dependent random variation. The ratio of s^2log_x/s^2log_y follows the F distribution with N^{x-1} and N^{y-1} degrees of freedom (Lewontin 1966).

Correlation coefficients were computed between stability and means for the various traits. Regression analysis of variety grain yield on environment mean yield provided information on consistency of performance over environment.

Methods for Measuring Stability

Several statistics are available for computing the variance of traits of varieties grown over several environments. Low variance of traits indicates high stability. The most common of these methods are listed below. More details are given in the references cited.

1. **Range, x-y.** The range between the minimum (x) and maximum (y) values is considered an estimate of variance. This parameter is easy to compute, but it is not accurate.
2. **Variance, s^{2x}.** The variances of s^{2x} and s^{2y} are computed for two varieties. A test of significance of the ratio of two variances can be done by the F distribution. However, the disadvantage of s^{2x} is that it is affected by the unit of measurement (mm, cm, feet, etc.) and by the mean (Lewontin 1966).
3. **Coefficient of variation (CV).** The CV = (Sx/x)100 is independent of the mean but no test of significance is available for statistical comparisons (Lewontin 1966).
4. **s^2log_x.** The variance (or standard deviation) of the logarithms of measurements gives a measure of intrinsic variability, which is invariant under a multiplicative change. It is independent of the unit of measurement. It follows an F distribution with N^{1-1}, N^{2-1} df, and allows for a valid statistical comparison (Lewontin 1966).
5. **Regression analysis.** A regression analysis is based on the performance of a variety (Yi) over the environment mean of all varieties (Xi). It was first used by Finlay and Wilkinson (1963) and by Eberhart and Russell (1966). A stable variety is one with b = 0 and $s^2_{d_i}$ (deviation from regression = 0.0). A consistently high-yielding variety has high mean (xi), b above 1.0 and $s^2_{d_i}$ = 0.0. The advantage of this method is that it gives a practical way of measuring consistency of high performance. Stable varieties (b = 0) with a high mean yield do not exist in practice (Adegoke and Frey 1987; Westcott 1987; Hadjichristodoulou 1988).
6. Other methods are available, the merits of which are discussed by Lin *et al.* (1986) and Becker and Leon (1988).

Results

Comparison of Stability of Varieties

The differences in $s^2 \log_x$ among varieties were significant in the nine traits (grain yield, total biological yield, plant height, heading date, number of spikes/m^2, 1000-grain weight, number of grains/spike and harvest index). The critical F value of the ratio of $s^2 \log_x$ of two varieties was 2.26 (P = 0.05). The ratio of the highest and lowest values in each trait was 4:10, significant at P = 0.01. Three major groups could be distinguished in all traits, i.e., stable varieties (low $s^2 \log_x$ values), unstable varieties (high $s^2 \log_x$ values) and the larger group of varieties having medium stability (intermediate values for $s^2 \log_x$).

Association of Stability among Traits

The relationship of stability among the nine traits was studied by the correlation coefficients of $s^2 \log_x$ among the 50 varieties for pairs of traits. There were differences in the correlations among pairs of traits. All significant correlation coefficients among stability of traits were positive, most of them at P = 0.001 (Table 1).

Comparisons of Traits for Stability

Plant height with mean $s^2 \log_x$ over the 50 varieties 0.003 was the most stable trait followed by 1000-grain weight, harvest index and heading date with $s^2 \log_x$ = 0.0056, 0.0062 and 0.0086, respectively (Table 2). Grain yield, straw yield and total biological yield exhibited the lowest stability with $s^2 \log_x$ = 0.025, 0.023 and 0.020, respectively. Stability of number of grains per spike was intermediate, $s^2 \log_x$ = 0.016. The F value (df=799-999) for significant differences among traits was around 1.13 (P = 0.05) and 1.19 (P = 0.01). The ratio of the mean $s^2 \log_x$ among traits was higher than the above values, except for grain yield, straw weight and sheaf weight, which were the least stable traits.

Correlation Coefficient: Grain Yield and Stability of Traits ($s^2 \log_x$)

Grain yield was correlated positively with $s^2 \log_x$ of heading date (r = 0.39, P = 0.01) and negatively with $s^2 \log_x$ of harvest index (r = -0.55, P = 0.01) and of number of grains/spike (r = -0.30, P = 0.05). Thus, high-yielding varieties were less stable in heading date, but more stable in harvest index and number of

Table 1. Correlation coefficients between stability ($s^2\log_x$) of traits of 50 barley varieties.

	Biological yield	Straw yield	Harvest index	Heading date	Plant height	Spikes /m²	Grains /spike	1000-grain weight
Grain yield	0.63***	0.42**	0.59***	0.08	0.50***	0.35*	0.49***	-0.01
Biological yield		0.93***	-0.07	0.04	0.43**	0.36**	0.15	-0.01
Straw yield			-0.12	0.09	0.34*	0.34*	0.16	-0.08
Harvest index				0.14	0.19	0.11	0.61***	-0.11
Heading date					-0.08	-0.08	0.04	-0.13
Plant height						0.47***	0.26	-0.22
No. spikes/m²							0.42***	0.02
No. grains/spike								-0.19

*, **, *** P=0.05, 0.01, 0.001.

Table 2. Mean and range of variance estimates of traits of 50 barley varieties from 16-20 environments.

	CV (%)		$s^2\log_x$ (× 10³)	
Trait	Mean	Range	Mean	Range
Grain yield	31	18 - 49	24.8	8.4 - 50.7
Straw yield	30	22 - 40	22.5	8.8 - 45.5
Total biological yield	28	19 - 41	20.1	6.7 - 40.2
Heading date	18	9 - 29	8.6	1.6 - 40.2
Plant height	12	7 - 18	3.1	0.9 - 7.6
Harvest index	16	10 - 26	6.2	1.9 - 25.4
Number of tillers/m²	30	17 - 42	19	2 - 38.5
18 2-row varieties			19	2 - 33.0
32 6-row varieties			20	9 - 38.5
1000-grain weight	16	11 - 22	5.6	2.3 - 9.7
18 2-row varieties			4.4	2.3 - 7.8
32 6-row varieties			6.3	2.9 - 9.7
No. grains/spike	29	18 - 68	16.1	6.5 - 39.4
18 2-row varieties			17.4	6.5 - 39.4
32 6-row varieties			15.4	6.8 - 32.3

After Hadjichristodoulou (1990b).

grains/spike. Stability of the other traits (grain yield, sheaf weight, straw weight, 1000-grain weight, plant height and number of tillers/spike) was not correlated withgrain yield ($r = 0.06$-0.24). The correlation coefficient between grain yield and the regression coefficient (b) of variety grain yield on environment mean yield was $r = 0.56$, $P = 0.001$. Consistently high-yielding varieties (5.2-5.4 t/ha) had b higher than 1.0 (1.0-1.29), while low-yielding varieties had b around 0.5 (0.31-0.77).

Discussion and Conclusions

The present study showed that developmental stability for nine traits, including yield, is genetically controlled. These findings support the ideas put forward by Bradshaw (1965), the limited data on plant height presented by Aastveit and Aastveit (1984) and on the number of spikes/m^2, heading date and 1000-grain weight reported by Hadjichristodoulou (1985, 1987c, 1990a). It is, thus, possible to use developmental stability of adaptive traits in breeding programs aiming at developing consistently high-yielding varieties.

Before using stability of traits in breeding programs it is necessary to study whether stability of a given trait in the target environment is associated with consistency of performance. High mean tiller number and stability of number of tillers/m^2 were associated with consistently high yield in drylands (Hadjichristodoulou 1985, 1987b).

Late varieties were more stable in heading date than early varieties (Hadjichristodoulou 1987c). This strong negative association between stability of heading date and earliness may be the reason why stability of heading date was not associated with stability of seven of the eight traits. The latest determined trait in the developmental cycle of the plant, 1000-grain weight, was among the most stable traits, and its stability was not associated with the stability of any of the other eight traits. It seems that translocation of stem reserves to the grain, especially in dry seasons (Daniels *et al.* 1982), eliminates the variation in 1000-grain weight caused by variation in other traits.

Stability of plant height was correlated with stability of four of the eight traits, including stability of grain yield. Contrary to this, Aastveit and Aastveit (1984) found no significant correlation between stability of straw length and of grain yield.

The oligogenic or polygenic control of traits has an influence on the variance of traits. In the present study polygenically controlled traits, such as grain and straw yield, were actually the most variable traits. Although one of the most obvious traits affected by environment is height, it was the most stable of the nine traits studied.

The correlation of grain yield with the two stability parameters, $s^2 \log_x$ and b, was different, not significant in the first, and positive ($r = 0.56$) in the second. In the present study consistently high-yielding varieties (b above 1.0) gave the highest grain yield, as they responded to improved conditions better than low-yielding varieties. Similar conclusions were reached in other studies (Adegoke and Frey 1987; Westcott 1987; Hadjichristodoulou 1988).

It can be concluded that stability of traits is genetically controlled, stability of one trait is often associated with stability of other traits and that high grain yield is associated with stability of harvest index, number of grains/spike and heading date.

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Discussion

Ahmad Al-Rawi

What are the reasons for the high yields you get in Cyprus, where rainfall is the same as in the other areas?

A. Hadjichristodoulou

The production of grain expressed in kg of grain ha^{-1} mm^{-1} of rainfall is relatively high. In a study conducted by ICARDA in 1977-1978, using a trial as the same varieties grown in many countries in the region, barley in Cyprus produced 12.5 kg of grain ha^{-1} mm^{-1} rainfall, while in other countries the production was lower, as low as 4 kg ha^{-1} mm^{-1} rainfall. The reasons are that the winters of Cyprus are mild compared with, for example, Syria and Jordan, and the plants continue to grow in the winter, when water use efficiency is high. Secondly, Cyprus farmers, from 50 years ago, apply modern practices such as fertilizer use, optimum sowing date, mechanical sowing and harvesting.

M. Ababneh

In terms of seed production what is the major yield component: number of main spikes/unit area or number of tillers/unit area?

A. Hadjichristodoulou

Consistently high grain yield over a wide range of conditions can be obtained from varieties giving high number of tillers and having high stability of number of tillers/m^2 (or plasticity of tillering capacity/plant). Such varieties will produce an average of one tiller/plant if all seeds germinate. But in dry areas, very frequently a significant percentage of the seeds do not germinate because of inadequate soil moisture to support the seedlings up to the tillering stage. In this case, the established plants produce more than one tiller in order to fill all the space available, producing secondary tillers. Faced with this situation, the breeder must select single plants in F_2-F_6 generation having 3-6 tillers, more or less of the same height and earliness as the main tiller. Varieties developed in this way will not suffer from low-yielding secondary tillers.

S. Ceccarelli

1. At what stage should we screen for variety of adaptive traits?
2. Are there conditions that are best for screening for stability of tillering?

A. Hadjichristodoulou
1. At the beginning the breeder must identify which traits are the major causes of variation in grain yield. Then the optimum values and stability of these traits must be determined for each region. The method of using stability of adaptive traits must be applied from the F_2 generation, when no yield data are recorded, but also in yield trials, when grain yield is recorded, in order to eliminate genotype × environment (year) interaction.

2. The easiest way to test for stability of tillering is to test genotypes (varieties) under two seed rates, one low (30 kg/ha) and one high (100-120 kg/ha). The genotypes with a high number of tillers/m^2 under both seed rates are expected to have stability of tillering/unit area. Also, testing under two contrasting conditions, one favoring good stand (high rainfall) and one causing extremely low stand (dry conditions), will give a test for stability of tillers.

A. Al-Rawi
Do you think that new technique will enhance genetic gain in barley in the near future? It seems that classical genetics is very slow in the breeding process.

A. Hadjichristodoulou
Your question actually refers to the comparison of conventional breeding with the new biotechnology techniques (genetic engineering). At present, very little from the new methodology can be directly applied to breeding in dry areas. Definitely, the new technology will increase the efficiency of breeding. However, for the time being, breeders have to rely on the existing knowledge. When the new technology reaches the stage of application, it will concern mainly the development of new germplasm. Testing this material for adaptation to dry areas and for consistency of performance will have to be done with available selection strategies. Therefore, the development of such methods, as discussed in the paper, will definitely enhance genetic gain in barley breeding.

Improved Varieties and their Influence on Barley Productivity in the Limited Rainfall Region of Northern Iraq

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Abstract

This paper presents the efforts made to introduce and spread new barley varieties in the limited rainfall region (200-350 mm) of Northern Iraq. The new cultivars were Gezira 1 (6-row black barley) and Rihane 03 (6-row white barley). The local black (2-row black barley) was used as a check. The experiments were conducted at seven locations: Kirkuk, Fatsa, Ain Husan, Hukna, Kahriz, Mosul and Tel-Marak of Al-Gezira region. The area of the experiments ranged from 250 m^2 to 12.5 ha at different localities. Rihane 03 exceeded the local black by 14% in straw yield and 31% in grain yield (3223.3 and 2513.0 kg/ha, respectively). It also exceeded Gezira 1 by 42% in straw and 19% in grain yield. A field day for 63 farmers demonstrated the acceptability of Rihane 03 and the farmers requested seed of the new varieties.

Introduction

Barley (*Hordeum vulgare* L.) is the second largest cereal crop after wheat in both area and production in Iraq. The total area in 1984/85 was 1.45 million hectares with a total production of 1.33 million tons (average of 919.2 kg/ha; Adary 1989). Most barley is grown in the limited rainfall zone (200-350 mm) because it is better adapted to drought conditions than wheat (Adary *et al.* 1991). However, very limited work has been done to breed or introduce new barley cultivars to the region. Local black barley is widely grown by farmers in the region, but little work has been done to improve this variety through mass selection (Al-Fakhry 1981) or crossing.

Introduction of new barley cultivars is common in Iraq. This has resulted in many introductions of barley, including Supergelan (1932), California Mariout (1936), Balady 265 (1939), Arivat (1961), Numar (1971), CM67 (1971) and Gezira 120 (1973). None of these cultivars have been used in large-scale production in Al-Gezira.

Rihane 03 was introduced to the region in 1985. During the test period (1986 to 1989) it exceeded the local black at Hammam Al-Alile by 33 to 124% with a rainfall range from 204 to 540 mm (Anonymous 1985). Under one supplementary irrigation at heading time with 80 kg N and P/ha, Rihane 03 gave a yield of 4442 kg/ha whereas the local Aswad gave 2296 kg/ha (ICARDA 1983).

The aim of the study reported in this paper was to introduce improved cultivars to the farmers' fields and study their adaptation at different locations in the Al-Gezira region.

Materials and Methods

Two improved cultivars were used: Gezira 1 (an improved cultivar resulting from the cross of Arivat × local Aswad produced by the Ministry of Agriculture and Irrigation) and Rihane 03 (an introduction from ICARDA in 1985). The local black was used as a check cultivar. These cultivars were planted at seven locations (250 m^2 to 12.5 ha) during the 1991/92 growing season: Kirkuk, Kahriz, Fatsa, Ain Husan, Hukna, Tel-Marak and Mosul. The rate of planting was 120 kg/ha and the planted area was fertilized by compound fertilizer N-P-K, 27-27-0 at a rate of 160 kg/ha. Modern seed drills were used to plant these cultivars under rain-fed conditions. A field day was held for 63 farmers of Al-Gezira where they observed the crop during near-maturation stage at Al-Fatsa (18 May 1992).

At maturity, 10 samples, each of 1 m^2, were harvested at random from each field to estimate biological yield, straw yield, grain yield and plant height. A total harvest of the field was done by combine for each field to obtain the actual grain yield per unit area, although some grain loss occurred because of different times of harvest in each area.

Results and Discussion

Productivity of Rihane

Productivity of Rihane over different localities is presented in Table 1. The production per unit area ranged from 1240 kg/ha at Kahriz to 3400 kg/ha at Mosul. As mentioned before, these rates are lower than that based on samples (Table 2).

The productivity levels of Rihane at different locations were acceptable under the limited rainfall conditions and it is recommended that this variety be increased and distributed for large-scale production on farmers' fields.

Table 1. Production† of Rihane 03 in Iraq, 1991/92.

Farmer	Location	Area (ha)	Yield (kg/ha)
M. Abdul Rahman	Fatsa	2.0	1414.0
N. Jalood	Hukna	2.0	2041.5
J. Al-Hasney	Kahriz	2.5	1240.0
A. Zugair	Ain Husan	2.0	1920.0
M. Sadoon	Tel-Marak	1.5	2120.0
Kirkuk Station	Kirkuk	12.5	1840.0
Mosul Station	Mosul	250 m^2	3400.0

† Based on total harvest of the field.

Table 2. Estimates† of agronomic characters of Rihane 03 at different locations, 1991/92.

Location	Biological yield (kg/ha)	Grain yield (kg/ha)	Harvest index	Plant height (cm)
Fatsa	4910	2682.5	0.56	68.4
Kirkuk	4656	2323.3	0.50	87.8
Kahriz	5206	2580.0	0.50	68.0
Mosul	10624	4555.5	0.43	97.4
Ain Husan	6176	1814.0	0.29	66.7
Hukna	5140	2832.0	0.55	60.0

† Based on 10 samples of 1 m^2.

Comparison of Rihane 03, Gezira 1 and Local Aswad

Table 3 shows straw and grain yields for Gezira 1, Rihane 03 and local Aswad at four locations. Rihane 03 gave the highest straw yield at Fatsa, Hukna and Ain Husan. However, at Kahriz, the local Aswad gave the highest. The range of straw yield for Rihane 03 was 2504 to 4362 kg/ha in different regions. For Gezira 1, the range was from 1888 at Fatsa to 2692 kg/ha at Ain Husan. Rihane 03 exceeded both Gezira 1 and the local Aswad at Al-Fatsa, Hukna and Kahriz. At Ain Husan, Gezira 1 was the highest. On the average over all locations, Rihane 03 gave 14% increase in straw yield and 29% in grain yield over the local Aswad. This result is in agreement with the results reported previously (ICARDA 1983; Anonymous 1985). Gezira 1 exceeded the local Aswad by 9.8% in grain yield but it gave 19% less in straw yield. Also, Rihane exceeded Gezira 1 in straw yield by 42% and grain yield by 19% (Table 3).

Table 3. Straw and grain yields (kg/ha) for three barley varieties, 1991/92.

	Rihane 03		Gezira 1		Local Aswad	
Location	Straw	Grain	Straw	Grain	Straw	Grain
Fatsa	2504	2682	1888	1624	2246	1510
Hukna	2790	2832	2052	2274	1908	1862
Ain Husan	4362	1814	2692	2468	3850	2120
Kahriz	3238	2580	2474	2068	3256	2186
Mean	3223	2477	2276	2108	2825	1919
Increase (%) over						
Local	14	29	−19	10		
Gezira	42	19			24	−9

Conclusions

According to the results obtained from this research, it is evident that productivity of the improved cultivars Rihane 03 and Gezira 1 is at acceptable levels under the limited rainfall conditions of northern Iraq. Thus they are recommended for increase and distribution to the farmers of the region.

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Adary, Adnan N. 1989. "Rihane" a new high yielding introduction of barley (*Hordeum vulgare* L.) for limited rainfall region of northern Iraq. Mesopotamia Journal of Agriculture 21(4):121-304.

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Discussion

S. Ceccarelli
Under drought, 6-row varieties have lower harvest index than 2-row varieties, whereas plant height is the reverse.

A. Adary
I agree with that but in one test in Al-Gezira we didn't get enough real drought to notice this relationship.

M. Ababneh
Is there any positive correlation between plant height and harvest index in this study?

A. Adary
The correlation coefficients between plant height and harvest index were not calculated in this study.

٢- هنالك حاجة للتوسع في إجراء المشاهدات لاكبر عدد من المزارعين لتعريفهم بأهمية إستعمال الصنف المحسن وإضافة السماد على محصول الشعير من أجل زيادة المزارعين المتبنين لهذه التقنيات مما سيؤدي إلى رفع إنتاجية الشعير على مستوى المزارع وعلى المستوى الوطني .

جدول رقم (٦) : نسبة مساهمة الصنف المحسن والتسميد في زيادة انتاج الشعير من الحب والقش(كغم / هكتار) عند الزراعة في مشاهدات موسعة في حقول المزارعين خلال المواسم ١٩٨٩/٩٠ و ١٩٩٠/٩١ و ١٩٩١/٩٢ .

الموسم الزراعي	زيادة الانتاج العائد للصنف ٪		زيادة الانتاج العائدللتسميد ٪	
	حب	قش	حب	قش
١٩٨٩/١٩٩٠	٢ر١٠	-	٥ر١٥	-
١٩٩٠/١٩٩١	٨ر٧	٥ر١١	٥ر٤٤	٢ر٢٢
١٩٩١/١٩٩٢	١ر٢٦	٢٧	٦٢	٩ر٤٦
المعدل	٧ر١٤	٢ر١٩	٧ر٤٠	٦ر٢٤

السماد فقد وصلت في معدلها ٩ر٤٦٪ . ويلاحظ أن أعلى زيادة تحققت كانت في جنوب الاردن حيث بلغت ٢ر٦٠٪ كنتيجة لاستعمال الصنف المحسن و ٤ر٩٨٪ نتيجة إستعمال السماد .

وفي تلخيص للنتائج للمواسم الثلاث جدول رقم (٦) يلاحظ بأن نسبة الزيادة في إنتاج الحب العائدة للصنف قد بلغت ٧ر١٤٪ وتفاوتت خلال المواسم ما بين ٨ر٧٪ في موسم ٩٠/٩١ ولغاية ١ر٢٦٪ في موسم ٩١/٩٢ وهو الموسم الاكثر إنتاجا نتيجة كميات الامطار الجيدة التي سقطت خلال هذا الموسم . ويلاحظ بأن تأثير السماد كان أكبر ويعادل ضعف تأثير الصنف المحسن على زيادة إنتاجية الحب ، حيث بلغت الزيادة ٧ر٤٠٪ وتراوحت ما بين ٥ر١٥ ولغاية ٦٢٪ في موسم ١٩٩١/٩٢ وهذا أيضا يشير إلى زيادة الاستجابة للسماد مع تحسين رطوبة التربة . ولا تختلف الزيادة في إنتاج القش عما ذكر في إنتاج الحب ، فكان عطاء السماد أعلى من الصنف المحسن (٦ر٣٤٪ مقارنة و ٣ر١٩٪) . إلا أن الصنف المحسن كان له أثر أكبر على زيادة إنتاج القش مقارنة بأثرة على زيادة إنتاج الحب .

الاستنتاجات والتوصيات

١- يلاحظ بأن هنالك تأثير واضح للصنف المحسن وللتسميد على زيادة إنتاجية الشعير من الحب والقش ، إلا أن الزيادة المتحصل عليها تتباين مع تباين مواقع الزراعة والمواسم الزراعية .

٢- يلاحظ أن للسماد تأثير أكبر على زيادة إنتاجية الشعير من الحب والقش مقارنة بتأثير الصنف المحسن ، حيث وصل تأثير السماد ضعف تأثير الصنف المحسن . كما ويلاحظ وبشكل عام ، إستجابة صنف الشعير المحلي بشكل أكبر للسماد من الصنف المحسن .

جدول رقم (٥) : تاثير الصنف المحسن والتسميدعلى إنتاجية الشعير من القش (كغم/ هكتار) في الاردن عند زراعته في مشاهدات موسعة في حقول المزارعين خلال الموسم الزراعي ١٩٩١/١٩٩٢ .

المواقع	المعاملات				زيادة الانتاج العائد للصنف (٪)			زيادة الانتاج العائد للتسميد (٪)			عدد المشاهدات
	صنف محسن +	صنف محسن -	بلدي +	بلدي -	+	-	المعدل	صنف محسن	صنف بلدي	المعدل	
شمال الاردن	٣٠٥٠	٢٦١٠	٢٥٣٠	٢١٧٠	٢٠ر٥	٢٠ر٣	٢٠ر٤	١٦ر٨	١٦ر٦	١٦ر٧	٨
وسط الاردن	٢٦٦٠	٢٣٦٠	٢١٣٠	١٤٦٠	٢٤ر٩	٦١ر٦	٤٣ر٣	١٢ر٧	٤٥ر٩	٢٩ر٣	١
جنوب الاردن	٣٨٢٠	٢٤٠٠	٢٩٧٠	١٢٥٠	٢٨ر٦	٩٢ر٠	٦٠ر٣	٥٩ر٣	١٣٧ر٦	٩٨ر٤	٧
منطقة الطفيلة	٢٠٧٠	١٠٧٠	١٧٦٠	١١٦٠	١٧ر٦	-٧ر٧	٥ر٠	٩٣ر٥	٥١ر٧	٦٧ر١	٧
منطقة الشوبك	١٤٠٠	٩٦٠	١٠٨٠	٨٢٠	٢٩ر٦	١٧ر١	٢٣ر٤	٤٥ر٨	٣١ر٧	٣٨ر٨	١١
المعدل	٢٤٦٠	١٧١٠	١٩٨٠	١٣٢٠	٢٤ر٠	٣٠ر٠	٢٧ر٠	٤٣ر٨	٥٠	٤٦ر٩	

المصدر : وزارة الزراعة / مشروع المشرق / التقرير السنوي ١٩٩١/١٩٩٢ .

جدول رقم (٤) : تاثير الصنف المحسن والتسميدعلى إنتاجية الشعير من الحب (كغم/ هكتار) في الاردن عند زراعته في مشاهدات موسعة في حقول المزارعين خلال الموسم الزراعي ١٩٩١/١٩٩٢ .

المواقع	المعامـــــــــلات				زيادة الانتاج العائد للصنف (٪)			زيادة الانتاج العائد للتسميد (٪)			عدد المشاهدات
	صنف محسن +	صنف محسن -	بلدي +	بلدي -	+	-	المعدل	صنف محسن	صنف بلدي	المعدل	
شمال الاردن	١٤٥٠	١١٥٠	١٢٩٠	٩٨٠	١٤ر٤	١٧ر٣	١٤ر٩	٢٦	٣٢	٢٩	٨
وسط الاردن	١٤٦٠	١٣٦٠	١١٠٠	٧٦٠	٣٢ر٧	٧٨ر٩	٥٥ر٨	٧	٤٥	٢٦	١
جنوب الاردن	٢٣٢٠	٩٦٠	١٧٤٠	٥٩٠	٣٣ر٣	٦٢ر٧	٤٨ر٠	١٤٢	١٩٥	١٦٨ر٥	٧
منطقة الطفيلة	٩٣٠	٥٩٠	٨١٠	٤٩٠	١٤ر٨	٢٠ر٤	١٧ر٦	٥٨	٦٥	٦١ر٥	٧
منطقة الشوبك	٥٥٠	٤٩٠	٦٤٠	٤٨٠	-١٤	٢	٦-	١٢	٣٣	٢٢ر٥	١١
المعدل	١٣٤٢	٩١٠	١١١٦	٦٦٠	١٥ر٨	٣٦ر٣	٢٦ر٨	٤٩	٧٣	١٥ر٥	

+ مع تسميد

- بدون تسميد

المصدر : وزارة الزراعة / مشروع المشرق / التقرير السنوي ١٩٩١/١٩٩٢ .

جدول رقم (٢) : تأثير الصنف المحسن والتسميد على إنتاجية الشعير من القش (كغم/ هكتار) في الاردن عند زراعته في مشاهدات موسعة في حقول المزارعين خلال الموسم الزراعي ١٩٩٠/١٩٩١.

المواقع	المعامـــــــلات				زيادة الانتاج العائد للصنف (٪)			زيادة الانتاج العائد للتسميد (٪)			عدد المشاهدات
	صنف محسن +	صنف محسن -	بلدي +	بلدي -	+	-	المعدل	صنف محسن	صنف بلدي	المعدل	
شمال الاردن	٢٨٧٠	٢٢٣٠	٣٠٠٠	٢٢٢٠	٤ر٣-	٠ر١	٢ر١-	٢٨ر٧	٢٥ر١	٢١ر٩	٥
وسط الاردن	١٧٦٠	١٣٦٠	١٤٢٠	١١٧٠	٢٣ر٩	١٦ر٢	٢٠	٢٩ر٤	٢١ر٤	٢٥ر٤	٥
جنوب الاردن	٨٠٠	٦٤٠	٦٠٠	٦٤٠	٣٢ر٢	صفر	١٦ر٧	٢٥	٦ر٣-	٩ر٤	٨
المعدل	١٨١٠	١٤١٠	١٦٧٢	١٣٤٣	١٧ر٦	٥ر٤	١١ر٥	٢٧ر٧	١٦ر٧	٢٢ر٢	

+ مع تسميد

- بدون تسميد

المصدر : وزارة الزراعة / مشروع المشرق / التقرير السنوي ١٩٩٠/ ١٩٩١.

صنف : رم .

أعطى الصنف المحسن بدون تسميد زيادة في الانتاج بمقدار ٩ر١٩٪ في حين كان إنتاج الصنف المحلي أعلى مع التسميد . ويظهر ذلك بوضوح عند دراسة تاثير التسميد على زيادة الانتاج حيث أعطى الصنف المحلي زيادة مقدارها ٦١٪ مقارنة بزيادة ٢٨٪ مع الصنف المحسن .

أما الزيادة المتحصل عليها من القش (الجدول رقم ٣) فقد أظهرت النتائج أن الصنف المحسن يتفوق على المحلي بمقدار ٥ر١١٪ بغض النظر عن معاملة التسميد ، مع العلم أن إنتاجية الصنف المحسن من القش كانت أعلى من المحسن مع التسميد في إنتاجية القش . وتحقق من النتائج زيادة في إنتاجية القش مقدارها ٢ر٢٢٪ نتيجة التسميد بغض النظر عن الصنف المستخدم . وكما يلاحظ في الجدول ، فهنالك إختلافات واضحة بين المواقع ، حيث لم يكن للصنف المحسن تاثيرا يذكر على زيادة الانتاجية في شمال الاردن ، بينما كان له تأثير واضح في زيادة الانتاجية في كل من وسط وجنوب الاردن .

ومن الجداول رقم ٤ و ٥ تحقق زيادة في إنتاج الحب والقش في الموسم ١٩٩١/١٩٩٢ عند إستخدام الصنف المحسن مقارنة بالصنف المحلي وكذلك عند إستخدام التسميد . حيث أظهرت النتائج من الجدول رقم ٤ وعلى أساس معدل كافة المواقع ، زيادة بالحب للصنف المحسن مقدارها ١ر٢٦ ٪ لغض النظر عن التسميد ، في حين أدى التسميد إلى زيادة ٦٢٪ في إنتاج الحب . وكما تشير الارقام في الجدول أدى الصنف المحسن إلى زيادة ٣ر٣٦٪ في إنتاج الحب دون التسميد لكافة المناطق وبزيادة مقدارها ٨ر١٥٪ عن الصنف المحسن مع التسميد . مما يدل على أن إستجابة الصنف المحسن للتسميد هي أقل من إستجابة الصنف المحلي . وبشكل عام كانت الزيادة في إنتاج الحب عند إضافة السماد إلى الصنف المحلي ٧٣٪ مقارنة ب ٤٩٪ مع الصنف المحسن .

أما إنتاجية القش فقد زادت بنسبة ٢٧٪ نتيجة إستعمال الصنف المحسن جدول رقم (٥) وبلغت نسبة الزيادة في إنتاج القش ٣٠٪ عندما لم يستعمل السماد ، بينما كانت ٢٤٪ عند إستعمال السماد . أما الزيادة العائدة لاضافة

جدول رقم (٢) : تأثير الصنف المحسن وإضافة السماد على إنتاجية الشعير من الحب (كغم/ هكتار) في الاردن عند زراعته في مشاهدات موسعة في حقول المزارعين خلال الموسم الزراعي ١٩٩٠/١٩٩١.

المواقع	المعامـــــــلات				زيادة الانتاج العائد للصنف (٪)			زيادة الانتاج العائد للتسميد (٪)			عدد المشاهدات
	صنف محسن +	صنف محسن -	بلدي +	بلدي -	+	-	المعدل	صنف محسن	صنف بلدي	المعدل	
شمال الاردن	١٠٣٢	٨٢٢	١٢٩١	٩٢٢	-٨ر٢٠	-٨ر١٠	-٨ر١٥	٢٤	٤٠	٣٢	٥
وسط الاردن	٤٠٠	٣٠٠	٤٠٠	٣٠٠	صفر	٥٠	٢٥	٣٣	١٠٠	٥ر٦٦	٥
جنوب الاردن	٦٢٥	٤٨٨	٥٨٠	٤٠٥	٨ر٧	٥ر٢٠	٢ر١٤	٢٨	٤٣	٥ر٣٥	٨
المعدل	٦٨٢	٥٢٧	٧٥٧	٥٠٩	-٣ر٤	٩ر١٩	٨ر٧	٢٨	٦١	٥ر٤٤	

+ مع تسميد

- بدون تسميد

المصدر : وزارة الزراعة / مشروع المشرق / التقرير السنوي ١٩٩٠/ ١٩٩١.

صنف محسن : رم .

جدول رقم (١) : تأثير الصنف المحسن وإضافة السماد على إنتاجية الشعير من الحب (كغم/ هكتار) في الاردن عند زراعته في مشاهدات موسعة في حقول المزارعين خلال الموسم الزراعي ١٩٨٩/١٩٩٠ .

	المعامـــــــــلات				زيادة الانتاج العائد للصنف (٪)			زيادة الانتاج العائد للتسميد (٪)			عدد المشاهدات
المواقع	صنف محسن +	صنف محسن -	بلدي +	بلدي -	+	-	المعدل	صنف محسن	صنف بلدي	المعدل	
شمال الاردن	٨١٠	٦٠٠	٦٤٠	٥٦٠	٢٦ر٦	٧	١٩ر٩	٣٥	١٤	٢٤ر٥	٤
وسط الاردن	٩٩٠	١٠٠٠	١٠٧٠	١٠٧٠	-٧	-٧	-٧	٠٠	٠٠	٠٠	٣
جنوب الاردن	١٢٠٠	١٢٦٠	١٠٠٠	٩٢٠	٣٠	٣٧	٣٣ر٥	٢ر٥	٨ر٧	٥ر٦	٥
منطقة الشوبك	٨٦٠	٥٧٠	٨١٠	٦٧٠	٦	-١٤ر٩	-٤ر٥	٥٠	٣٠ر٨	٥٢ر٤	٧
المعدل	٩٩٠	٨٥٧	٨٨٠	٨٠٥	١٤	٦ر٦	١٠ر٣	١٩ر٤	١١ر٦	١٥ر٥	٨

+ مع تسميد

- بدون تسميد

المصدر : وزارة الزراعة / مشروع المشرق / التقرير السنوي ١٩٨٩/١٩٩٠ .

إستخدم بالمشاهدات أحد الاصناف المحسنة الثلاثة « رم ، أكساد ١٧٦ ، وصنف دير علا ١٠٦" حيث قورنت بصنف المزارع المحلي . تم تقدير إنتاجية الهكتار من الحب والقش بأخذ ستة عينات عشوائية متساوية من كل من المعاملات الداخلة في المشاهدة . مساحة العينة ٥م٢ .

النتائـج والمناقشـة

خلال ثلاثة سنوات من عمر مشروع المشرق ١٩٨٩/١٩٩٠ - ١٩٩١/١٩٩٢ أظهرت النتائج تفوق الاصناف المحسنة من الشعير على الاصناف المحلية وكذلك كان للتسميد أثرا فعالا في زيادة إنتاجية الشعير المحلي والمحسن .

ففي الموسم الزراعي ١٩٨٩/٩٠ تم تنفيذ"١٩"مشاهدة، أظهرت النتائج تفوقا للصنف المحسن وزيادة للانتاج مقدارها ٣ر١٠٪ مقارنة بالصنف المحلي في حين أدى التسميد إلى زيادة للانتاج الحبي من الشعير مقدارها ٥ر١٥٪ مقارنة بعدمه بغض النظر عن الصنف المستخدم (جدول رقم ١) . وظهر في نفس الجدول أن الصنف المحسن مع التسميد أعطى إنتاجية أعلى مقارنة بالصنف المحسن بدون تسميد (١٤٪ ، ٦ر٦٪ على التوالي) ، مما يدل على أن الصنف المحسن يستجيب إلى التسميد أكثر منه بدون تسميد . وهذا يظهر بوضوح تأثير السماد حيث كانت إستجابة الصنف المحسن للتسميد أكثر من الصنف المحلي بمقدار ٨ر٧٪ .

ومن الملاحظ في هذا الموسم تذبذب في زيادة الانتاج العائدة للصنف المحسن والتسميد ويعود ذلك إلى الاختلافات البيئية للمواقع المنفذة بها المشاهدات إضافة إلى الاختلاف في العمليات الزراعية بين موقع وآخر .

أما نتائج موسم ١٩٩٠/٩١ فقد أظهرت زيادة في إنتاج الحب العائد للصنف المحسن مقدارها ٨ر٧٪ و ٥ر٤٤٪ عائدة للتسميد (جدول رقم ٢) .

الاصناف نذكر منها"فن، روث، هرمل ، آرنا ، وجيزة " فتعتبر من الاصناف المبشرة والتي ينتظر إعتمادها وإكثارها .

وتشير توصيات تسميد الشعير في الاردن إلى إستخدام "١٠" كغم نيتروجين / هكتار و "٥٠" كغم خامس أكسيد الفوسفور / هكتار تضاف عند الزراعة .

تهدف هذه الدراسة التوسع بزراعة الاصناف المحسنة وإلى التوسع بإضافة السماد إلى محصول الشعير وذلك عن طريق إجراء مشاهدات في حقول المزارعين لكي يتيقنوا بأنفسهم من أثر هذه المعاملات على زيادة إنتاجيتهم من الحب والقش .

طريقة العمل

تم تنفيذ عدد من المشاهدات في حقول مزارعي الشعير بالاردن بإشراف مشروع المشرق . بواقع ٢ هكتار للشماهدة الواحدة . حيث إشتملت المشاهدة على أربع معاملات هي :

الصنف المحلي بدون سماد
الصنف المحلي مع سماد
الصنف المحسن بدون سماد
الصنف المحسن مع سماد

لتحديد تأثير الصنف المحسن والتسميد في زيادة إنتاج الشعير أضيف السماد بمعدل ١٠٠ كغم/ هـ من ثنائي فوسفات الامونيوم (٤٦٪ P_2O_5 ، ١٨٪ N) وزرعت المشاهدة بمعدل بذار ٧٠ كغم / هـ . تم زراعة المشاهدات من بداية تشرين الثاني وحتى كانون أول وزرعت معظم المشاهدات قبل سقوط الامطار (عفيرا) .

مقدمـــــة

الشعير محصول إستراتيجي يقع في المرتبة الرابعة بعد القمح والرز والذرة في العالم . وبسبب التقدم في صناعة الاعلاف محليا ودوليا، فقد تزايد إهتمام الاردن بالشعير، حيث يحتل المرتبة الثانية بعد القمح من حيث الاهمية والمساحة المزروعة ، حيث بلغ معدل المساحة المزروعة بالشعير خلال العقدين السابقين " ٤٧ر٥ " ألف هكتار ، بمعدل إنتاجي حوالي " ٢٤ " ألف طن سنويا ، وهذه الكمية تمثل ٣٢ر٤٪ من حاجة الاردن لهذه السلعة . وبلغ معدل إنتاج الهكتار خلال الفترة الزمنية " ١٩٧٣ - ١٩٩١" حوالي ٥٠٠ كغم .

بدأت أبحاث الشعير في الاردن وبشكل منظم مبني على أسس علمية وأهداف واضحة ، مع بداية الخمسينات من خلال وزارة الزراعة بتجارب مقارنة الاصناف ومدى ملائمتها للظروف المحلية ، وتجارب تأثير الاسمدة في زيادة إنتاجية الشعير لوحدة المساحة، إضافة إلى برامج التربية والتحسين ، حيث بدأ العمل بهذا البرنامج منذ ١٩٥٦ في محطة دير علا الزراعية وتم من خلاله التوصية بزراعة صنف الشعير أريفات " Arivat " وبدأ إكثاره مع بداية الستينات . وخلال الفترة الماضية وحتى الآن اشتملت أبحاث الشعير بالاردن على تجارب التربية ودراسة المدخلات الزراعية الحديثة، حيث تم في سنة ١٩٨٣ تخصيص محطتين لزراعة الشعير وأبحاثها هما محطة الرمثا ومحطة الغوير التابعتين لوزارة الزراعة الاردنية ، وتقع في المناطق محدودة الامطار"٢٠٠-٣٠٠ ملم سنويا".

لقد تم التوصل إلى مجموعة من الاصناف عالية الانتاج كما ونوعا والمتأقلمة مع ظروف الاردن المحلية في المناطق المطرية ، من خلال برنامج التربية الذي ينفذه المركز الوطني للبحوث الزراعية ونقل التكنولوجيا بالتعاون مع عدد من المؤسسات العلمية العالمية مثل " إيكاردا ، سيميت وأكساد" والمحلية الممثلة بالجامعات الاردنية . حيث تم الحصول على مجموعة من أصناف الشعير .
تم إعتماد ثلاثة منها هي " دير علا ١٠٦ ، أكساد ١٧٦، رم" وأما بقية

تأثير الاصناف المحسنة والتسميد
على إنتاجية الشعير
في الاردن

قاسم ممدوح ، حسين صالح وعلي غرايبه
المركز الوطني للبحوث الزراعية ونقل التكنولوجيا
عمان - الاردن

الخلاصة

نفذت مشاهدات في حقول المزارعين من خلال مشروع المشرق من أجل أن يرى المزارع تأثير إستعمال الاصناف المحسنة وإضافة الاسمدة على زيادة إنتاجية الشعير من الحب والقش . غطت المشاهدات شمال ووسط وجنوب الاردن ، حيث نفذت ١٩ مشاهدة في الموسم الزراعي ١٩٨٩/٩٠ و ١٨ مشاهدة في الموسم ١٩٩٠/١٩٩١ و٢٤ مشاهدة في موسم ١٩٩١/١٩٩٢ .

أشارت النتائج في المواقع المختلفة والمواسم المختلفة . بأن غلة الحب قد زادت بنسبة ٧ر١٤٪ عند إستعمال الصنف المحسن رم وبنسبة ٧ر٤٠ ٪ عند إضافة السماد . وفي المقابل زادت غلة القش بنسبة ٣ر١٩ ٪ عند إستعمال الصنف المحسن وبنسبة ٦ر٣٤٪ نتيجة لاضافة السماد .

هنالك حاجة للتوسع في إجراء مثل هذه المشاهدات ، لتصل إلى عدد أكبر من المزارعين ، وهذا سيؤدي بالنهاية إلى زيادة إنتاجية الشعير من الحب والقش على مستوى المزارع وعلى المستوى الوطني في الاردن .

Effect of Improved Varieties and Fertilizer on Barley Yield in Jordan

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Abstract

On-farm demonstrations were conducted through the Mashreq Project to show farmers the effect of improved barley varieties and fertilization on increasing grain and straw yield. The demonstrations were in the north, center and south of Jordan, with 19 demonstration in the 1989/90 season, 18 in 1990/91 and 34 in the 1991/92 season. Results over locations and seasons showed that grain yield can be increased by 14.7% when using the improved variety Rum and by 40.7% when fertilizer is applied. On the other hand, straw yield was increased by 19.3% as a result of using the improved variety and by 34.6% in response to fertilization. There is a need for more demonstrations to extend the technology to more farmers, which will eventually result in high barley productivity at the farmer and the national levels.

المراجـــــــــع

التقرير الفني السنوي للمشروع المشرقي للشعير والاعلاف والاغنام
(راب ٨٩/٢٦٠) للسنوات ١٩٨٩/١٩٩٠ و ١٩٩٠/١٩٩١ و ١٩٩١/١٩٩٢ .

الاستنتاجات

١- أظهرت الاصناف المبشرة تفوقا ملحوظا في إنتاج الحب على الصنف المحلي السائد عربي أسود خلال موسمين من الثلاثة مواسم التي نفذت هذه الدراسة فيها . وأظهرت النتائج تباينا لهذا التفوق بين المواقع وهذا يستدعي الاستمرار في هذه المشاهدات الى موسم آخر للتأكد من تفوق هذه الاصناف .

٢- أظهرت الاصناف المبشرة تفوقا ملحوظا في إنتاج القش في كل المواقع والمواسم التي نفذت فيها الدراسة ، مما يعطيها ميزة هامة نظرا لاهمية القش في تغذية الاغنام في مناطق المشروع .

٣- أهمية التسميد واضحة وكانت العامل الهام في زيادة الانتاج لذا لا بد من التأكيد على التسميد وإرشاد المزارع بالاستعمال السليم للسماد في الكميات المناسبة والوقت المناسب .

٤- لا بد من الاستمرار في إدخال واختبار سلالات مبشرة من الشعير متأقلمة من ظروف الجفاف في مناطق زراعة الشعير في القطر السوري .

جدول رقم (٦) : مقارنة إنتاجية الحب والقش (كغم / هكتار) لاصناف الشعير المختبرة خلال السنوات الثلاث وفي مختلف المواقع .

الصنف	الانتاجية كغم / هكتار				
	موسم ١٩٨٩/٩٠	موسم ١٩٩٠/٩١	موسم ١٩٩١/٩٢	معدل الثلاث	الزيادة على الشاهد (٪)
إنتاجية الحب					
عربي أسود	٢٣٠	٤٨٢	١٣٤٣	٦٨٥	-
WI2291	٢٨٠	٥٩١	١٢٩٢	٧٢١	٥
تدمر	٣١٠	٥١٤	١١٨٤	٦٦٩	٢-
زنبقه	-	-	١٢٨٨	-	-
إنتاجية القش					
عربي أسود	-	٤٠٧	١٥٦٢	٩٨٤	-
WI2291	-	٢٩٣	٢٠٠٩	١٢٠٠	٢٢
تدمر	-	٢٥٣	١٩٠٣	١١٢٨	١٥

جدول رقم (٥)

أثر الصنف والسماد على إنتاجية الشعير من القش (كغم/ هكتار) عند زراعته في حقول المزارعين في أربعة مواقع في منطقة الاستقرار الثالثة في محافظة الحسكة خلال الموسم الزراعي ١٩٩١/١٩٩٢ .

المعاملة	الاصناف	المواقع: تل أسود	المسعودية	أم جرحه	خربة شعيب	المتوسط	الزيادة على الشاهد (٪)	متوسط المعاملة
بدون تسميد	عربي أسود	٥٠٠	١٢٥٠	١٥٠٠	٢٠٠٠	١٣١٢	-	
	تدمر	٢٥٠	١٥٠٠	١٤٠٠	١٧٥٠	١٧٨٧	٣٦	١٥٢٤
	WI2291	١٢٥٠	٢٠٠٠	١٧٥٠	١٨٣٠	١٧٠٧	٣٠	
	زنبقه	٥٠٠	١٥٠٠	١٥٠٠	١٨٣٠	١٣٣٢	١	
مسمد	عربي أسود	١٧٥٠	٢٠٠٠	١٧٥٠	١٧٥٠	١٨١٢	-	
	تدمر	١٧٥٠	٢٢٥٠	١٥٠٠	٢٠٠٠	٢٠٢٠	١١	
	WI2291	١٢٥٠	٣٠٠٠	٢٥٠٠	٢٥٠٠	٢٣١٢	٢٧	١٩٩٤
	زنبقه	١٠٠٠	٢٢٥٠	١٧٥٠	٢٣٣٠	١٨٣٢	١	

المصدر : التقرير السنوي للمشروع المشرقي ١٩٩١/١٩٩٢ .

جدول رقم (٤) : أثر الصنف والسماد على إنتاجية الشعير من القش (كغم / هكتار) عند زراعته في حقول المزارعين في خمسة مواقع في منطقة الاستقرار الثانية في محافظتي الحسكة والرقة وذلك خلال الموسم الزراعي ١٩٩٠/١٩٩١ .

المعاملة	الصنف	المواقع							الزيادة (٪)	متوسط
		أم حجره	المليبية	المسعودية	العيوج	شركراك	بيرعاصي	المتوسط		
بدون تسميد	عربي أسود	٤١٠	٤٠٠	٦٥٠	٢٩٠	٢٠٠	١٩٠	٣٥٧	-	
	WI2291	٢٧٠	٦٠٠	٤٩٠	٢٦٠	١٠٠	١٧٠	٣١٥	١٢-	٣١٨
	تدمر	٢٧٠	٢٩٠	٤٥٠	٣٢٠	١١٠	١٥٠	٢٨٢	٢١-	
مسمد	عربي أسود	٢٧٠	٤٤٠	١٠٠٠	٢٧٠	٣٤٠	٢٢٠	٤٤٠	-	
	WI2291	٤٩٠	٥٠٠	٧٥٠	٣٦٠	٢٤٠	٤٠٠	٤٧٣	٨	٤٤٦
	تدمر	٤٩٠	٥٥٠	٦٤٠	٥٦٠	١٦٠	١٥٠	٤٢٥	٣-	

المصدر : التقرير السنوي للمشروع المشرقي لموسم ١٩٩٠/١٩٩١ .

شهر آذار . إلا أن التفوق إستمر في بعض المواقع وبشكل ملحوظ خاصة في مواقع نيلونان والمسعودية .

أما أثر السماد على إنتاج الحب فكان واضحا وخلال المواسم الثلاث . حيث أدى التسميد إلى زيادة إنتاج الحب بنسبة ٤٨٪ . ٣٠٪ و٣٩٪ خلال المواسم ١٩٨٩/٩٠ . ١٩٩٠/٩١ . ١٩٩١/٩٢ على التوالي .

كما هو معلوم فإن إنتاج القش يعتبر أمرا هاما بالنسبة للمزارع خاصة المالك للاغنام . حيث يعتبر القش أحد المصادر الغذائية الهامة خلال فصل الشتاء عندما تشح الاعلاف خاصة المالئة منها . لقد تم قياس إنتاج القش خلال الموسمين ٩١و ٩٢ (الجدولان ٤ و ٥) حيث تبين بأن الصنف WI2291 قد تفوق في إنتاج القش عن الصنف المحلي بنسبة تراوحت ما بين ٨-٣٠ ٪ . وتراجع في حالة واحدة فقط . أما الصنف تدمر . فلا يبدو أنه منافس للمحلي في هذه الصفة . حيث يلاحظ بأن إنتاجيته قد إختلفت مع إختلاف المواقع والمواسم الزراعية . كذلك تأثرت بإضافة السماد أو عدم إضافته .

ويلاحظ من هذه الجداول بأن للتسميد أثرا واضحا على زيادة إنتاج القش . حيث أدى إلى زيادة ٣٨٪ في القش خلال الموسم ١٩٩٠/٩١ وكانت هذه النسبة ٣٠٪ في الموسم التالي . مما يؤكد أهمية التسميد على رفع إنتاجية كل من الحب والقش . ويتوقع أن يساعد التسميد على تحسين نوعية القش المنتج من حيث رفع نسبة البروتين فيه بالرغم من أنه لم يتم دراسه هذه الصفة .

وفي محاولة لتلخيص النتائج المتحصل عليها خلال المواسم الثلاث . كمعدل لكافة المواقع التي تم إجراء الاختبارات فيها . (جدول ٦) يمكن أن يلاحظ بأن الاصناف المبشرة قد تفوقت في إنتاج الحب بشكل طفيف على الصنف المحلي في بعض المواسم خاصة موسمي ١٩٨٩/٩٠ و ١٩٩٠/٩١ . بينما أظهر تفوقا واضحا في إنتاجيتها من القش . حيث تفوق الصنف تدمر ١٥٪ والصنف WI2291 بنسبة ٢٢٪ وهذا يشير الى أهمية الاصناف المحسنة في صفة انتاج القش والذي يعتبر مصدرا هاما لتغذية الاغنام في مناطق عمل مشروع المشرق.

جدول رقم (٣) : أثر الصنف والتسميد على غلة الشعير الحبية (كغم/هكتار) عندما زرع في حقول المزارعين في خمسة مواقع في منطقة الاستقرار الثالثة في سوريا خلال الموسم الزراعي ١٩٩١/١٩٩٢ .

المعاملات	الصنف	الموقع: نيلونان	تل أسود	المسعودية	أم حجرة	خربة شعيب	المتوسط	الزيادة على الشاهد(٪)	متوسط المعاملات
	عربي أسود	٦٤٠	٥٥٠	١٣٥٠	١٥٥٠	١٥٠٠	١١٢٠		
غير مسمد	WI2291	٦٦٠	٤٦٠	١٣٠٠	١٢٠٠	١٥٠٠	٩٣٢	١٧-	
	تدمر	٩٤٠	٤٠٠	١٦٠٠	١٠٦٠	١٥٠٠	١١٠٠	٢-	١٠٥٩
	زنبقة	١١٠٠	٥٢٠	١٣٣٠	١١٣٠	١٣٣٠	١٠٨٤	٣ر٣-	
	عربي أسود	٩٩٠	١١٠٠	٢٠٢٠	١٧٢٠	٢٠٠٠	١٥٦٦		
	WI2291	٦٦٠	١٠٦٠	١٤٧٠	١٥١٠	٢١٠٠	١٣٦٤	١٣-	
غير مسمد	تدمر	١١٨٠	١٠٧٠	٢٠٦٠	١٣٦٠	١٨٣٠	١٤٨٤	٥-	١٤٧٦
	زنبقة	١١٠٠	١١٢٠	١٩٨٠	١٤٢٠	١٨٥٠	١٤٩٢	٥-	

المصدر : التقرير السنوي للمشروع المشرقي لموسم ١٩٩١/١٩٩٢.

جدول رقم (٢)

أثر الصنف والتسميد على غلة الشعير الحبية (كغم/هكتار) عندما زرع في حقول المزارعين في ثمانية مواقع في منطقة الاستقرار الثالثة في سوريا خلال الموسم الزراعي ١٩٩٠/١٩٩١ .

المعاملات	الصنف	الموقع: تل التوت	فريتان	أم حجرة	الميلبية	السعودية	العيوج	شركراك	بيرعاصي	المتوسط	الزيادة على الشاهد٪	متوسط المعاملات
بدون تسميد	عربي أسود	٩١٥	٧٥٠	٢٨٠	٣٩٠	٥٢٠	٢٦٠	٢٢٠	١٨٠	٤٣٩	-	
	WI2291	١٣٥٥	١٠٥٠	١٠٠	٤٣٠	٥٢٠	٢٦٠	٩٠	١٨٠	٤٩٨	١٣	٤٦١
	تدمر	١٠٠٠	٨٣٠	٢٧٠	٣٤٠	٥٦٠	٢٧٠	١٣٠	١٧٠	٤٤٦	١	
مسمد	عربي أسود	١١٢٥	٨٥٠	٣٢٠	٤٠٠	٥٩٠	٣٤٠	٢٥٠	٢٢٠	٥٢٤	-	
	WI2291	١٨٧٠	١٣٥٠	١٧٠	٣٧٠	٥٩٠	٤٠٠	٣٢٠	٤٠٠	٦٨٤	٣٠	٥٩٧
	تدمر	١٣٩٠	٩٢٠	٢٥٠	٤٥٠	٦٢٠	٦٦٠	١٤٠	١٧٠	٥٨٣	١١	

في هذا الموسم تم حصاد موقعين فقط في محافظة حماه وهما تل التوت - وفريتان ولم تحصد باقي المواقع بسبب الجفاف الذي ساد المنطقة.

المصدر : التقرير السنوي للمشروع المشرقي ١٩٩٠/١٩٩١.

جدول رقم (١): أثر بعض المعاملات على الغلة الحبية (كغم/ هكتار) لمجموعة أصناف من الشعير زرعت في منطقة الاستقرار الثالثة في حقول المزارعين في محافظتي الحسكة والرقة خلال الموسم الزراعي ١٩٨٩/١٩٩٠ .

المعاملة	الاصناف	المواقع: أم حجره	تل خضر	بيرصران	الكنطري	المتوسط	الزيادة على الشاهد(٪)	متوسط المعاملة
بدون تسميد	عربي أسود	١٠٠	١٩٠	٢٧٠	١٨٠	١٩٠	-	
	WI2291	١٢٠	٢٢٠	٣٢٠	١٢٠	٢٠٠	٥	٢١٠
	تدمر	١٥٠	١٦٠	٤١٠	٢٢٠	٢٤٠	٢٦	
مع تسميد	عربي أسود	١٢٠	٢٩٠	٣٣٠	٢٧٠	٢٥٠	-	
	WI2291	٢٣٠	٣٩٠	٤٧٠	١٦٠	٣١٠	٢٤	٣١٠
	تدمر	١٦٠	٢٥٠	٧٤٠	٣٠٠	٣٦٠	٤٤	
مكافحة أعشاب	عربي أسود	١٢٠	٢٠٠	٢٨٠	٢٢٠	٢١٠	-	
	WI2291	١٥٠	٣٠٠	٢٤٠	١١٠	٢٣٠	٩	٢٢٢
	تدمر	١٦٠	٢٠٠	٢٨٠	٢٢٠	٢٤٠	١٤	
مع تسميد	عربي أسود	١٥٠	٣٠٠	٢٧٠	٣٠٠	٢٨٠	-	
+	WI2291	٢٧٠	٥٠٠	٥٢٠	١٤٠	٣٦٠	٢٨	٢٥٠
مكافحة أعشاب	تدمر	١٩٠	٢٥٠	٧٧٠	٣٠٠	٤٠٠	٤٢	

المصدر : التقرير السنوي للمشروع المشرقي ١٩٨٩/١٩٩٠.

هطلت الامطار وبشكل مناسب منذ شهر كانون الثاني مما ساعد على نمو النباتات بشكل جيد إلا أن حدوث الرياح في ٢٠-٢٥ آيار أدى إلى حدوث إنفراط السنابل وإلى فقدان قدر بحوالي ٣٠٪ من الانتاج (التقرير الفني السنوي لمشروع المشرق ١٩٩٠/٩١).

ج- موسم ١٩٩١/١٩٩٢

اتصف هذا الموسم بهطولات مطرية وفيرة في بدايته ، إلا أنه رافق ذلك البرد الشديد . وإنقطاع الامطار في شهري آذار ونيسان أدى إلى البطء في تطور النبات . وعاد النمو للتحسن بعد ذلك نتيجة لهطول الامطار من جديد . وصاحب نهاية الموسم فترات من إعتدال في درجات الحرارة أعطت النباتات فرصة من أجل تشجيع تكوين السنابل وإمتلائها مما كان له الاثر الواضح على زيادة الانتاج (التقرير الفني السنوي لمشروع المشرق ١٩٩١/٩٢) .

النتائج والمناقشة

تلخص الجداول رقم ١ ، ٢ و ٣ إنتاجية الشعير من الحب تحت المعاملات المختبرة وذلك للمواسم ١٩٨٩/٩٠ ، ١٩٩٠/٩١ و١٩٩١/٩٢ . فيلاحظ من الجدول ١ ، تفوق الاصناف المبشرة على العربي الاسود وهو الصنف المحلي السائد في المنطقة . وتحت كافة المعاملات ، حيث يصل هذا التفوق الى ٤٣٪ للصنف المبشر تدمر تحت ظروف التسميد ومكافحة الاعشاب ، بينما يصل الى ٤٤٪ عند إجراء عمليات التسميد فقط ، والى ٢٦٪ عند الزراعة بنفس طريقة وأسلوب المزارع .

وفي الموسم الثاني يلاحظ أن هنالك نفس الاتجاه إلا أن نسبة التفوق كانت أقل منها عن الموسم السابق ، حيث كانت حوالي ١١٪ لتدمر ووصلت ٣٠٪ للصنف WI2291 وفي الموسم ١٩٩١/١٩٩٢ لوحظ تراجع في أداء هذه الاصناف ، قد يعود الى الظروف الجوية خاصة ظروف تدني درجات الحرارة والصقيع خلال

زرعت المشاهدات في النصف الثاني من شهر تشرين الثاني وبإستعمال معدل بذار ١٠٠ كغم / هكتار.

الظروف المناخية السائدة

قبل التحدث عن النتائج التي تم التوصل اليها سيتم إستعراض سريع للظروف المناخية خاصة كميات الامطار الساقطة التي سادت خلال مواسم الدراسة .

أ- موسم ١٩٨٩/١٩٩٠

كانت الامطار قليلة منذ بداية الموسم وحتى شهر شباط ولكنها كانت موزعة بشكل جيد ساعدت على إستمرارية النمو ثم توقفت خلال شهر آذار وهي الفترة الضرورية لنمو النبات وخاصة أنها تصادف مرحلة الاستطالة . ثم عاودت الامطار هطولها خلال شهر نيسان بشكل جيد في محافظتي الحسكة والرقة ، إلا أن حدوث الصقيع الشديد كان له تأثير سلبي كبير على نمو المحصول وخاصة في محافظة حماه خلال الفترة من ١٦-١٩ آذار ، مما أدى إلى القضاء على نسبة كبيرة من النباتات ، الامر الذي أدى إلى عدم إمكانية حصاد حقول تلك المحافظة (التقرير الفني السنوي للمشروع المشرقي ٨٩/٩٠) .

ب- موسم ١٩٩٠/١٩٩١

اتصف هذا الموسم في محافظتي الرقة والحسكة بفترات إنقطاع في الامطار لمدد طويلة وخاصة في شهري كانون الاول والثاني وبحدوث الصقيع الشديد منذ بداية الموسم ، مما أدى إلى تأخير البزوغ إلى شهر شباط ، حيث هطلت الامطار بوفرة مما ساعد النباتات على النمو بشكل جيد حتى شهر نيسان الذي إتصف بهبوب رياح مغبرة أثرت سلبيا على المحاصيل وأوقفت نموها . أما في حماه ، فكان الوضع مختلفا حيث

المواد وطريقة العمل

الاصناف المستخدمة :

أ- منطقة الاستقرار الثانية : عربي أبيض وفرات ١ ، واستعمل العربي الابيض شاهد للمقارنة.

ب- منطقة الاستقرار الثالثة : تدمر ، زنبقة ، WI2291 ، واستعمل الصنفان عربي أبيض وعربي أسود شاهدين للمقارنة .

زرعت الاصناف في مشاهدات في حقول المزارعين في كل من محافظات حماة ، الرقة والحسكة . في كل موقع زرع كل صنف بمساحة ٤,٠ هكتار قسمت إلى أربعة أقسام نفذت على كل قسم (١,٠ هكتار) المعاملات الاربع التالية :

١- طريقة المزارع وهي الزراعة بإستعمال بـذارة الديسك هارو دون إضافة السماد أو مبيد الاعشاب.

٢- التسميد بإستعمال المعاملة السمادية الموصى بها وهي :

أ- مناطق الاستقرار الثانية

إستخدم فيها ٥٠ كغم /هـ يوريا (٤٦٪ N) دفعة أولى عند الزراعة و ٧٥ كغم/هـ نترات أمونيوم (٣٠٪ N) دفعة ثانية عند الاشطاء و١٠٠ كغم/هـ سوبرفوسفات عند الزراعة دفعة واحدة.

ب- مناطق الاستقرار الثالثة

إستخدم فيها ٢٥ كغم/هـ يوريا (٤٦٪ N) دفعة أولى عند الزراعة و ٧٥ كغم/هـ نترات أمونيوم (٣٠٪ N) دفعة ثانية عند الاشطاء و١٠٠ كغم/هـ سوبرفوسفات دفعة واحدة عند الزراعة.

٣- مبيدات الاعشاب بإستعمال مبيد الاعشاب 2 , 4 , D بالمعدلات الموصى بها .

٤- إضافة السماد وإضافة مبيد الاعشاب .

كانت كبيرة خاصة في الصنف WI2291 ، حيث زادت غلته بنسبة ٤٤٪ مقارنة مع غلته بدون تسميد . وكان الصنف WI2291 أفضل الاصناف في إنتاج القش . ويمكن القول بشكل عام أن الصنف المحلي عنده قدرة كبيرة على منافسة الاصناف الاخرى في الغلة الحبية وخاصة في المواسم الاكثر جفافا ، إلا أن هنالك أصنافا مبشرة يمكن أن يكون لها مستقبلا في زراعة هذه المناطق . كما ويلاحظ تأثير التسميد الواضح في زيادة إنتاج الحب والقش مع كل الاصناف المدروسة .

مقدمــــة

لمحصول الشعير مكانة متقدمة من بين المحاصيل الهامة في سورية حيث يحتل المرتبة الثانية بعد القمح من حيث الاهمية ، فقد تضاعفت المساحة المزروعة به بعلا في السنوات الاخيرة لمواجهة تنامي الثروة الحيوانية وإحتياجاتها للأعلاف ، بالاضافة إلى قدرته على تحمل الظروف البيئية القاسية وإقبال المزارعين على زراعته في المناطق الجافة .

ولذلك تتكثف الجهود البحثية لاستنباط أصناف جديدة قادرة على التأقلم مع الظروف البيئية الجافة وشبه الجافة . نتيجة لذلك تم التوصل إلى أصناف منها ما تم إعتماده ومنا ما هو مبشر ويختبر في مراحله الاخيرة .

وبهدف إيصال هذه الاصناف المستنبطة إلى المزارعين ، يقوم المشروع المشرقي بتنفيذ العديد من المشاهدات في حقولهم في مناطق الاستقرار الثانية والثالثة ، والتي تتراوح أمطارها السنوية ما بين ٢٥٠ - ٣٥٠ ملم . وتشتمل هذه المشاهدات على إختبار الاصناف المحسنة المعتمدة والاصناف المبشرة التي لم تعتمد بعد . ومقارنتها بالاصناف التي يزرعها المزارع .

الاصناف المحسنة وأثرها على زيادة غلة الشعير

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مديرية البحوث العلمية الزراعية
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خلاصـــــة

أختبرت مجموعة من أصناف الشعير (المعتمدة والمبشرة) في حقول المزارعين وبإستخدام أسلوبهم في الزراعة . لارشادهم على أهمية هذه الاصناف وإستكمال دراسة المبشر منها لمعرفة أداءها تحت ظروفهم. تمت الاختبارات في منطقتي الاستقرار الثانية (٢٥٠ -٣٥٠ ملم) والثالثة (٢٥٠ ملم).

ففي منطقة الاستقرار الثانية في محافظة حماه تم الاختبار في موسمي ١٩٨٩ - ١٩٩١ تحت أربع معاملات هي : الزراعة بطريقة المزارع - طريقة المزارع مع إضافة السماد - طريقة المزارع مع إضافة مبيد الاعشاب - وطريقة المزارع بإضافة سماد ومبيد عشبي . أما في موسم ١٩٩١/٩٢ فقد أستعملت معاملتين هي بطريقة المزارع بإستخدام السماد أو بدون السماد .
تفوق الصنف فرات ١ على الشاهد المحلي الصنف عربي أسود في موسم ١٩٩٠/١٩٩١ بمعاملة طريقة المزارع بزيادة قدرها ١٥٪ وتفوق بزيادة ٤٪ عند إضافة السماد و٢٠٪ عند إستخدام المبيد العشبي و١٠٪ بإستخدام المبيد والسماد . إلا أن الفروقات بين فرات ١ والمحلي لم تكن معنوية في موسم ١٩٩١-١٩٩٢.

أما في منطقة الاستقرار الثالثة . فطبقت مشاهدات إشتملت على عدد من الاصناف المبشرة إلى جانب الصنف المحلي عربي أسود . وزرعت بإضافة السماد ودون إضافة السماد . ومن متوسط نتائج المواسم الثلاث . تبين عدم وجود فروقات بين الاصناف من حيث غلة الحب . إلا أن الاستجابة للتسميد

Improved Cultivars and their Effect on Barley Yield Improvement

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Abstract

Several promising barley lines were evaluated in farmers' fields to show farmers the potential of these cultivars under different cultural practices. The tests were conducted in Zones 2 and 3 in northern Syria. In Zone 2 (250-350 mm annual rainfall), Furat 1 and the local were compared under four treatments in the 1989 and 1991 seasons: (1) farmer's practice, (2) farmer's practice + fertilizer, (3) farmer's practice + herbicide and (4) farmer's practice + fertilizer + herbicide. In the 1991/92 season, only treatments with and without fertilizer were used. Furat 1 gave an increase in grain yield over the local which was 15% under the farmer's practice, 4% with fertilizer, 20% with herbicide and 10% when both fertilizer and herbicides were used. In Zone 3 (250 mm annual rainfall), the demonstration included several promising barley lines. Only fertilizer treatments were applied and compared with no fertilization. In the three seasons barley showed a significant response to fertilizer. The promising cultivar WI 2291 showed superiority for straw yield over the other cultivars, and also had the highest response to fertilizer (a 44% increase in yield).

Sheep Nutrition, Breeding and Reproduction

Improving Performance of Awassi Flocks by Modifying Feeding

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Abstract

In the Mashreq region most sheep are still kept in nomadic or semi-nomadic systems, which utilize range and crop by-products in addition to having long periods of hand-feeding. These systems present special problems for research and extension. Although we have little indication of how relevant western feeding standards are for Awassis, there is little alternative to using them as a basis for ration formulation. The energy cost of walking large distances (> 5 km/day) to graze very sparse vegetation for most of the year may exceed the intakes of energy from the herbage. The small intakes of herbage may, however, be critical in preventing mineral and vitamin deficiencies in current systems, in which mineral and vitamin supplements are not fed. Fertility and prolificacy can be increased by improving liveweight and level of feeding before mating. However, more information is needed on the intake of nutrients from grazing cereal stubbles, the main feed source in the mating period (June-September), and the changes in nutrient intake if sheep are fed protein or energy supplements while grazing stubble. There is some evidence that the feeding levels used by farmers in Syria in late pregnancy and early lactation are above the energy requirements for the level of production of the ewes. The lack of response to these high-energy intakes may be due to the use of diets that are deficient in protein. This paper discusses some of the nutritional problems of Awassi sheep with the aim of developing guidelines for the management of nutrition in the different systems in the region.

Introduction

In many countries, guidelines to help flockowners manage the nutrition of sheep flocks throughout the annual cycle have been developed by combining information from feeding standards, experimentation on responses of performance of ewes to level of nutrition and practical experience. There are considerable problems in developing similar guidelines for Awassi and other fat-tail breeds for use in the systems of West Asia. There has been little experimentation on the nutrition of these breeds and there are few indications of how far the feeding standards developed in northwest Europe, the USA and Australia from calorimetry and detailed experimentation on small numbers of thin-tail sheep are relevant to fat-tail breeds. There is little alternative to using them as a starting point.

A large proportion of the sheep in the region are kept in flocks that are nomadic or semi-nomadic (75% in Syria). The application of guidelines for management of nutrition is not easy in these systems, but, in other parts of the world, guidelines have been developed, using patterns of change in body condition or weight, for the management of systems in which the sheep are at pasture throughout the year. All the systems in West Asia now have a period of 100-150 days in winter and early spring in which the sheep are dependent on hand-feeding of feedstuffs from the cropping areas. In most flocks, this period includes late pregnancy and early lactation, the periods with highest nutrient requirements. In view of the length of this feeding period and its importance for the productivity of the flock, considerable savings could occur if the right amounts of correctly formulated rations were fed, resulting in reduced intakes, increased efficiency of food utilization, or improved performance.

In this paper, we have taken the guidelines developed for the management of ewe flocks in Britain as a starting point for managing the nutrition of ewes of fat-tail breeds. The British guidelines (MLC 1988) were based on feeding standards published by ARC (1980, 1984) and MAFF (1984), with some modification of the protein requirements in pregnancy as a result of experimental results.

Maintenance Requirements

There is a difficulty in deciding, in the absence of experimental data, the probable maintenance requirements of ewes that spend many hours each day throughout the year walking and grazing, often in very sparse vegetation.

In his analysis of survey data on sheep-feeding systems in northern Syria, Thomson (1987) increased the MAFF maintenance allowance, which already contains an allowance for grazing activity, by 30% to allow for the long distances walked by the flocks. This would allow for walking 10.5 km on flat land, or 100 m vertically and 9.4 km horizontally, using the ARC (1980) values of 2.6 and 28.0 kJ kg^{-1} liveweight km^{-1} for the horizontal and vertical components of walking, respectively, and assuming that efficiency of use of energy for muscular work is the same as for maintenance. C. Prieto (Estación Experimental del Zaidén, Granada: pers. comm.) estimated that the energy cost for goats of walking and grazing in poor mountain pastures in southern Spain was 11% of maintenance requirement. A survey by Jaubert and Oglah (1987) found that flocks taken to graze rangeland for approximately 5 hours/day in winter consumed 20% more feed/head than the ewes in flocks that remained in the village. The performance was similar in both groups of flocks, suggesting that walking long distances to graze poor pasture in winter has a greater cost than the intake obtained.

More data are needed on the energy cost of grazing sparsely vegetated rangeland. The limited information available calls into question the practice, almost universal at present in the region, of taking flocks to graze all through the winter, even when feeding them large amounts of other feeds at other times of the day.

Currently, at least in Syria, the contribution of rangeland grazing to the flock's annual energy requirements is low and falling. Thomson *et al.* (1989) calculated that the contribution ranged from 25 to 50% in the three villages in the survey. The 25% contribution of rangeland fell to less than 15% in the year with below-average rainfall, in which the period of hand-feeding was extended by 50%. Since then, the contribution has certainly fallen, as sheep numbers have increased by 50% in Syria and the rangeland has been further degraded. Grazing in rangeland may make a slightly greater contribution to protein intake than to energy intake, as the protein content of many range plants, especially in spring, is higher than that of many of the feeds used. Range grazing might make a vital contribution to the intake of minerals and vitamins in the current systems, in which minerals and vitamins are not added to the diets or made available on a free access basis. The appearance of symptoms of vitamin E/selenium deficiency in lambs in Syria following the dry years of 1990 and 1991, in which there was very little growth of rangeland, supports the suggestion that the small intakes of herbage from the range are critical for the avoidance of deficiencies in the current systems.

It seems probable that substantial savings in feed could result from eliminating grazing in rangeland in winter and early spring, when herbage growth is negligible and feed requirements high, and feeding correctly formulated diets that include minerals and vitamins. This could lead to a beneficial resting of rangeland, if all flockowners in an area made this change in management. Experimentation and on-farm trials are needed to test the benefits and costs of this change in management.

Nutrition at Mating

Most surveys show that lambing percentages (defined as the number of lambs reared per 100 ewes put to the ram) are low in flocks in West Asia. For example, in the survey published by Thomson *et al.* (1989), 87 lambs were born per 100 ewes put to the ram, but this fell to 65% lambs reared because the percentage of lambs reared was only 75%. Although many factors, including breed, disease (both in ewes in pregnancy and in lambs) and management at lambing time, can affect lambing percentage, nutrition before and at mating can affect the proportion of both barren ewes and of ewes producing twin lambs.

Great emphasis was put in the past on the effects on the lambing percentage of flushing, the practice of giving a high level of nutrition for 2 or 3 weeks before mating started. An analysis by Coop (1962) clearly showed that two separate effects of nutrition occur at mating. One is an effect of the body condition (or weight) of the ewes, which Coop called the static effect, and the second is the effect of current level of nutrition, the dynamic effect. Body condition at mating was found to have the larger effect on lambing percentage, with the actual level of nutrition at the time of mating being less important, except in very thin ewes. A large amount of experimentation subsequently has confirmed the effect of body condition at mating on the number of ova shed from the ovaries at oestrous, although there are a few breeds (e.g., Cheviot and Finnish Landrace) in which there is little or no effect.

Effects on fertility of liveweight at mating have been demonstrated in Awassi ewes. Thomson and Bahhady (1988) found that weight at mating affected lambing rate, defined as the number of pregnant ewes per 100 ewes put to the ram, up to a weight of about 53 kg, with no further response at higher weights (Table 1). A small proportion of ewes (2-4%) weighing more than 43 kg produced twin lambs. Similarly, in a long-term stocking rate experiment (MLC 1982) at ICARDA, lambing percentage increased above 100% in some years, when weight at mating was above 50 kg. These results come from experiments in which different nutritional levels were imposed for long periods and thus do not allow a separation of the effects of body condition and of current nutrition. It is important that research is carried out to estimate the magnitude of the static and dynamic effects in fat-tail breeds, as, in West Asia, they are generally mated when they are grazing cereal stubble and may be subjected to wide fluctuations in nutrient intake, as they move on to, and then graze down, individual areas of stubble. It is, therefore, very important to know at what range of body condition the fertility of the fat-tail ewe is likely to be affected by level of nutrition at mating.

Stubble Grazing

In the West Asia region, mating and a large part of pregnancy occur while ewes are grazing stubble, and thus clear information is needed on the intakes of nutrients by ewes grazing stubble and on their responses to high-energy or high-protein supplements. Data exist from Morocco (Guessous *et al.* 1989) and now from ICARDA, where intakes of heads, leaf and stem were calculated from quadrats cut at intervals of 2 to 5 days as sheep grazed barley stubble for 28 days at stocking rates of 20, 40 and 60 sheep/ha (ICARDA 1992). As intakes of heads and leaf

Table 1. Effect of liveweight at mating on fertility of Awassi ewes (Thomson and Bahhady 1988).

	Mean weight (kg)					
	34.0	39.5	43.5	48.5	52.5	57.0
Lambing rate†	76	71	95	93	100	100
Percentage of twins	0	0	2	2	4	0

† Lambing rate = (No. ewes pregnant/no. ewes put to ram) x 100.

declined and of stem increased, the intakes of nutrients declined rapidly: at 40 sheep/ha from 14 MJ of metabolizable energy (ME) and 80 g of crude protein (CP) on day 3 of the grazing period, to 6 MJ and 20 g on day 12 and 2 MJ and 1 g on day 22.

Early Pregnancy (Months 1-3)

The fertilized ovum is at first free in the uterus, but, at about day 18 of pregnancy, implantation in the wall of the uterus takes place and development of the placenta starts. The placenta and uterus continue to grow through the first 3 months of pregnancy. At the end of the third month the placenta is fully developed and the uterus only increases slightly in weight by the end of pregnancy (Table 2). The foetus or foetuses are, however, very small at 3 months. A single foetus in a 45-kg ewe only weighs about 0.6 kg, 13% of its weight at lambing, and twin foetuses will have a total weight of about 1.7 kg, 21% of their final weight.

The proportion of fertilized ova implanted is affected by extremes of both high and low nutrition and by high temperature. Implantation in fat-tail ewes mated in midsummer in West Asia may be reduced by very high temperatures and fluctuating nutrient intake, if ewes are forced to completely utilize stubbles. Immediately after mating, the management should be adjusted to ensure that intakes are not below maintenance. This may be difficult to achieve in flocks mated over a long period.

A few studies have shown that very low nutrition in the second and third months of pregnancy can slow the development of the placenta and reduce its final size, which in turn can limit the transfer of nutrients from the mother to the foetus in the last weeks of pregnancy and result in a smaller foetus at lambing. A maintenance level of nutrition (6.3 MJ of ME and 65 g CP/day for a 45-kg ewe) is certainly adequate to avoid these effects and, in ewes in good body condition, a reduction in body weight of up to 7% in months 2 and 3 of pregnancy will have no effect on the subsequent growth of the foetus. Such reductions, however, are difficult to manage in flocks with wide spreads in the dates of mating, as ewes will still be coming into first fertile oestrous, or be at the stage of implantation, when other ewes have reached the end of their first month of pregnancy.

Table 2. Weights of the products of conception (kg) in a 45-kg ewe with a single foetus (Robinson *et al.* 1977).

Days after conception	Uterus	Placenta	Fluids	Foetus
60	0.31	0.44	0.45	0.05
90	0.43	0.69	0.99	0.56
120	0.60	0.69	0.81	2.26
135	0.18	0.69	0.75	3.70
145	0.77	0.69	1.13	4.57

Late Pregnancy (Months 4 and 5)

In the last 2 months of pregnancy, the growth of the foetus or foetuses is rapid (Table 2) and, as the efficiency of conversion of energy to foetal growth is very low (approximately 0.13), nutrient allowances (Table 3) increase rapidly. In the last 2 weeks of pregnancy, the energy allowances are 40 and 65% higher in ewes with single and twin foetuses, respectively, than the allowance required in months 2 and 3 of pregnancy. Protein requirements in pregnancy are supplied if the diet contains 10 g CP/MJ of ME, except for ewes with twin foetuses, which need a diet with minimum protein:energy ratio of 12.7 g/MJ of ME in the last 2 weeks of pregnancy. The allowances in Table 3 are for a diet with a high energy concentration of approximately 11 MJ/kg DM. Diets with lower energy concentrations will require higher intakes of energy and protein. For example, for a diet with an ME concentration of 8 MJ/kg DM, the allowances are 10% higher. Not only are higher intakes of nutrients required on poorer quality diets, but it is more difficult to supply them, as voluntary intakes of diets with lower energy concentration are lower than those of higher density diets.

Table 3. Metabolizable energy allowances (MJ/day) for maintenance and in late pregnancy for a 45-kg ewe on a diet with a ME concentration of 11 MJ/kg DM (MAFF 1984).

	Weeks before lambing		
	6	4	2
Maintenance	6.3		
Single foetus	7.2	8.0	8.8
Twin foetuses	7.7	8.9	10.3

More than 90% of the secretory tissue in the udder is laid down in the last 50 days of pregnancy, with a little deposition still continuing in the first few days of lactation. Underfeeding in late pregnancy results in a reduction in the secretion of colostrum and a delay of several hours in the onset of full lactation after lambing. This is more common in ewes with twin foetuses that have had a diet with low protein content. Very severe undernutrition, resulting in a large reduction in lamb birthweight, can lead to reduction of milk yield in the subsequent lactation of 10-35%.

In West Asia, flocks are usually fed diets consisting almost entirely of straw during pregnancy. Calculations suggest that on these diets the intakes are less than the allowances, especially for protein. Experimentation is needed to assess the extent of reductions in birthweight resulting from feeding predominantly straw in late pregnancy and the responses to feeding supplements to bring the intakes of nutrients close to the nutrient allowances.

Lactation

Nutrient allowances for lactation are difficult to state, as underfed ewes can maintain a high level of milk production by utilizing fat reserves if the withdrawal stimulus by the lambs is strong. Only about 10% of total body protein is labile and can be mobilized to support lactation. For example, in a 45-kg ewe the mobilized protein will be sufficient for only 6 kg of milk. In early lactation, therefore, protein intake has a greater effect on milk production than energy intake.

The intakes of ewes producing 1 kg of milk/day, which is sufficient for the lamb to grow at 200 g/day, have to be substantially increased above the allowances in late pregnancy. Energy and protein intakes have to be increased by 60% in early lactation (Table 4) to prevent utilization of any body reserves. In ewes losing 0.5 of a condition score in the first 6 weeks of lactation (3 kg in a 45-kg ewe) an increase in energy intake of 30% is needed but protein intake needs to increase by 65%, as the absolute requirement for protein is slightly higher than for a ewe maintaining weight.

Table 4. Daily allowances in lactation for metabolizable energy and crude protein for 45-kg ewe (MLC 1982).

Milk yield (kg)	Change in body score†	Energy (MJ)	Protein (g)
1.0	0	14.2	140
	-0.5	11.4	145
1.5	0	17.7	180
	-0.5	15.0	210

† In the first 6 weeks of lactation.

Survey data from northern Syria indicate that flockowners usually increase feeding in lactation by offering large amounts (> 1 kg) of barley or mixtures of concentrated feedstuffs, such as cottonseed cake, wheat bran, bread and sugar beet pulp. Daily intakes between November and February in 2 years were 17.0 MJ of ME and 170 g CP, almost sufficient for ewes producing 1.5 kg of milk/day, rather than the 0.8 kg that the lamb growth rate of approximately 160 g/day indicates was actually produced (Jaubert and Oglah 1987). Jaubert and Oglah suggest that part of the poor average response to the level of feeding in lactation may result from a proportion of the ewes being in low body condition at lambing because of poor feeding in pregnancy. In other situations, where high ratios of barley:straw are fed, the diet may be deficient in protein for lactating ewes.

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Discussion

H. Nabulsi

1. Feeding sheep in lots during the winter gives a time of rest to rangelands and avoids tracking over small plants.
2. Stubble intake depends on stocking rate. The herder must keep an eye on the score and condition of his flock so as to supplement the feed if necessary.

T. Treacher

1. I think the possibility of improving rangeland by eliminating or minimizing grazing in winter and early spring is important and could actually save feed, if there is a high energy cost to grazing sparse pasture.
2. I am sure that a good shepherd can do much to prevent undernutrition in the stubble grazing period by watching his sheep. As mating usually takes place during the period when stubble is grazed, it is very important to define the optimal range of body condition at mating. This will enable adjustment of management so that the majority of the flock are in a condition in which the current level of nutrition, unless very extreme, will have little effect on the fertility of the flock.

M. Harb

How could you measure maintenance level without using the very expensive calorimetric method?

T. Treacher

By doing experimentation on the level of feeding, which will give us some indication of the requirements.

M. Harb
Do you think that a complete correct diet should be prepared to be supplemented in winter?

T. Treacher
Complete diets could be used but they are expensive as they have to be prepared using expensive machinery. I feel the real need is to give information to farmers so they are more fully aware of the nutritive value of different feeds available at the moment and how to combine them to give a resonably well-balanced diet.

Recent Work at ICARDA on the Quality of Feeds and Supplementation Strategies

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Abstract

This paper summarizes 10 years of results of ICARDA's experiments on barley straw quality. The work aims to provide cereal breeders with a rapid means of predicting the nutritive value of straw, especially in years when it is likely to be of poor quality. Sheep were fed up to nine different varieties of barley straw grown in 10 years having typical year-to-year rainfall variation. Straw varieties were ranked on the basis of their long-term mean voluntary intakes. Differences between varieties were more consistent in years of good grain yield, in which straw production was also high but of relatively poor quality. The ranking of varieties was well correlated with *in vitro* digestibility, acid detergent fibre and rate of gas production *in vitro,* but not with protein content because the ranking of varieties for protein content changes from year to year. Voluntary intake of varieties has recently been predicted well by near infra red spectroscopy.

Recent experiments investigated the best use of supplements. Changing the time at which concentrate supplements are fed relative to grazing straw or stubble can be a cost-free management intervention. Feeding a supplement at, or 4 hours before, feeding straw resulted in higher intakes of straw than feeding it 4 hours after straw. Both barley and cottonseed cake supplements increased straw intake by up to 50%. Urea treatment is often used to increase the digestibility and voluntary intake of straw. The digestible organic matter intake of sheep fed low-protein barley straw was 288 g, of urea-treated straw 556 g and of urea-supplemented straw as much as 450 g. The beneficial supplementary effects of *Atriplex halimus* browse, *Salsola vermiculata* browse, pea straw and common vetch straw were assessed as replacements for conventional supplements such as cottonseed cake.

Intake of Barley Straw Varieties

When ICARDA in the early years tried to introduce a high-yielding barley variety (Beecher) to farmers, they reported that the sheep did not like to eat the straw, and occasionally bled in the mouth when they did eat it. Since then, animal nutritionists have been cooperating with barley breeders in finding quick ways to screen barley varieties for quality early in the breeding programs.

It is not possible to give a fixed definition of barley straw quality because sheep benefit from characteristics of the straw in different ways according to how much straw is fed, what other feeds are in the diet, and how much the sheep are expected to produce. ICARDA has assumed that straw provides most of the dietary dry matter, and that if farmers feed supplements they will be minimal in quantity and cost. In ICARDA trials, the variety preferences of lactating sheep have been similar to those of sheep that do not need much more than maintenance energy (i.e., not growing, pregnant or lactating).

The benchmark measure of quality is voluntary intake, which is closely correlated with metabolizable energy intake, which is in turn an excellent predictor of performance. The problem is that voluntary intake measurements have to be replicated to be meaningful, and are therefore expensive and cannot be performed on small samples of experimental varieties.

Currently we are developing quick routine tests that can be done on coarsely milled samples of straw. We have been working mainly with chemical tests, but behavioral tests (e.g., palatability) and micro-anatomical measurements (e.g., cell wall thickness distribution) are also possible. This is because it is easy to store and sample milled straw and, if needed, analyses can be repeated at any time for extra precision. In the past, we have measured characteristics that can be estimated on the intact straw such as leaf to stem ratio or plant height. However, plant height, itself a desirable economic character, is negatively correlated with leafiness, a component of straw value. Therefore, so as not to have conflicting breeding aims, we must ensure that stems as well as leaves have good nutritive value.

A second reason for using laboratory measurements is that we can use them to predict voluntary intake directly. Laboratory measures include Near Infra-red Reflectance Spectroscopy, which can be applied to a large number of samples and has been successfully calibrated (by Fuad Jabi el-Haramein at ICARDA) against voluntary intake.

Variation in Barley Straw Quality

Year-to-year differences in weather are the most important cause of variation of barley straw quality. Nutritional value is closely correlated with rainfall in the three months before maturity, February to April in Tel Hadya. Table 1 shows some averages of intake and other indicators of nutritive value for several years of differing spring rainfall.

Differences in quality between varieties are most important to farmers in years with high rainfall, when straw tends to be of low quality, particularly if farmers can be persuaded to store straw for feeding in drier years. Fortunately, it is in the wet years that straw quality is most consistently affected by variety (Table 2). We also found that differences between varieties were most stable when we gave supplements to prevent protein deficiency. Since the protein content of straw varies unpredictably from one year to another, supplementation of sheep with protein allows the more stable characteristics such as fiber content and fiber quality to have a greater effect on intake. Sheep respond to protein supplements in smaller quantities than energy supplements, as will be shown in the next section, even though there is not a great difference in the cost per kg between, say, barley grain and cottonseed cake in the Mashreq region.

The last column in Table 3 (overall mean intake) is a sort of "genetic merit score" for nutritive value. Where we did digestibility trials, the digestible organic matter intakes were always closely correlated with voluntary organic matter intakes.

We have been looking at different chemical and physical tests to see which of them are best correlated with the merit score just mentioned. The best relationships are for *in vitro* digestibility, acid detergent fibre, and near infra-red predictions of intake. When we predicted digestibility or fiber by near infra-red, the result was

Table 1. Relationship between quality indicators and spring rainfall in nine barley straw varieties.

Year	Rainfall (mm)†	OM intake (g/54 kg bodywt.)	NDF‡	ADF	ADL	DOMD	N
			(g/kg DM)				
1989	24	1632	674	328	32	598	10.6
1990	73	1115	755	391		564	6.6
1984	82	1006	746	426		426	4.7
1985	95	982	732	422	49	409	5.3
1983	118	740	738	472		377	4.9
1986	124	892	794	480	67	414	4.1
1982	126	933	769	439		388	5.3
1988	219	627	796	484	76	392	3.0

† February to April.
‡ OM = organic matter; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; DOMD = digestible OM in dry matter; N = nitrogen.

Table 2. Correlations between actual intakes and overall mean intake† of different barley straw varieties by Awassi sheep.

	Unsupplemented		Supplemented	
Year	r	No. vars.	r	No. vars.
Wet springs (115-230 mm, Feb-Apr)				
1983	0.96, 0.98	3		
1986	0.89	4	0.70, 0.58	4
1986			0.94, 0.64	4
1988	0.66, 0.47	4	0.97	4
1988	0.74	9		
Dry springs (20-110 mm, Feb-Apr)				
1984	0.46	8	0.69, 0.94	4
1985	0.51	9	0.71	9
1989	0.01	4		
1989	0.23	6		

† See Table 3.

also well correlated with merit score. Protein content, for reasons just mentioned, and the electrical energy needed to grind the sample (Hohenheim University results), were poorly correlated with merit score. Generally, the relationships were best when straw was harvested after a dry spring.

Times of Feeding Supplement and Straw

The time of day at which to feed concentrate supplements (relative to when stubble is grazed or straw is fed) is a simple, cost-free management decision. Supplements can be fed, for example, before grazing, at midday, after grazing or during the night. Farmers have traditionally fed supplements in the evening after animals have been grazing. They claim that if they feed supplements such as barley in the morning, sheep will eat less when grazing and, if they feed supplements in the evening, they will keep sheep warm at night. We have performed two experiments with ewe lambs to measure whether any difference results from feeding a supplement at one time of day rather than another. Supplements that help rumen microbes to ferment fibre could be most effective if fed in the morning and low-protein supplements might depress fibre digestion least if they were fed later than the straw.

Voluntary Intake

In the first experiment we fed supplements 3.5 hours before, at the same time as, and 3.5 hours after *tibn*. In the second experiment the relevant time intervals were 4 hours. The supplements were cottonseed cake (low and high levels in the respective experiments), barley, and the same quantity of barley with urea (in the second experiment only). The quantities are shown in Table 4. We used Awassi ewe lambs in digestibility crates fed *ad libitum*. The experiment included 11 days in which sheep became adapted to the diets and 10 days in which we measured the quantity and composition of feed, refused feed and feces. There were 4 and 3 sheep on each treatment weighing about 39 kg.

Digestibility

In the first experiment all supplements provided the same amount of protein, and in the second experiment they all provided the same amount of digestible organic matter. The effect of time of feeding was not significant, but there did seem to be an advantage in feeding cottonseed cake at the same time as *tibn* in both experiments (Table 4). This was not true when barley was fed.

Barley caused the intake of *tibn* to increase, by 27-44% in the first and 19-27% in the second experiment. Cottonseed cake increased *tibn* intake by 33-54 and 29-54%, respectively. Urea did not increase the intake of barley-*tibn* diets, suggesting they already contained sufficient rumen-degradable protein. Both supplements increased straw digestible organic matter intake by a slightly greater percentage than they increased straw intake.

Urea Treatment, Urea Supplementation and Coarse Milling

Farmers in the Middle East have a number of different options for improving straw-based rations for sheep. They have traditionally chopped or coarsely milled cereal straw to produce *tibn* for feeding sheep. They say this reduces feed selection and waste. Milling also allows a greater proportion of digestion to occur in the small intestine (with a small sacrifice in rumen digestion). This can lead to higher intakes and more efficient energy metabolism.

Table 3. Long-term mean voluntary organic matter intakes (g/day), corrected for between-experiment variation but not for supplementation, for a sheep weighing 54 kg (metabolic body size 20 $kg^{0.75}$).

Variety	Unsupplemented (U)		Supplemented (S)		Overall mean
	Mean	No. expts	Mean	No. expts	(U+S)/2
Beecher	702	13	716	8	708
Badia	708	3	830	3	769
Arar	744	3	876	1	810
C63	790	9	826	8	808
ER/Apam	772	10	856	8	814
Rihane 'S'	756	4	926	1	841
Antares	844	4	892	1	868
Arabi Aswad	766	3	928	1	847
Arabi Abiad	860	11	924	6	892

Table 4. Dry matter intake of *tibn* when supplements were fed before, at the same time, or after *tibn* was offered.

Daily supplement	None	Relative time of feeding supplement			SE of mean
		Before	Together	After	
***Tibn* intake (g DM/day)**					
Experiment 1					
None	410				
Barley, 240 g		575	595	525	
Cottonseed cake, 80 g		595	635	550	35
Experiment 2					
None	490				
Barley, 165 g		625	580	605	
Barley 165 g, urea 17.1 g		625	600	650	
Cottonseed cake, 229 g		635	750	680	38
Digestible OM intake (g/day)					
Experiment 1					
None	180				
Barley, 240 g		270	270	235	
Cottonseed cake, 80 g		270	295	260	18

Urea Treatment and Supplementation

Urea treatment is also an option and can increase the digestibility and voluntary intake of straw. Typically, each ton of straw is ensiled with urea dissolved in water in a closed container. The urea decomposes into ammonia (and some carbon dioxide) which improves the digestibility of fibre. Urea can also be used in much smaller quantities, as a nitrogen supplement. We tested the relative merit of urea supplementation and urea treatment in both coarsely milled and long straw, using 24 Awassi castrated males in digestibility crates.

We treated straw in two of the six treatments according to the method of M. Hadjipanayotou (Agricultural Research Institute, Nicosia, pers. comm.). Each kg of straw was mixed with a solution of 40 g urea in 0.4 L of water in large black heavy-gauge polythene bags. This was a relatively low rate of urea application. After 3 months (January to March) the bags were opened and the straw laid out in the shade to lose free ammonia and moisture. After this, treated and untreated straw contained 84 and 30 g crude protein (CP) respectively; the untreated straw was supplemented with 20 g urea/kg to give a calculated CP that was equivalent to that of the treated straw.

Voluntary dry matter (DM) intake was increased from 717 to 1026 g/day by supplement but was no greater (1030 g/day) with urea treatment. Digestible organic matter (OM) in the DM was increased from 402 to 436 g/kg by supplementation, and to 540 g/kg by urea treatment. Liveweights were affected in the same way as metabolizable energy (ME) intakes. Rumen ammonia level was low in control sheep (8-26 mg N/L) and was increased by both supplement (43-140) and treatment (83-207).

The advantage of urea treatment over supplementation was in digestibility rather than intake. As a result, sheep ate more ME. However, the increase in ME intake due to supplementation was 2.4 MJ/day, over half as much as the 4.0 MJ/day increase achieved with treatment. We used only 40% of the quantity of urea (16 rather than 40 g/kg straw as fed). It is likely that we would have obtained a similar response using two or three times less urea for supplementation.

We consider urea for animal feeding to be a scarce resource in WANA and that the crude protein content of mature barley straw is a greater constraint to intake than organic matter digestibility. We will continue to advise that it is better to supplement a larger number of sheep with urea than to feed a smaller number of sheep with urea-treated straw. In some circumstances, for example with nitrogen-fertilized wheat straw, there may be a relatively greater response to urea treatment; the economics of treatment also may be more favorable where a less expensive source of ammonia such as ammonia gas can be used.

Coarse Milling

Coarse milling of straw reduced spillage to practically nil. Because selection was eliminated, analysis of straw CP was lower and fibre fractions were higher in the diet consumed (Table 5). The higher digestibility (DOMD) of milled straw was unexpected.

Saltbush Foliage as a Supplement to Barley Straw

There is an ecological need to introduce shrubs into the barley/livestock zone because they capture wind-blown soil, can help prevent water erosion, are tolerant of drought and are efficient water users. These advantages are not immediately attractive to farmers, who we believe will become more interested in shrubs if they can be used to improve animal nutrition.

Table 5. Dietary content, intake, digestibility and calculated ME intake of straw alone, with urea supplementation or with urea treatment.

Straw	Crude protein (g/kg DM)	NDF† (g/kg DM)	ADF† (g/kg DM)	DM intake (g/day)	Digestible OM in DM (g/g DM)	MEI‡ (MJ/day)
Unsupplemented						
Long straw	32	700	410	720	0.38	4.1
Tibn	27	800	450	710	0.43	4.6
Urea-supplemented						
Long straw	88	690	410	970	0.41	5.9
Tibn	84	790	440	1080	0.47	7.6
Urea-treated						
Long straw	84	600	340	1100	0.53	8.8
Tibn	84	800	490	960	0.55	8.0

† NDF = neutral detergent fibre, ADF = acid detergent fibre.
‡ Metabolizable energy intake, assuming that 1 kg digestible OM = 15 MJ ME.

We expect saltbushes (halophytes) to be more useful in mixed diets than when fed alone, because of high concentrations of sodium (32-82 g/kg dry matter), potassium (13-41), calcium (13-21) and magnesium, and 50 g/kg of potentially toxic oxalate. We have therefore commenced research to determine how intake of barley straw and digestible nutrients responds to supplementation with halophyte browse.

Twenty-eight castrated male sheep were used in an intake and digestibility trial (methods described above) in which we supplemented barley straw with either minerals or the foliage of shrubs harvested in August. We fed two levels (about 200 and 400 g/day) of each of three shrubs: *Salsola vermiculata*, *Atriplex halimus* ecotype 1 and *A. halimus* ecotype 2. The latter was a fleshier type of plant.

Halophyte increased the intake of *tibn* and the dietary digestibility in proportion to the amount we offered (Table 6), a result that has been reported for *A. nummularia* by Wilson (1966). Intake of straw supplemented with *A. halimus* ecotype 2 was slightly higher than when other varieties were fed. The calculated DM digestibility of halophytes was about 0.7. This figure was, however, inflated by the large amounts of soluble ash they contained.

The three varieties of halophyte fed seemed to be suitable supplements for barley straw. For each kg of halophyte DM fed, the voluntary barley straw intake increased by between 340 and 630 g DM. The most likely reason for the increased intake was because it corrected the protein deficiency of the straw. The CP content of the halophytes averaged 150 g/kg DM, in comparison with the barley straw which contained 33 g CP/kg DM.

Table 6. The effect of halophyte supplements on the intake and digestibility of barley straw.

Supplement	Dry matter intake (g/day)				DMD† (g/g)
	Saltbush	*Tibn*	Total	Digestible	
None		705	705	320	0.45
Salsola: 200 g	210	750	960	480	0.50
400 g	390	860	1250	660	0.52
A. halimus type 1: 200 g	210	780	990	510	0.51
400 g	350	870	1220	650	0.53
A. halimus type 2: 200 g	220	880	1100	560	0.51
400 g	410	920	1330	740	0.54
SEM	9	38	42	31	0.017

† Dry matter digestibility.

In addition to investigation of halophytes as protein supplements, we are interested in measuring dietary preferences and effects on the performance of sheep grazing stubble when halophytes are grown in barley fields, in determining how the rumen adapts to oxalates and the large water intakes that occur when sheep eat diets high in halophytes, and in defining other consequences to the animal of high mineral and oxalate levels.

Pea Straw and Common Vetch Straw as Supplements to Barley Straw

It is a fascinating possibility that one kind of straw can be a supplement to another (McMeniman *et al.* 1988). We have seen that the rumen-degradable nitrogen content of barley straw can be low enough to limit microbial activity in the rumen. In such cases straw intake and ration digestibility improve when a supplement containing relatively more crude protein than the straw is fed. Ruminants often can benefit from a larger supply of protein than can be synthesized by rumen microbes, which is one reason why cottonseed cake increased straw intake more than barley + urea in one of the experiments described above. Legume hays or straws can be valuable supplements containing both kinds of protein.

In an intake and digestibility trial that was part of the Ph.D. studies of Eunice Carter, we fed barley straw, mixtures of barley and pea straws containing 33, 67 or 100% pea straw, mixtures of barley and vetch straws containing similar levels of vetch straw, and a "standard" diet containing barley straw and 15% cottonseed cake. We fed each of the eight treatments to six sheep.

Table 7. Intakes (g/50 kg body weight) and digestible OM in the DM (g/kg) of barley straw with legume straw supplements.

Supplement	Crude protein (g/kg DM)	DM intake (g/day)	DOM intake (g/day)	Digestible OM in DM (g/g DM)
None	22	785	360	0.46
Pea straw: alone	79	1220	595	0.49
33%	41	955	455	0.48
67%	60	1070	490	0.46
Vetch straw: alone	78	1575	810	0.52
33%	41	1065	515	0.48
67%	59	1345	670	0.50
15% cottonseed cake	64	1250	615	0.49
SEM		43	22	0.015

Pea and vetch straws had very similar crude protein contents (Table 7). Vetch straw was a little more digestible than pea straw, which may have helped to increase voluntary intake. Sheep ate more of the 67% vetch straw ration than they did of ration supplemented with cottonseed cake, even though it contained less crude protein. Pea straw supplements increased voluntary intake, but only by 50-60% of the increase caused by the comparable vetch straw supplement.

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Discussion

B. Al-Rawi
How about the effect of gossypol when you use cottonseed cake in your diet?

A. Goodchild
We used cottonseed cake as a protein supplement rather than as a source of energy. Therefore we rarely use it for more than 20% of the ration. Whole cottonseed may be toxic when fed at higher levels to ruminants in which rumen fermentation is slow. Cottonseed cake that has been heated during oil extraction, as we use, is much safer.

M. Abu Zanat
It is well known, and documented in the literature, that supplementing the grazing animals in the morning will replace the voluntary feed intake, but in your experiments this is not clear.

A. Goodchild
The major effect of time of supplementation appeared with cottonseed cake rather than barley: straw intake was greatest when cottonseed cake was offered at the same time as straw, probably because the rumen microbes that digested cellulose were stimulated.

H. Nabulsi
Do you think that ICARDA is putting too much emphasis on straw?

A. Goodchild
I agree that straw is less important in some countries than others, especially where much of the grain has to be imported. ICARDA livestock scientists are supporting breeders in their efforts to increase straw yields in dry years, and are also working with forage legumes and atriplex.

M. Ababneh
The *tibn* quality depends on leaf/stem ratio. How is this affected by rainfall?

A. Goodchild
Leafiness tends to be greatest in short plants during dry years. I think it is important to breed for grain and straw yields rather than for leafiness. That does not stop breeders from selecting for stem quality.

Urea Blocks and Agricultural By-products for Feeding Sheep in the Critical Rainfall Zones, Mashreq Region

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Abstract

The sparse vegetation in the critical rainfall zones of the Mashreq region provides a weak feed resource base that can mainly sustain sheep. As a result, small ruminants have been part of the agricultural production systems in the region. Given the growing dependence on foreign sources for both livestock products and livestock feedstuffs, the need for greater and improved use of domestic resources becomes more evident. Crop residues and agro-industrial by-products that are not widely utilized at present can fill at least part of the gap between supply and demand for conventional feed resources. Furthermore, the efficiency of utilization of traditional feed resources like cereal straws can be improved significantly by applying basic principles of ruminant nutrition. Sugarbeet pulp, citrus pulp, olive cake, tomato pulp, brewers grain, poultry excreta and others can be utilized as straight feeds and/or as supplements for upgrading the nutritional value of cereal straws and of feedstuffs available for grazing from the range during the long dry period. This paper reviews experiences within and outside the region of using nonconventional by-products as animal feedstuffs, the methods employed for upgrading their nutritional, storage and handling qualities and how urea blocks can be utilized as a means for enhancing greater and improved use of available resources.

Introduction

The sparse vegetation in the countries of the Mashreq region provides a weak feed resource base that can mainly sustain sheep. As a result, small ruminants have been part of the agricultural production systems in the region. The existence of animals in the agricultural system not only complements other parts of the agricultural system, but also adds stability to a farmer's income and consumption, adds liquidity to the cash flow, provides flexibility to farmer's management options, has social value and serves as a store of wealth.

Despite the substantial rate of growth of sheep populations, sheep meat and milk production (Table 1), the countries of the Mashreq region continue to import sheep meat and milk products. Furthermore, all three countries are importers of barley grain and of other animal feedstuffs for feeding the existing animal population. Supplementary feeding of sheep by concentrate diets mainly based on cereal grains and wheat bran is practised for a considerable part of the year.

Given the growing dependence on foreign sources for livestock products and feedstuffs there is an obvious need to develop domestic resources to the maximum. Opportunities in this area do exist. Crop residues and agro-industrial by-products that are not widely used at present can fill at least part of the gap between supply and demand for conventional feed resources. Furthermore, the efficiency of utilization of traditional feed resources like cereal straws, used as an indoor feed or as stubble grazing, can be improved significantly by applying basic principles of ruminant nutrition. Sugarbeet pulp, citrus pulp, olive cake, tomato pulp, brewers grain and poultry excreta can be utilized as straight feeds instead of imported feedstuffs and/or as supplements for upgrading the nutritional worth of cereal straws and of feedstuffs available for grazing during the long dry period. Multinutrient urea blocks, made of a variety of agricultural by-products, can also be used as supplements for sheep and goats on poor-quality roughages.

This paper reviews experiences within and outside the region on the possibilities of using agricultural by-products as animal feedstuffs, methods employed for upgrading their nutritional, storage and handling qualities and how urea blocks can be utilized for enhancing greater and improved use of available resources.

Inventory of Materials

Crop residues, agro-industrial by-products and animal wastes can comprise at least part of the finished diet of ruminant animals (Hadjipanayiotou 1987). However, to make the best use of by-products it is important to know the type, quantity, seasonal availability, alternative uses and cost of by-products; to tabulate their feeding value by studies with local animals and feeding systems, and to assess the location of by-products versus location of livestock (number of animals, expected animal productivity). The quantities of by-products available can be estimated from the main product produced (Table 2).

Agro-industrial By-products

High-moisture agro-industrial by-products (18-20% DM) such as citrus, sugarbeet and tomato pulp are of high nutritional value. Although dehydration of these

Table 1. Sheep populations, milk production and imports in Iraq, Jordan and Syria.

	Iraq		Jordan		Syria	
Item	1986	1990	1986	1990	1986	1990
No. sheep (1000 head)	8981	9600	930	1260	11,669	14,395
Mutton and lamb (1000 head, 16 kg/head)	1278	1600	270	284	4498	4530
Sheep milk (1000 t)	170	175	15	20	420	439
Barley imports (t)		210,000		209,490		106,470
Sheep meat imports (t)		10,000		8882		439

Source: FAO Production and Trade Yearbooks (1986a, 1986b, 1990a, 1990b).

by-products results in a product that is very easy to handle, it adds overhead costs. About 250-280 L of fossil fuel and 200 kwh of electricity are required to produce 1 t of dry material (88-90% DM).

In some countries these by-products are given to animals either fresh or after being sun-dried. In this way, however, only small quantities of the by-product can be utilized under the production system prevailing in the region. High-moisture by-products offered fresh are wasted to some extent and the most soluble nutrients run away with effluent. On the other hand, high-moisture agro-industrial by-products exposed to sun for drying can ferment and sour quickly, and may become a fly-breeding nuisance. Furthermore, the material may get moldy, which has adverse effects.

Transportation of these by-products is uneconomical so they must be utilized close to the production site. The presence of animals in the area and the development of methods for processing and feeding by-products that are simple, effective, low-cost, safe and acceptable at the farmer level is of great importance for enhancing their utilization.

Citrus pulp, grape marc, sugarbeet pulp and tomato pulp have been successfully ensiled with low moisture content crop residues (chopped straw, groundnut shells) or screened poultry litter. Such silages replaced conventional feedstuffs (i.e., concentrates); some animal performance data are given in Table 3.

Sugar beet tops and crowns may comprise an important source of feed DM in certain areas. Collectable fresh (15% DM) material yield is estimated at 30 t/ha. The main contaminant of beet tops is silica from soil which can vary from 8 to 25% of the DM. Sugarbeet tops should be ensiled in alternate layers with dry by-products (straw, groundnut shells, poultry litter); the liquid effluent can be collected and used as feed.

Olive Cakes

This by-product is used to a limited extent in animal feeding. Crude olive cake, a mixture of kernels and pulp, is the residue after the extraction of oil by pressure or centrifuging. It has a low nutritive value, and because of its high ether extract content (about 11.5%) cannot be kept. Extraction of oil from olive cake is an essential step because not only is oil a valuable product, it also improves the storage quality and digestibility of the residue. Removal of stones, using a screen, strong air draft or a combination of the two, results in a product of better nutritional value. Olive cake may be a valuable source of roughage, especially in dry years when there is scarcity of cereal straws.

Table 2. Ratio of residue (by-product) to main product.

Residue	Ratio
Wheat, barley, rice, oat straw	1 : 1
Maize, millet, sorghum stovers	2 : 1
Groundnut hulls	0.32 : 0.68
Olive cake (OC)	1 : 2.7
Solvent-extracted OC (SEOC)	1 : 3.5
Screened, solvent-extracted OC (SSEOC)	1 : 8.0
Olive pulp	1 : 7.2
Grape marc	0.06 : 0.94
Citrus pulp	0.45-0.6 : 0.55-0.40
Tomato pulp	0.07 : 0.93
Sugarbeet pulp	0.25-0.33 : 0.75-0.67
Caged layer excreta (kg DM $head^{-1}$ day^{-1})	0.026
Broiler litter (kg DM $head^{-1}$ day^{-1})	0.020†

† Including litter.

Table 3. Effect of sugarbeet pulp/poultry litter silage (4:1) fed to lactating Awassi ewes (from Allen 1991).

	Control	Silage
No. of animals	23	23
Days on test	49	49
Initial weight (kg)	61.1	59.3
Final weight (kg)	65.4	63.2
Weight gain (g/day)	88	80
Milk yield (g/day)	543	508
Feed intake (g $head^{-1}$ day^{-1})	1228	956
Concentrate	464	395
Lentils	240	203
Leguminous straw		1043
Silage (33% DM)		

The use of olive cake can be enhanced by introducing the cake in urea blocks; the inclusion level can be from 10 to 50%. Such blocks have been made in Cyprus, Tunisia and Syria. Another alternative use of olive cake is to ensile it with poultry litter and with a small quantity of an ingredient rich in soluble carbohydrates, such as ground corn grain.

Animal Wastes

Traditionally, animal waste is applied to farm land as fertilizer. It has been shown, however, that the economic value of animal excreta, including bedding and associated material, is 3 to 10 times greater than its value as a plant nutrient (Smith and Wheeler 1979). In both nutritional and economic terms, poultry litter has the highest value and cattle waste the lowest.

A serious obstacle to the feeding of animal excreta to livestock is pathogenic organisms present in the litter. Thus, animal excreta should be processed before feeding to animals. Caswell *et al.* (1975) have shown that poultry waste can be rendered free of pathogens by autoclaving, fumigation and dry heat alone or in combination with paraformaldehyde. In addition, other methods of processing, such as ensiling (Caswell *et al.* 1977) and deep stacking (Strickler 1977) have been effective in eliminating or killing pathogens.

Dried poultry litter has been used successfully in diets of Friesian heifers, fattening bull calves and kids, and lactating Chios ewes and Damascus goats (Hadjipanayiotou 1984). Replacement of cottonseed cake and part of barley grain with poultry litter in a concentrate mixture fed to lactating Damascus goats in Syria did not adversely affect milk yield (558 g/day for control vs. 621 g/day for goats fed poultry litter).

Because of increased cost of fossil fuel, the initial high costs for installing a dehydration plant and the considerable loss of nitrogen (about 30%), the ensiling of litter with high-moisture agro-industrial by-products (citrus pulp, sugarbeet pulp, tomato pulp, grape marc) is strongly recommended.

Crop Residues

Cereal straws and dry mature plants in the grazing areas are the major feed resource for small ruminants from June to September (cereal straws) and October to February. Apart from low digestibility, one of the main factors limiting straw intake is its low nitrogen content. Studies carried out in Cyprus (Hadjipanayiotou *et al.* 1975) showed that Chios yearlings given straw alone suffered severe weight losses (85 g/day). Furthermore, straw intake decreased with time and was accompanied by an increase in weight losses. The practice applied so far, i.e., feeding the poor-quality roughages along with large quantities of concentrates with or without any supplement (cereal stubble grazing period) results in a decreased cellulolytic activity in the rumen leading to a low digestibility. This low digestibility can be considerably improved by treatment with chemicals (NaOH, urea, ammonia gas, NH_4OH). In studies carried out at the Cyprus Agricultural

Research Institute, straw treated with 10% urea solution at the rate of 400 ml/kg had higher voluntary intake, metabolizable energy intake and crude fibre and dry matter digestibility by 47, 77, 40 and 26%, respectively, than untreated straw.

When upgraded urea-treated straw was given to high-yielding dairy and/or growing animals on an overall good-quality diet, response to urea treatment was marginal. Conversely, when treated straw was given to animals on a poor feeding regime, response to treatment was highly significant.

Supplementation feeding is another method for improving straw intake and utilization. Supplementation feeding of straw with soybean meal (150 g head^{-1} day^{-1}) or molasses-urea mixture ad libitum resulted in increased straw intake. Similarly, straw intake by mature Chios ewes was increased by 31, 22 and 19% when straw was supplemented with soybean meal (80 g soybean meal + 170 g barley grain), 240 g barley grain + 10 g urea or 250 g barley grain head^{-1} day^{-1}, respectively.

ICARDA studies showed that addition of barley grain (around 170 g head^{-1} day^{-1}) changed liveweight losses on unsupplemented straw into modest liveweight gains but there were no significant increases in the supply of dietary energy from straw. Provision of cottonseed cake (around 130 g head^{-1} day^{-1}) significantly improved the organic matter intake from straw and resulted in substantial liveweight gains. Egyptian studies showed that the nutritive value of low-quality by-products is improved by the addition of protein or energy-rich supplements, as well as by combining them with good-quality feedstuffs such as alfalfa or berseem.

Urea Blocks

The potential of multinutrient blocks to increase both the level and efficiency of livestock production and its profitability has been substantial, and might be proven a major technology breakthrough for extensive milk and meat production systems.

It is well recognized that a continuous supply of urea in the rumen increases the nutritional value of poor-quality roughages (Campling *et al.* 1962). Urea, consumed over a short period of time, is rapidly converted to ammonia in the rumen and on poor-quality roughage diets is rapidly absorbed and converted to urea and lost in urine. On the other hand, urea incorporated into blocks can be consumed on a regular basis in small but frequent meals; thus, in extensive grazing situations this is a husbandry practice regularly providing grazing animals with fermentable N (Leng 1984). In addition, blocks have been considered as an ideal mode for supplementation because of the convenience in transportation, storage and particularly ease of application by the farmers (Sansoucy 1986).

Composition of urea blocks

Urea blocks were initially made of large quantities of molasses. Although molasses-urea blocks (MUB) gave some very positive results in many parts of the world, their wider use could not be applied in many other countries or areas within countries because molasses is not available. As a result, block manufacturing with or without limited (30 to 5%) quantities of molasses has been applied using a variety of agricultural by-products (olive cake, fresh sugarbeet pulp, citrus pulp, tomato pulp, brewers' grain, wheat bran, brewers' yeast) and poultry excreta (Hassoun 1989; Hadjipanayiotou *et al.* 1991; Hadjipanayiotou 1992).

A number of binders such as cement, ground quicklime [CaO], slaked lime [$Ca(OH)_2$], plaster of Paris [$CaSO_4 \cdot 2H_2O$] and bentonite have been used. The level of binder required is highly correlated with the ingredients used and the block storage period prior to despatch. The quantity of binder required was reduced to 4% when even small levels (5%) of molasses were used. Variable levels (2-20%) of urea inclusion have been used by various workers; macrominerals (e.g., NaCl), microminerals, vitamins, pharmaceuticals and other additives may be incorporated into blocks.

Block manufacturing

Blocks can be manufactured by small agro-industries and by families. The latter, however, requires training for farmers since high levels of urea might lead to urea poisoning. The urea-block manufacturing process (mixing of ingredients, moulding, unmoulding, curing/drying) has been described by Hadjipanayiotou *et al.* (1991) and Allen (1991).

Manpower, buildings and other equipment requirements for a plant that outputs 1000 t/year have been estimated by Allen (1991) based on Sudanese and Syrian experience.

Animal response to blocks

Studies carried out in Syria (Allen 1991) showed that sheep grazing cereal stubble during the dry period (July to October) and not given any supplement performed significantly better when given urea blocks (Table 4). Similarly, Pakistani studies (Hadjipanayiotou 1984, 1987; Habib *et al.* 1991) demonstrated that block feeding was highly effective in improving the growth rate of yearlings (control - 29 g/ day, block + 113 g/day). This increase incurred a marginal cost of 0.80 PRs/kg body weight gain (1 US$=21 PRs). Early studies (Mirza *et al.* 1988) with lambs grazing dry range showed a similar, although less pronounced, positive response to blocks. This was ascribed to a better feeding regime prior to block feeding in the latter case. In the same study, comparison of conventional concentrates with block feeding showed the economic benefits of using blocks over concentrates on dry range (7.99 vs 10.85 PRs/kg gain or 36% improvement).

Table 4. The effect of urea block feeding on the performance of Awassi sheep grazing cereal stubbles in two areas of Syria.

	Salamieh		Sweida	
Treatment	Control	Block	Control	Block
No. of animals	100	100	71	64
Weight changes (g/day)	−105	−31	31	87
Block intake (g/day)		97		60

These results clearly demonstrate that block feeding is a useful economic strategy in overcoming dry season losses of grazing lambs. This appears to have a large impact on the lifelong performance of the animals. The lambs showing faster growth on a block lick supplement will reach maturity earlier, and with healthy breeding the overall life productivity of the animals should be greatly enhanced.

There was also a positive effect of blocks on milk yield and reproduction. In the studies of Habib *et al.* (1991), block feeding increased the daily milk yield in both cows and buffaloes. However, the effect was greater in cows than in buffaloes (42 vs 22%). The average daily milk yield increased from 3.8 to 5.4 L in cows and from 3.7 to 4.5 L in buffaloes.

Indonesian studies (Hendratno *et al.* 1991) have shown that molasses urea blocks improved milk yield of Friesian cows and Etawa crossbred goats. Similarly, MUB supplementation reduced gestation period, the time between pregnancies and improved kid birthweight, kid weight gain and milk yield of goats.

Conclusions

Experience gained within and outside the region indicates that crop residues, agro-industrial by-products and animal wastes can be used for feeding ruminant animals. Simple, low-cost and safe technologies already tested in Syria can be applied in other countries of the region for processing/upgrading by-products. Where straw is available in large quantities and it comprises a considerable part of the diet, chemical treatment with urea will improve the returns of animal owners. Based on the promising results from feeding multinutrient blocks in increasing both the level and efficiency of livestock production, it is safe to recommend urea-block feeding to ruminants grazing cereal stubble and mature dry plants on the range.

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Discussion

B. Jamal
Do you expect an effect on milk and meat quality by using the by-product in sheep feeding?

M. Hadjipanayiotou
In a long study conducted in Cyprus, no effect was observed. However, we should be careful about some toxic material that might be present in some of the by-products.

Sheep Improvement in the Mashreq Project in Iraq

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Abstract

A total of 2053 records on purebred sheep (Iraqi Awassi, Turkish Awassi and Assaf) and their crossbred lambs were analyzed for body weight at birth, weaning, 6 and 9 months of age. Crossbreeding of Iraqi Awassi with Assaf and Turkish Awassi increased average daily gain by 18.3 and 5.4%, respectively. The influence of year and ewe breed groups on milk yield and lactation period was studied on 1828, 201 and 53 records of Iraqi Awassi ewes, Turkish and Assaf ewes. The results revealed that Turkish and Assaf were superior ($P < 0.01$) to Iraqi Awassi sheep for milk yield by 47.2 and 45.1%, respectively.

Introduction

Sheep in Iraq are triple-purpose animals, providing milk and wool in addition to meat. These products are the most important sources of income to sheep owners. For more efficient production of meat, milk and wool it is important that sheep have good adaptability, fertility, longevity and efficient feed conversion. Sheep production can be increased by increasing the number of animals, which produce at the same level, or by increasing production per animal. Increasing the production is usually more efficient. It could be possible to increase the overall value of the animals by improving both the genetic and non-genetic factors responsible for high production and thereby increase productivity per animal. Genetic improvement will be effective only where nutrition, management and disease control are adequate to permit animals to express their genetic potential. There is a great opportunity to increase productivity of sheep in Iraq through utilization of available native breeds (Aziz 1977; Al-Rawi *et al.* 1982; Hermiz 1988; Al-Nidawi 1991).

This paper concerns what is known about genetic variation in native sheep and how it was used to improve efficiency of sheep production. It is also the purpose of this study to review literature on selection objectives and criteria used in Iraq as well as to discuss results obtained in a breeding program of crossbreeding among Turkish Awassi Assaf, D'man, Hamdani and local Awassi.

Materials and Methods

The breeding program at Al-Radwanieh sheep-breeding center started in March 1990 after the importation of 170 (33 males and 137 females) head of Turkish Awassi and 100 head of Assaf sheep. Local Awassi, Hamdani and D'man breeds were obtained locally. The main objectives of the breeding program are: (1) to improve local Awassi sheep for extensive systems, usually for dryland farming, through within-breed selection and crossing local Awassi with Turkish Awassi, (2) to obtain improved populations of two-way crossbreds for semi-intensive systems, and (3) to obtain a population of four-breed crosses characterized by good genetic potential for growth rate, milk yield and prolificacy, which is suited mainly for semi-intensive systems.

Research efforts and recording schemes at Al-Radwanieh were initiated with the cooperation of the IPA Agricultural Research Center, UNDP, AFESD and ICARDA. The total number of sheep for each breed group are presented in Table 1. The breeding season started in April each year. All matings were sire-identified or pedigreed using hand matings. Table 2 summarizes hand-mating carried out during the breeding season of 1992. Hormonal treatments were used as artificially controlled estrous and super ovulation. Intravaginal sponges were used for estrous synchronization followed by an injection of 500-750 IV PMSG for increasing the ovulation rate.

Animals were ear-tagged and the following records were kept for each one: body weight at birth, weaning, 6 and 9 months of age; mating date; ram used; lambing date; type of birth; sex; milk yield at various stages of lactation, and body dimensions. Milk yield was recorded 2 weeks after parturition. Lambs were separated from their dams at 0700 hours during the 1991 and 1992 seasons. Milking started at 1400 hours and milk weight was recorded for each ewe. The biweekly single test was multiplied by 2 as an estimate of daily milk yield. Lactational milk yield was calculated by multiplying the daily milk yield of the test by its corresponding period (usually 2 weeks) until the ewe dried up. Data were subjected to statistical analysis using a SAS program.

Sheep grazed shrubs, weeds and available green pasture for the whole winter and in the spring. They received 250-500 g of concentrate mixture during the season, late pregnancy and lactation. During summer, the animals grazed the stubble of barley and wheat fields. Mineral block and water were available at all times. The animals were regularly vaccinated and dosed against diseases and internal parasites. Two dippings were carried out yearly to control ectoparasites.

Table 1. Number and breed groups of sheep at Al-Radwanieh breeding station.

		Rams		Ewes		Lambs		
Breed	Group	Adult	Yrlg.†	Adult	Yrlg.	Male	Fem.	Total
Local	Awassi (L)	14	11	1478	122	79	86	1790
Turkish	Awassi (T)	23	30	125	30	66	51	325
Assaf	A	22	5	47	5	21	17	117
Hamdani	H			28				28
D'man	D	6						6
T × L			61		60			756
A × L			36		31			517
D × L								4
T × H						3	2	5
Total		65	143	1678	248	739	675	3548

† Yrlg. = yearling.

Table 2. Summary of reproductive activities during spring 1992.

Breed of rams	Breed group of ewes					Breed group of yearling ewes					Total
	T	A	L	H	D	T × L	A × L	T	A	L	
Turkish (T)	113		321			29		27		26	516
Assaf (A)		45	504	7	7		24		6	11	604
Local (L)			131							21	152
D'man (D)			44	21						2	47
Hamdani (H)					4						4
T × L			75			21				8	104
A × L			81				8			16	105
Total	113	45	1156	28	11	50	32	27	6	84	1552

Results and Discussion

Year and breed group effects were significant ($P < 0.01$) for lactational milk yield and lactation period. Breed group least-squares means for lactational milk yield ranged from 43.2 kg (local Awassi) to 62.7 kg (Assaf) and 63.6 kg (Turkish Awassi) (Table 3). Corresponding figures for lactation period were 143.7, 143.6 and 155.1 days. These results indicated that under similar environmental conditions and management systems, Turkish Awassi and Assaf exceeded local Awassi for lactational milk yield by 47.2 and 45.1%, respectively. Lactational milk yield increased from 41.2 kg in 1991 to 49.3 kg in 1992. Such increments were due to improved feeding and selection applied on ewes after the end of their lactation.

Year, breed group, type of birth and sex significantly affected weaning weight, and total body gain from birth increased from 2.95 kg in 1991 to 3.2 kg in 1992 (Table 4). Corresponding figures for weaning weights, total gain and average daily gain were 14.2-16.9 kg, 11.5-13.7 kg and 77-134 g/day, respectively. These results were lower than those reported by Eliya (1969) and Yalcin (1986). Eliya (1969) indicated that average milk yield of Iraqi Awassi ranged from 42 to 75 kg. Milk production of a large Awassi flock kept at Ceylanpinar State farm in Turkey was 90-155 kg (Yalcin 1986). Pekel *et al.* (1993) stated that mean lactation yield obtained on the randomly selected ewes on Ceylanpinar State farm until 1985 varied roughly between 140 and 223 kg, depending on the level of feeding.

At Al-Rashidia Sheep Station an experimental flock of 400 is part of a long experiment on developing a strain of Awassi sheep with high milk production. Milk yield of Awassi ewes was recorded in 1984 with one test yield every week. Some individuals attained a record of 100 kg per lactation. Hamdani sheep are the largest of all Iraqi breeds at all ages followed by the Awassi (Table 5). Awassi ewes are the best milk producers followed by Hamdani ewes (Bhat 1985). Selection experiments using body weight as a selection criterion were done at the Abu-Ghraib Experimental Station for the Awassi breed and at Aski Kalak Station for the Hamdani breed during the early 1970s. The results were successful in increasing body weight in both Awassi and Hamdani breeds. There was an increase of about 6 kg of body weight in one generation (Bhat 1985). Unfortunately, no sustained efforts in this direction have been made, and most attempts have not yielded the desired results.

At Al-Sho'la Station a project on selection for body weight and growth rate is applied on 200 ewes and another selection program is being applied on 150 other ewes for twinning rate with a single control line of 150 ewes for both experiments. Selection intensity was 70% on the female line and 5% on the male line. Sires were selected on the basis of their own growth performance and dams on their mothering ability.

Table 3. **Mean comparisons for some milk production in sheep.**

Source of variation	N	Total milk yield	Lactation (d)
Year			
1991	938	41.282	120.412
1992	1144	49.344	164.858
Ewe breed group			
Turkish	201	63.623	155.124
Local	1828	43.248	143.737
Assaf	53	62.765	143.604
Interaction			
1991 × A. Turkish	116	58.978	135.491
1991 × A. Local	803	38.222	118.712
1991 × Assaf	19	62.558	100.158
1992 × A. Turkish	85	69.962	181.918
1992 × A. Local	1025	47.185	163.342
1992 × Assaf	34	62.881	167.882

Table 4. Least-squares means of body weights and total gain.

Source of variation	No. animals	Birthwt. (kg)	Weaning wt. (kg)	Gain (kg)	ADG (g)	%
Year						
1991	795	3.0	14.3	11.6	77	
1992	1258	3.2	17.0	13.7	134	
Breed of lambs						
Turkish (T)	195	3.1	15.9	12.8	108	16.1
Assaf (A)	44	3.1	17.0	13.9	117	25.8
Local (L)	574	3.1	15.2	12.2	93	25.8
T × L	735	3.1	15.6	12.6	98	5.4
A × L	505	3.2	15.1	11.9	110	18.3
Type of birth						
Single	1438	4.2	18.2	14.0	137	26
Twin	536	3.3	16.1	12.8	115	26
Triplet	73	2.8	15.0	12.2	107	26
Tetra	6	2.0	13.7	11.7	26	26
Sex						
Male	1055	3.2	16.2	13.0	114	97
Female	998	3.0	15.3	12.3	97	97

Table 5. Comparison of production traits in Iraqi breeds of sheep.

Trait	Awassi		Arabi		Karradi		Hamdani	
	Male	Female	Male	Female	Male	Female	Male	Female
Weight (kg)								
Birth	4.5	4.3	3.5	3.0	4.0	3.5	5.0	4.5
Weaning	28.0	25.0	20.0	18.0	24.0	22.0	30.0	27.0
Yearling	50.0	45.0	38.0	30.0	40.0	34.0	55.0	50.0
Mature	65.0	55.0	50.0	40.0	50.0	42.0	80.0	65.0
Fleece	2.5	2.0	2.0	1.5	3.0	2.3	4.0	2.5
Milk production (kg)	106		40		60		80	
Lactation period (d)	142		140		130		145	
% ewes lambing	75		55		80		89	
Lambing %	120		104		104		124	

Unfortunately, no published data are available for the genetic gain attained. Selection involves development of a high twinning line; a female born as a twin and/or who gave at least one lambing with twins was selected from the foundation population; a male selected for the flock must be born as a twin, and his mother should have given at least two lambings with twins. Although data were collected but not analyzed, preliminary results showed that twinning rate was expected to be around 130%.

Conclusions

The rate of genetic improvements attained varies with the trait to be improved in the various flocks. Body weight and growth rate are relatively easy to measure and have medium to high heritability. Multiple birth has low heritability. So, if within-breed methods of improvement are to be used, intensive selection must be undertaken to build up a flock of ewes of high prolificacy or to use a highly prolific breed such as D'man to introduce gene(s) responsible for twinning rate. Milk production traits have medium heritability and need accurate evaluation of rams (progeny testing) as well as ewes for entry into selected flocks. Crossing among local breeds with high milk-producing breeds could enhance genetic improvement of the local breed. Therefore, at Al-Radwanieh breeding station, crossbreeding and selection are the main technique for local sheep improvement. Such a breeding plan could exploit additive and non-additive gene effects of milk yield, growth rate and prolificacy.

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Breeding Systems and Selection Strategies for Sheep and Goat Improvement in Cyprus

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Abstract

The aim of any breeding program is to genetically improve one or more traits of economic importance in a population. The choice of a breeding and selection system depends on the degree of inheritance of the trait(s), the selection pressure (selection differential) and the generation interval. The necessary prerequisites to ensure genetic progress are the implementation of a performance recording scheme and sound evaluation procedures and the organization of a program for the dissemination (diffusion) of improved genetic material in the population. Animal breeding in Cyprus aims at genetically improving milk and meat production through selection and/or crossbreeding, the production of improved types suitable for the environmental conditions they are called to perform in and the evaluation of the important environmental effects affecting animal productivity. The performance of purebreds and crossbreds under a semi-intensive production system, the procedures followed for the evaluation of superior individuals and the selection systems are discussed. Future work on breed evaluation and selection procedures and the formation of a synthetic breed involving two sheep breeds are also presented.

Introduction

The diversity of objectives, the different management systems and breeds, the level of farmer's organization and the degree of involvement of government institutions in the development, implementation and maintenance of recording schemes, are some of the reasons for the variety of programs for genetic improvement of sheep and goats.

The aim of any breeding program is to genetically improve one or more traits of economic importance. The choice of the appropriate breeding program depends on the degree of inheritance, the selection pressure and the generation interval. Hence the first step in developing an improvement program is to define the breeding goals and devise techniques appropriate for their measurement. The necessary tools for developing any improvement program are:

1. Performance recording
2. Genetic evaluation procedures
3. Organization of a system for the diffusion of genetic material.

In general, we recognize three major production objectives: milk, meat and wool in the case of sheep, or hair in the case of goats. The main targets of genetic improvement in Cyprus have been milk and meat.

Selection Objectives and Criteria

Selection is the deliberate differential reproduction of some individuals from others. It is either natural or artificial. In the world of animal production and improvement we are only concerned with artificial selection.

The main selection objectives in milk breeds are yield and quality of milk. Milk yield can be defined (in our breeding goals) as total production, part-lactation production following weaning, or peak yield. It is important that we define the selection trait, because we shall have to measure it with accuracy and precision.

Defining the selection criteria in meat breeds may be cumbersome. Should we measure liveweight, growth rate or carcass weight? How about measuring carcass composition? How important is mothering ability, litter size, quantity of milk suckled, fertility of ewe (goat), etc.? Should we combine some of these traits into a total score (index) or should we select each trait independently? Do we have the means (tools) to measure these traits and sound evaluation procedures to objectively evaluate individual animals?

There are many selection criteria to choose from if we want to improve milk, meat or both. However, some traits may be antagonistic to each other. Therefore, reliable estimates of the genetic parameters (heritabilities, genetic variances and covariances) and the generation interval are essential.

Our choice should always be to identify selection criteria that are easy to measure and that describe the selection objective directly. In some cases it may be costly to do that. We then can resort to indirect selection criteria that are highly associated genetically with the primary selection criterion.

Selection for Superior Breeding Stock

Selection for superior breeding stock is the process by which individuals are chosen, on the basis of their phenotypic merit, to be used as parents of the next generation. A number of systems of selection are available, such as:
1. Mass selection
2. Pedigree selection
3. Progeny test
4. Selection based on collaterals
5. Selection for specific or general combining ability.

The methods of selection available to the animal breeder are, regardless of the selection system employed:
1. Linebreeding
2. Inbreeding
3. Outcrossing
4. Grading up
5. Crossbreeding
6. Formation of new breed.

Selection Tools

Performance Recording

The first and most important selection tool is performance records. The magnitude and intensity of recording depends largely on the degree of organization and technical support of government or private institutions. It is often costly. We generally recognize two types of recording schemes: on-station and on-farm performance recording systems. The minimum requirements for either system are:

1. Individual identification of all animals
2. Mating and lambing dates
3. Type of birth and/or litter size
4. Monthly controls of milk yield (morning and evening)
5. Fat content of milk
6. Liveweight records of lambs at regular intervals (birth, before and after weaning)
7. Liveweight records of ewes at mating and at lambing.

This basic recording structure can be adapted to the specific situation of different areas.

Estimation of Breeding Values

Genetic evaluation procedures should combine, in an optimum way, the performance of the individual and of its relatives (sire, dam, collaterals). Non-genetic effects such as season of freshening, age (or lactation number) at parturition and lactation length also should be considered.

If the trait under selection pressure can be measured on the individual (liveweight), mass selection is the best selection procedure. When milk yield is under selection, the use of relatives (dam, sibs or progeny) becomes an integral part of the procedure, since it can only be measured in one sex. When we aim for the simultaneous improvement of more than one traits, we must employ one of the following tools:

1. Independent culling levels
2. Tandem selection
3. Selection based on total score (index).

A recently developed evaluation procedure combines information on the individual with that of its relatives using Best Linear Unbiased Predictors (BLUP) under an "Animal Model."

The selection index method has been used for over a decade in Cyprus. The basic requirements for its development are:

1. Estimates of genetic parameters (Tables 1 to 4)
2. Adjustment factors (additive or multiplicative) for growth traits (Tables 5 and 6)
3. Adjustment factors (additive or multiplicative) for milk production (Tables 7 and 8).

Breeding Programs

The decision as to which program should be employed for the genetic improvement of any population depends on a number of factors. The general idea is to utilize available resources and employ a breeding program at minimum cost. A necessary prerequisite for the choice of the best suitable breeding program is the knowledge of the kind of gene action (additive or nonadditive) with the greater influence on the traits we wish to improve.

Table 1. Estimates of heritability, genetic and phenotypic variances and economic weights used in computing selection indexes of Chios sheep.

Character	Parameter			Economic weights
	Heritability	Genetic	Phenotypic	
Liveweight (kg)				
Weaning	0.46	2.95	6.41	1.00
105 day	0.68	9.38	13.75	1.00
Milk yield (kg)				
90 day	0.31	1436.90	4635.15	0.15
Total	0.34	1700.06	5024.35	0.15

Table 2. Estimates of genetic and phenotypic covariances and correlations among traits used in computing selection indexes of Chios sheep.

Character	90-day milk yield		Total milk yield	
	Genetic	Phenotypic	Genetic	Phenotypic
Covariances				
Weaning weight	-0.56	-7.49	-0.34	-11.58
105-day weight	2.80	-2.71	3.37	- 8.22
Correlations				
Weaning weight	-0.07	-0.06	-0.02	- 0.06
105-day weight	0.19	-0.02	0.11	- 0.03

Table 3. Estimates of heritability, genetic and phenotypic variance and economic weights used in computing selection indexes of Damascus goats.

Character	Parameter			Economic weights
	Heritability	Genetic	Phenotypic	
Liveweight (kg)				
Weaning	0.77	5.90	7.63	1.0
140-day	0.78	12.66	16.23	1.0
Milk yield (kg)				
90-day	0.45	1596.42	3514.54	0.10
Total	0.28	3271.43	11898.08	0.10

Table 4. Estimates of genetic and phenotypic covariances and correlations among traits used in computing selection indexes of Damascus goats.

Character	90-day milk yield		Total milk yield	
	Genetic	Phenotypic	Genetic	Phenotypic
Covariances				
Weaning weight	1.31	-9.37	2.99	-14.92
140-day weight	15.94	8.98	36.98	14.31
Correlations				
Weaning weight	1.31	-9.37	2.99	-14.92
140-day weight	0.26	0.03	0.43	0.03

Table 5. Effects of crossbreeding and estimates of heterosis in Chios × Awassi lambs.

Breed or cross	Trait†				
	BWT	WWT	WT15	ADG1	ADG2
Chios (Ch)	4.0	13.5	27.5	0.215	0.230
Awassi (A)	4.9	16.8	30.7	0.257	0.238
Ch × A	5.1	17.1	30.1	0.260	0.220
A × Ch	4.2	16.2	31.9	0.250	0.274
Heterosis (%)	4.5	10.9	6.5	8.1	5.6

† BWT = birthweight, WWT = weaning weight; WT15 = weight at 15 weeks; ADG1 = average daily gain from birth to weaning; ADG2 = average daily gain from weaning to 15 weeks.

Upgrading of native populations using an 'improver' breed, systematic crossbreeding schemes aiming at the utilization of general and specific combining ability and breed substitution are some of the available methods that can be used to improve the productivity of the local breeds of sheep and goats. Several methods are available for the selection of superior breeding stock, such as mass selection, pedigree selection, progeny test and selection based on collateral relatives.

Table 6. Reproductive traits of Chios × Awassi ewes.

Breed or cross	Trait†				
	LSB	LSBL	LWTB	LSWN	LWTWN
Chios (Ch)	1.73	1.61	6.6	1.50	20.3
Awassi (A)	1.12	1.10	5.4	1.07	17.0
Ch × A	1.42	1.39	6.7	1.34	21.2
A × Ch	1.25	1.24	6.1	1.20	19.6
Heterosis (%)	neg.	neg.	6.67	neg.	9.38

† LSB = total lambs born/ewe lambing; LSBL = lambs born live/ewe lambing; LWTB = litter weight at birth; LSWN = lambs weaned; LWTWN = litter weight at weaning.

Table 7. Milk production of Chios × Awassi ewes.

Breed or cross	Trait†					
	MLK90	DAYS	TOTMLK	FAT1	FATKG	FCM
Chios (Ch)	130	161	174	6.4	11.1	179
Awassi (A)	113	173	173	7.3	12.7	194
Ch × A	131	133	167	6.5	11.0	175
A × Ch	119	118	150	6.5	9.8	157
Heterosis (%)	2.88	neg.	neg.	neg.	neg.	neg.

† MLK90 = 90-day milk yield (after weaning); DAYS = days in milk; TOTMLK = total milk yield; FAT = fat percent; FATKG = fat yield; FCM = milk yield corrected at 6% fat content.

Table 8. Lamb traits of Chios × East Friesian crosses.

Breed or cross	Trait†				
	BWT	WWT	WT15	ADG1	ADG2
Chios (Ch)	4.0	13.5	27.5	0.215	0.230
EF × Ch (F1)	4.7	16.7	31.0	0.247	0.250
EF × Ch (F2)	4.2	14.8	31.3	0.246	0.266
(EF × Ch) × Ch	4.4	14.2	30.8	0.231	0.267
Ch × (EF × Ch)	4.4	14.6	31.5	0.240	0.269

† BWT = birthweight, WWT = weaning weight; WT15 = weight at 15 weeks; ADG1 = average daily gain from birth to weaning; ADG2 = average daily gain from weaning to 15 weeks.

Whatever the proposed program, it should be kept in mind that an efficient improvement program must generate genetic progress and ensure the diffusion of improved genetic material to the entire population (recorded and nonrecorded flocks).

Animal Improvement in Cyprus

The first serious attempts to improve livestock production were initiated with the importation of 'improvers' (Chios, Awassi and East Friesian sheep and Saanen and Damascus goats). Animal breeding work aimed at:

1. Improving, through selection, the traits of economic importance, such as milk, and meat
2. Producing, through crossbreeding, types which would combine the favorable attributes of the parental breeds
3. Estimating the necessary genetic parameters for important economic traits and determining the appropriate methods for their improvement
4. Evaluating environmental effects that affect production and developing appropriate adjustment factors.

Comparisons among breeds and estimation of heterotic effects for several breed crosses were carried out over a number of years for traits of economic importance (Mavrogenis 1982, 1983, 1988a). Reproductive traits were monitored systematically for ewes and lambs to establish breed differences in fertility, sexual maturity, seasonality of breeding and prolificacy. Crossbreds were evaluated under three different production systems (Mavrogenis 1988b). Selection procedures within purebreds, based initially on single trait selection, utilize the index method for the simultaneous improvement of both milk and meat production in Chios sheep and Damascus goats (Mavrogenis 1985; Mavrogenis and Constantinou 1990). Milk production is evaluated on the basis of the dam's 90-day production following weaning and lamb liveweight on the individual at 105 or 140 days of age for lambs and kids, respectively (Mavrogenis and Constantinou 1991a, 1991b). These early criteria for liveweight were decided upon following studies showing that, unlike weaning weight, they were free of maternal effects and were genetically independent of mature weight (Mavrogenis 1985; Mavrogenis and Constantinou 1990).

The selection scheme for both sheep and goats is organized in three levels (tiers). Closed-nucleus units are maintained for Chios sheep and Damascus goats (700 sheep and 800 goats) at three government stations. About 4000-5000 sheep and goats in private flocks are also under recording with some assistance from the government (extension). About 7% of males and 33% of females are selected as breeding replacements every year in the nucleus flocks. No migration into these closed flocks is allowed. About 10% of the males from the nucleus flocks are distributed to the multiplication units (private recorded flocks) and some 200 males to the commercial herds each year. There is free exchange of genetic material between recorded and nonrecorded flocks. AI is practised on a limited scale. To enable the identification of both parents, hand-mating is practised in the nucleus flocks. No assortative mating is followed but random mating is. The necessary precautions are maintained against relational interbreeding (matings among related individuals are avoided) (Ricordeau *et al.* 1992).

Crossbreeding Studies

Crossbreeding studies were at some point restricted to the most promising breed groups, i.e., between Chios × Awassi and Chios × E. Friesian. The crossbreeding programs with Awassi aimed at improving the ability of Chios and its advanced crosses with the Cyprus fat-tailed sheep to withstand adverse management and environmental conditions. The program involving the E. Friesian breed aimed at further improving the milking capacity and udder conformation traits as well as the growth potential of the Chios breed and its crosses.

Estimates of heterosis showed that in some cases crossbreeding was not the best method of improvement and that much more work was needed to understand the mode of inheritance and the effects of crossbreeding (Tables 5 to 10). For example, estimated heterosis in Chios × Awassi reciprocal crosses was 4.5% for birth weight and 10.9% for weaning weight, whereas estimates for litter size were negative and for litter weight were positive. The studies involving the E. Friesian indicated that maternal effects could be important and further studies aiming at breed formation were initiated.

Selection Studies

The estimation of heritabilities for and genetic associations among important economic traits indicated that genetic progress by selection would be effective. Evaluation procedures were improved using correction factors for the most important environmental effects and by the incorporation of grand-dam proofs in evaluating milk production. Based on those estimates, selection on the basis of the index should be effective and genetic change for milk was estimated at about 6.7 kg/year and 1.8 kg/year for liveweight.

Table 9. Reproductive traits of Chios × East Friesian ewes.

Breed or cross	Trait†				
	LSBMLK	LSBLDAYS	LWTB	LSWN	LWTWN
Chios (Ch)	1.73	1.61	6.6	1.50	20.3
EF × Ch (F_1)	1.91	1.83	8.5	1.70	25.6
EF × Ch (F_2)	1.69	1.60	7.2	1.48	21.6
(EF × Ch) × Ch	1.83	1.80	7.9	1.63	24.3
Ch × (EF × Ch)	1.58	1.54	6.9	1.49	23.4

† LSB = total lambs born/ewe lambing; LSBL = lambs born live/ewe lambing; LWTB = litter weight at birth; LSWN = lambs weaned; LWTWN = litter weight at weaning.

Table 10. Milk production of Chios × East Friesian ewes.

Breed or cross	Trait†					
	MLK90	DAYS	TOTMLK	FAT	FATKG	FCM
Chios (Ch)	130	161	174	6.4	11.1	179
EF × Ch (F_1)	155	161	215	5.9	12.6	212
EF × Ch (F_2)	126	143	164	6.1	10.0	165
(EF × Ch) × Ch	131	144	169	6.1	10.2	170
Ch × (EF × Ch)	123	140	165	6.1	9.9	166

† MLK90 = 90-day milk yield (after weaning); DAYS = days in milk; TOTMLK = total milk yield; FAT = fat percent; FATKG = fat yield; FCM = milk yield corrected at 6% fat content.

Present and Future Work

Four projects are currently being implemented, all aiming at the genetic improvement of sheep and goats. A selection study involving the Chios sheep was initiated 3 years ago to measure response to selection for total score (index) and a crossbreeding study involving E. Friesian and Chios. A similar selection study is being implemented for Damascus goats, while a local goat breed is being evaluated under two different production systems.

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Discussion

A. Al-Rawi
Do you think if you don't have heterosis in crossbreds you should not give the male to farmers?

A. Mavrogenis
I don't recommend giving crossbred rams to farmers; I would give him purebreds.

M. Duwayri
1. Were you expecting heterosis in the commercial traits, i.e., milk, meat, etc.?
2. What type of mating did you use? Is artificial insemination (AI) or embryo transfer technology used to enhance production of F_1 hybrid?

A. Mavrogenis
1. No, I was not expecting heterosis in milk or in growth rate.
2. We use hand mating, natural service, not AI. AI is not used in Cyprus because of nonacceptance by the farmers. The fertility rate following the use of hormones and AI is as low as 50% compared with a natural mating fertility rate of 85%

(after two cycles of mating). Embryo transfer is not used extensively, only experimentally at research stations.

S. Hamadeh
What are the reasons for no heterosis in fitness traits in Awassi × Chios crossbred sheep?

A. Mavrogenis
One possible explanation might be that litter size in sheep is moderately heritable ($h^2=0.25$) and influenced by additive gene action.

Factors Affecting Reproductive and Lactation Performances of Awassi Sheep

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Abstract

Awassi sheep are considered the most important sheep breed of the Middle Eastern countries. The breed is recognized as one of the highest milking sheep in the world, but its reproductive performance is fairly low. Milk and lamb sales constitute over 80% of the income from sheep, so improvements in milking ability and number of lambs weaned will increase the social and economic welfare of producers. Recent research shows that producers are not milking more than 60-70 kg and weaning not more than 0.7 lambs per ewe per year. It has been clearly shown by various researchers that milk yields can be increased to 100-120 kg and the number of lambs weaned to 1.0 or more, if production methods are changed and inputs are increased. Reproductive efficiency and milk production are closely related to genetic and environmental factors. Genetic improvement can take a long time, but improvement of environmental factors generally results in good responses in shorter periods of time. This paper discusses the factors associated with increasing milk yield and the number of lambs weaned per ewe served.

Introduction

Sheep production is the most important livestock production activity in most of the arid and semi-arid areas of the Middle East, Near East, Far East and Africa. It provides food, fiber, income, social security, even prestige to some. Although its products are strategic commodities for the people and the governments, it has been ignored by governments and therefore production has remained unchanged, as primitive as the old nomadic sheep husbandry of our ancestors.

In the Arabian peninsula and the southeastern part of Turkey, Awassi is the dominant breed. Syria, Iraq, Jordan and Turkey have approximately 30 million Awassi sheep. According to the surveys conducted in all these countries producers get 60-70 kg milk and wean 0.7 lambs per ewe annually. These are very low levels of production.

Results of research on this breed indicate that there are many factors affecting reproductive performance of Awassi such as age (Finci 1957; Goot 1966; Fox *et al.* 1971; Wallach and Eyal 1974; Kassem *et al.* 1989; Gürsoy 1992) and level of nutrition (Younis *et al.* 1978; Gürsoy and Özcan 1983; Özcan *et al.* 1992), Similarly the results of numerous research studies indicate that lactation performances are affected by level of nutrition (Bulgurlu 1960; Bulgurlu and Sevgican 1964; Gürsoy and Özcan 1983), age or lactation sequence (Eliçin 1970; Karam *et al.* 1971; Wallach and Eyal 1974), lamb rearing systems, time of lambing, methods and number of milkings, size of litter and health in general.

It is possible to achieve substantial improvements in production at the farmers' level. The small increments of improvement may add up to significant increases in their income levels.

This paper deals with the macro-environmental factors that significantly affect reproductive efficiency and the lactation yield of Awassi sheep, and the means by which production can be improved.

Factors Affecting Reproductive Efficiency

Like all quantitative traits, reproduction is affected by both genetic and environmental (nongenetic) factors. It is known that intra-breed variation is mostly due to environmental factors, but manipulating the nongenetic factors is easier and results are obtained in a shorter time.

Genetic Make-up

Reproductive performances of some sheep breeds in terms of lambs born per lambing ewe are given in Table 1. Inter-breed differences are significant; Finnish Landrace, Chios, Romanov, East Friesian, D'man, Javanese, Horro and Hu-Yang breeds are some of the well-known prolific breeds (Sönmez and Kaymakçi 1987; Owen 1988).

The Awassi sheep is generally considered to be a nonprolific breed similar to Akkaraman, Morkaraman, Daglıç, Karayaka and Kivircik breeds. One of the valid theories about the low prolificacy of Awassi argues that Awassi has been selected for high milk yield and size while reproductive efficiency has been neglected. Favoring rams of larger size created bias against twin-born, slow-growing lambs (Epstein 1985). Another view emphasizes the preferences of the producers for single-born thrifty lambs because of the insufficient level of nutrients provided by meager conditions that caused high lamb mortality in multiple births (Özcan 1990).

Table 1. Reproductive performances of some sheep breeds (Sönmez and Kaymakçi 1987).

Breed	Lambs born/100 lambing ewes	Breed	Lambs born/100 lambing ewes
Anatolian Merino	118	Javanese	160
Awassi	115-117	Karacabey Merino	137
Border Leicester	113-181	Karakul	100-125
Cheviot	114-178	Kivircik	108-117
Chios	161-227	Konya Merino	144
Clun Forest	155	Langhe	139
Columbia	120-156	Leicester	120-167
Corriedale	106-125	Lincoln	129-157
Cotswold	144-150	Merino	103-161
D'man	198-267	Oxford Down	135-172
Dorset Horn	127-158	Rahmani	124
East Friesian	100-102	Rambouillet	110-161
Finnish Landrace	156-227	Romanov	195-231
German Meat	150-230	Romney Marsh	108-142
Merino	115-163	Southdown	116-170
Hampshire	160	Suffolk	100-181
Herro	>200	Teksel	188
Hu-Yang	117	Welsh Mountain	115
Ile de France	119	Zigaja	144-151
Imroz	160		

Research showed that the twinning rate of ewes that have twinned once or twice previously is 42% (Finci 1957). Turner *et al.* (1972), in their study on the response to selection for multiple births in the Australian Merino, found that the twin-born sheep had 31% more lambs/ewe joined than the single-born ewes. This indicates that twinning has some genetic components.

Table 2 gives the heritability (h^2) of twinning and lambs born/ewe joined (LBEJ) for some breeds. Heritability of twinning ranges between 0.04 and 0.22. Heritability of LBEJ is somewhat higher than twinning but it also ranges between 0.03 and 0.50 (Sönmez and Kaymakçl 1987).

Table 2. Heritability of twinning and lambs born/ewe joined (LBEJ) in some breeds.

	Breed	Age	h^2
Twinning	British	2-5	0.04-0.22
	Swedish	2-5	0.09
	Rahmani	2-7	0.08
	Ossimi		0.04
LBEJ	Australian Merino	2	0.03-0.20
	American Rambouillet	3	0.35
	Mountenin	2+3	0.19
	British	2-6	0.21
	Romney (New Zealand)	2-4	0-0.07
	Finnish Landrace		0.04
	Konya Merino		0-0.15
			0.03-0.17
			0.03-0.50
			0.20
			0.13

Environmental Factors

Many environmental factors are known to govern reproductive performance of Awassi sheep. Determining the magnitude of their effects is very important because the expected improvements are more pronounced and achieved in shorter periods.

Age of Ewe

It has been clearly shown that the age of the ewe affects twinning to a great extent. Table 3 shows the effect of age on the number of lambs/ewe lambed for different breeds (Sönmez and Kaymakçl 1987). Twinning rate increases up the 4th and 5th lambing and then declines gradually (Tables 4, 5). In Ceylanpinar analyses of the lambing records of 27 flocks showed that yearlings have fewer twins (2.1%) and the number of lambs born/ewe served is significantly lower than the other ages. The rates for barrenness, conception rate, abortion and stillbirth were similar for all ages. According to these results, keeping ewes until 8-9 years of age increases the number of lambs/ewe served compared with keeping a very young flock. Precocity is an important source of increasing returns from sheep but it depends on factors such as breed, weight, nutrition and management of the lambs. The early maturing breeds can have precocious lambing at the age of almost one year and therefore are mated at the age of 7-8 months when they reach 60-70% of their mature size. Awassi lambs have been shown to have successful precocious lambing (Finci 1957). This is a potential cost-minimizing practice because it cuts almost one full year of costs and provides appreciable income from the sales of lamb and milk. In fact, it requires at least semi-intensive to intensive management and the lambs should reach at least 35-40 kg before mating. Otherwise, this practice will adversely affect the lifetime production of the yearling.

Table 3. Relationship between age and lambs born/lambing ewe (adapted from Sönmez and Kaymakçi 1987).

Breed	Age of ewe								
	1	2	3	4	5	6	7	8	>9
Clun Forest		1.36	1.60	1.66	1.85	1.70	1.30		
German Meat Merino		1.18	1.28	1.34	1.40	1.26			
Romanov		2.40	2.37	2.30					
Finn		2.19	2.24	2.12					
Finn	2.0	3.00	3.30	3.40	3.40				
German Merino		1.19	1.26	1.39	1.40	1.41	1.39	1.37	1.41
Black-headed meat type		1.09	1.18	1.20	1.27	1.25	1.26	1.22	1.18
Chios		1.97	2.31	2.32	2.38	2.25	2.25	2.11	1.66
Imroz		1.05	1.08	1.11	1.18	1.41	1.10	1.23	1.50
Anatolian Merino		1.08	1.19	1.40	1.34				
Konya Merino		1.25	1.45	1.57	1.62	1.54	1.50		

Level of Nutrition

In general, a low plane of nutrition adversely affects the reproductive performance of sheep. The effects are primarily seen in the sexual maturity of the lambs, oestrus activity of the mature ewe, the number of ova shed, fertilization and implantation of ova (conception), viability of embryo and fetus as well as the lamb survival after birth (Economides 1986). In reality, farmers do not care about the number of lambs born or twinning rate; all they care about is the number and the weight of lambs they market.

Table 4. Influence of age on twinning (Finci 1957).

Age group (years)	Twinning ewes	
	No.	%
2	45	3.27
3	88	6.40
4	190	13.82
5	208	15.13
6	266	19.35
7	233	16.94
8	215	15.64
9	130	9.45

There have been numerous research studies on the effect of a high plane of nutrition on the reproductive performance of Awassi sheep. Table 6 gives the results of a study carried out on Ceylanpinar State Farm. Flushing increased the number of lambs born/ewe served by 29% and the twinning rate by 21.5% (Gürsoy and Özcan 1983). These increases are not totally attributable to flushing because some improvement was due to the semi-intensive conditions provided. For instance, barrenness figures were found to be 12% for the extensive and 5.3% for the semi-intensive systems. The significant differences among the lamb survival rates originated from the different levels of nutrition provided to the flocks before and after lambing.

An important aspect, however, is the economical analyses of flushing, steaming up and supplemental feeding at post-lambing stages. Any production-increasing practice can only be adopted if the farmer sees and believes that it provides a distinct economic benefit. Hence, all the nutritional betterments require economical analyses because different conditions prevail in different areas and all production increases may not necessarily be feasible.

Weight of Ewe

There is a close relation between the weight of ewe and its reproductive performance. In other words, as the liveweight of the ewes increases, lambs born/lambing ewe (LBLE) increase accordingly. Table 7 gives the relationship between liveweight and lambs born/lambing ewe for some breeds (Sönmez and Kaymakçı 1987). For instance, for every kilogram of liveweight increase in the Chios breed (from 34 to 54 kg), LBLE increases around 6%. High body condition, arising from better nutrition and management, is essential for a higher lamb crop in all breeds of sheep.

Table 5. Reproductive data on Awassi sheep at Ceylanpinar State Farm (Gürsoy 1992).

	Age of ewe (years)												
	2		3		4		5		6		7		Mean %
Trait	n	%	n	%	n	%	n	%	n	%	n	%	
Ewes mated	2312	-	1770	-	3361	-	2640	-	2771	-	2166	-	-
Ewes conceived	2218	95.9	1707	96.4	3203	95.3	2465	93.4	2580	93.1	2026	93.5	94.6
Infertile ewes	94	4.1	63	3.6	158	4.7	175	6.6	191	6.9	140	6.5	5.4
Abortions and stillbirths	55	2.4	55	3.1	116	3.5	56	2.1	49	1.8	34	1.6	2.4
Ewes lambed	2163	93.6	1645	92.9	3087	91.9	2409	91.3	2547	91.9	1992	92	92.3
Single	2114	91.4	1503	84.9	2574	76.6	2018	76.4	2203	79.5	1701	78.5	81.2
Twins	49	2.1	142	8	513	15.2	391	14.8	344	12.4	291	13.4	11.05
Lambs born	2212	95.7	1787	101	3600	109	2800	106.1	2891	104.3	2283	105.4	108.6
Male	1096	49.6	940	52.6	1762	49.5	1364	48.7	1466	50.7	1159	50.8	50.3
Female	1115	50.4	847	47.4	1838	51.1	1436	51.3	1425	49.2	1124	49.2	49.8
Lambs/ewe mated	1	95.7	1	101	1.1	109	1.1	106.7	1	104.3	1.1	105.4	103.7
Lambs/ewe lambed	1	102.3	1.1	108.6	1.2	116.6	1.2	116.2	1.1	113.5	1.2	114.6	112.0.5

† Expressed as percentage of ewes mated.

Table 6. Reproductive performance of Awassi sheep under extensive and semi-intensive conditions (Gürsoy and Özcan 1983).

	Management system			
	Extensive		Semi-intensive	
Traits	n	%†	n	%
Ewes mated	349		356	
Ewes conceived	307	88.0	337	94.7
Infertile ewes	42	12.0	19	5.3
Abortions and	14	4.0	8	2.3
stillbirths	239	83.9	329	92.4
Ewes lambed				
Single	275	93.9	238	72.3
Twins	18	6.1	91	27.7
Lambs born	311	89.1	420	118.0
Lambs/ewe lambed	1.1	106.1	1.2	127.7
Lambs/ewe mated	0.9	89.1	1.2	118.0

† Expressed as percentage of ewes mated.

Table 7. Relation between lambs born/lambing ewe and liveweight in some sheep breeds.

Liveweight class (kg)	No. lambs born/lambing ewe			
	Chios	Imroz	German Merino	Black-headed meat type
< 35	1.61	1.08		
35.1-44	1.82	1.11		
44.1-55	2.37	1.63	1.14	1.05
55.1-62			1.14	1.10
62.1-69			1.26	1.14
69.1-76			1.35	1.23
> 76			1.42	1.16

Other Factors

Among other factors, time of mating (atmospheric temperature and length of daylight), fertility of ram, method of mating, the number of rams joined, age and semen characteristics of ram may be considered as highly important.

It is a common practice to join 1 ram/30-40 ewes for natural mating of Awassi and other breeds in Turkey. This may be considered as joining too many rams, but taking into account the extensive conditions and poor feeding conditions, it may then be justified. A higher number of ewes/ram may extend the mating and definitely the lambing season, resulting in low fertility and poor uniformity of lambs. In the case of AI it is not recommended to harvest more than two ejaculates daily and flushing of rams is highly recommended for higher lambing rates.

Rams must undergo semen evaluation because low semen quality will have a detrimental effect and cause a high rate of infertility.

Ways to Improve Reproductive Performance

The most important and meaningful criterion for reproduction is lambs weaned/ewe joined (LWEJ). This term incorporates fertility, fecundity, lamb survival, maternal effects and management as a whole (Galal 1986). To increase LWEJ the following measures may be taken into consideration:

1. Select rams and ewes that are twin born and keep those ewes with twinning records for a longer time.
2. Select the rams from families of high reproductive performance.
3. Cull the ewes with infertility records.
4. Select heavy and large-framed rams and ewes.
5. Do not tolerate reproductive defects.
6. Select rams with large and even-sized testicles.
7. Ensure that breeding stock possesses all the desirable characteristics of the Awassi breed.
8. Apply flushing 3 weeks before mating and discontinue flushing for the ewes already mated.
9. Provide a higher nutritional level 4 weeks prior to lambing.
10. Confine the ewes to the lambing quarter a few days before lambing.
11. Regularly screen for brucellosis and other diseases that cause abortion.
12. Implement the annual vaccination program very strictly.
13. In case of natural mating, do not allow more than 40 ewes/ram under extensive management conditions.
14. Do not use less than 0.2 ml of fresh semen/insemination.

15. Use progestagens and gonadotropins (e.g., PMSG) for synchronization and super-ovulation if cheaply available.
16. Crossbreed with high-milking, prolific breeds (Chios and East Friesian) if management conditions are favorable.

The above measures may cause significant increases in the reproductive performances of Awassi sheep and it is worth remembering that under the existing management conditions in Turkey, Iraq, Syria and Jordan increases in fecundity will cause a drastic fall in birthweights of lambs, leading to very high mortalities. Hence, measures for increased reproduction should include higher level of nutrition and better management.

Factors Affecting Lactation Performances

Sheep milk is the major source of animal protein in the diets of southeastern and eastern Turkey and the arid and semi-arid areas of the Middle East. It is consumed in great quantities in the form of milk, yoghurt, leban, lebne, cheese and butterfat. These products, which are consumed by the household and presented as gifts, are not taken into consideration as returns of sheep by the producers or researchers. In the extended families of the Middle East these constitute a great sum and should not be neglected or underestimated. Whatever their actual rank among the returns from sheep, they are important products of Awassi sheep.

Many factors affect the milking ability of Awassi. Like all quantitative traits some are genetic and some are environmental.

Genetic Make-up

Awassi sheep is a dairy breed and is known as the second-highest yielding breed after the famous German East Friesian breed. The East Friesian breed is highly unadaptive to the arid and semi-arid conditions where Awassi performs very well. According to recent FAO publications the Awassi can produce as much as 1463 liters (Epstein 1985). Mean lactation yields exceeding 500 kg have been recorded in the improved purebred flocks.

Recent reports from different areas of the Middle East verify the existence of significant differences among the various strains of Awassi sheep (Bahhady *et al.* 1992; El Rawi and Mohammad 1992; Gürsoy *et al.* 1992). A significant part of variation under the same conditions stems from the genetic make-up of the ewes concerned. This fact justifies the great prospects of genetic improvement through selection (Table 8).

Environmental Factors

Among the nongenetic (environmental) factors, the age of ewe, level of nutrition, suckling regime, time of lambing, body condition, twinning, type of feed, method and number of milkings and diseases may be listed as important ones.

Age of Ewe

Tables 9 and 10 summarize the findings of various researchers. It can be seen that milk production increases by age up to the 4th and 5th lactations and then starts to decline gradually (Finci 1957; Eliçin 1970; Wallach and Eyal 1974).

Table 8. Comparisons of lactation traits (X ± Sx) of the top 43 State Farm exceptional ewes in 1989 (combined with 1988 screening).

	Exceptional ewes		
Traits	National	State Farm‡	Control ewes
Lactation length (days)	192.0±4.1a†	205.9±1.7b	187.1±4.4a
Minimum	133	159	95
Maximum	213	224	222
Lactation yield (kg)	230.5±10.9a	209.7±7.0b	222.8±9.3a
Minimum	119.7	253.9	97.5
Maximum	374	469	360
Mean daily milk yield (kg)	1.19±0.04a	1.91±0.04b	1.19±0.03a
Minimum	0.9	1.2	0.7
Maximum	1.8	2.3	2.0
Maximum individual daily milk yield (kg)	2.15±0.1a	2.66±0.1b	2.10±0.1a
Minimum	1.3	2.1	1
Maximum	3.8	4.2	4.3
Number of ewes	37	43	43

† Values within a column followed by the same letter are not significantly different at the 5% level.

‡ 1987 and 1988 screening.

Table 9. Milk yields (kg) of Awassi ewes of different ages in Iraq (Karam *et al.* 1970).

Age of ewe (yrs)	No.	Milk yield (kg) 90 days pre-weaning	Post-weaning	Total lactation	Mean length of lactation (days)
2	7	75.3	3.5	78.8	140
3	9	108.1	10.5	118.6	123
4	6	108.9	21.7	130.6	148
5	9	106.7	17.0	123.7	133

Level of Nutrition

Awassi is a dairy sheep and requires a certain quantity and quality of feed in order to meet its needs and produce accordingly. For instance, ewes weighing 60-70 kg require 0.8 feed units and 70 g digestible protein (DP) for maintenance and 1.6-1.9 kg dry matter (DM). A ewe producing 3 kg milk daily requires 2.5 feed units, 285 g DP and 2.0-2.7 kg DM (Epstein 1985). Generally, ewes lose weight during lactation, which indicates insufficient feeding.

Significant increases in milk yield may be expected by feeding ewes according to their production levels all over the Middle East. In areas where milk is in great demand and can be marketed without any difficulty it may be feasible to supplement ewes with commercial feed. Here the most important criterion may be the milk/feed price ratio. It was 2.5 in southeastern Turkey during the last lactation, owing to high price for white (feta) cheese. In any area where this ratio is above 1.0 it should be feasible to supplement the lactating ewes.

The high milk production values reported by Israel are partly due to the high level of nutrition offered to the ewes during lactation. A ewe can only express herself under the most favorable conditions. This clearly implies that it is not possible to force the genetic limits without offering all the nutrients in required amounts.

Low protein intake for a particular level of energy will reduce milk yield drastically. As milk yield increases, the minimum ratio of crude protein and metabolizable energy increases. Finally, increasing crude protein intake without increasing the metabolizable energy intake will stimulate milk production provided that the ewe has not reached her full capacity (Treacher 1989).

Table 10. Influence of age on lactation length of Awassi sheep (Eliçin 1970).

Age of ewe (yrs)	No. ewes	Lactations	Milk yield		Mean daily yield		Lactation length	
			kg	%	kg	%	days	%
2	55	1	116.04	100.00	0.75	100.00	155.96	100.00
3	40	2	144.69	124.24	0.87	116.22	164.32	105.36
4	49	3	165.06	137.51	0.98	129.92	167.73	107.55
5	66	4	175.01	150.81	1.03	136.56	170.16	109.10
6	24	5	168.02	144.79	0.94	124.34	179.00	114.77
7	33	6	158.65	138.15	0.92	112.60	170.81	109.52

Suckling Regime

The effect of suckling regime on the milk yield of sheep varies. For instance, Atzmon and Doron (1951) experimentally showed that lamb growth was not significantly different among the groups of lambs that suckled (1) all the milk for 8 weeks, (2) all the milk for 4 weeks and half the milk for another 4 weeks, (3) all the milk for 2 weeks and half the milk for another 6 weeks. Restricted suckling of this kind increased the marketable milk significantly. Eyal (1972) reported that weaning at any time after birth did not affect milk production of Awassi ewes.

In another experiment, 66 Awassi sheep were divided into two groups: (1) lambs were weaned after birth and artificially reared and the ewes were milked for 22 weeks, (2) lambs were allowed to suckle their mothers after each milking. No significant differences were found with respect to the marketable milk (Morag *et al.* 1970). Louca (1972) in Cyprus found that suckling for 12 hours and suckling all the milk did not have any significant effect on the milk yields. Zervas *et al.* (1979) in Greece found that weaning at either 3 or 6 weeks did not affect milk production significantly. Economides (1983) reported that weaning lambs at 35 and 70 days did not affect milk yields of the mothers.

Lawlor *et al.* (1974) studied the effect of early weaning on the lactation yields of Awassi, Chios and Cyprus Fat Tail breeds by weaning at birth, 2 and 25 days after birth. Awassi lactation yields were 195, 212 and 252 kg, respectively. Weaning at birth and 2 days after affected lactation yield significantly. Economides (1986) stated that restricted suckling increases marketable milk significantly but weaning at birth, and just a few days after lambing, adversely affects milk production in low-yielding breeds.

Torun (1987), in his study on the effect of early milking on the marketable milk of Awassi sheep, found that partial milking starting a week after lambing increased milk yield significantly compared with normal milking, which starts 2 months after lambing on Ceylanpinar State Farm.

It can be recommended that lambs be allowed to suckle all the milk for 30 days and then to suckle the residual milk for 30-60 minutes within the next 30 days and afterwards be weaned totally. It can be recommended that the high-yielding ewes be partially milked after lambing because they will have surplus milk that may cause udder problems if not emptied.

Time of Lambing

The normal lambing season in Turkey and the other Middle Eastern countries is concentrated in December and January. This is the time traditionally synchronized with the peak of vegetation. Hence lamb growth and milk production reach their maximum in March and April. Starting from the middle of May onwards, vegetation dries and fails to provide adequate nutrition. Observations with the summer-lambing sheep on Ceylanpinar State Farm and at the Çukurova University Farm showed that lamb growth, lactation length and yield declined because of high temperature, lack of lush vegetation and even adequate feed. Early lambing in October and November under extensive conditions affects lactation yield because normally sheep produce over 50% of the lactation yield within the first 8-10 weeks of lactation.

Twinning

Some studies on the Western breeds indicate that twin-lambing ewes have higher milk yields than single-lambing ewes (T. Treacher, ICARDA, pers. comm. 1992). There are no studies on Awassi that indicate this trend and a study is being conducted on a large sample of different ages in the Ceylanpinar population. If it is verified then it should be taken into consideration during selection of the breeding stock.

Method of Milking

It has been clearly shown that machine milking decreases milk production compared with hand milking and various research showed that hand-stripping in machine-milked ewes yielded 5-30% additional milk. Hand-stripping can harvest the alveolar milk, which contains 75% of the total fat (Unuanuna 1986).

According to Sarican and Demirören (1983), only 51-62% of the marketable milk can be milked by machine and it requires hand or machine stripping in order to increase milk harvest. Another 21-31% can be harvested by stripping.

Other Factors

Many other known or unknown factors affect milk production of sheep; some of these are interrelated. It is not the intention of this paper to include all factors involved.

Ways of Improving Milk Yield

Improving milk yield has two components: namely genetic and environmental factors. It takes a long time to achieve genetic improvement in milk production because heritability of this trait is low. Improvement through the improvement of environmental factors, although not permanent, is easier and results are achieved faster.

Genetic improvements include pure breeding and selection (Finci 1957) and crossbreeding with dairy breeds such as East Friesian to obtain the high-yielding Assaf type as named in Israel.

The following measures may be taken into consideration for improving the lactation yields of Awassi sheep:

1. Assess the lactation characteristics of the flocks and select rams from the twin-born lambs of the exceptional ewes. Do not use the same ram for more than 2 years.
2. Reserve the twin-born ewe lambs of exceptional ewes as replacements.
3. Acquire rams of high genetic value from other sources.
4. Use teaser rams 2 weeks prior to mating for oestrus synchronization. This will facilitate uniform milking.
5. Start partial milking with exceptionally high milkers right after lambing.
6. Feed ewes according to their milk production levels.
7. Allow lambs to suckle all the milk for the first 30 days and then shift them to suckling residual milk for 30-60 minutes after each milking for another 30 days; afterwards, wean them totally.
8. Provide silage or other lush roughage towards the end of lactation for extending the lactation period.

Conclusions

Awassi sheep, with their present level of production, have good potential in genetic selection for milk yield and efforts should be increased for attaining this goal. However, even with its present genetic make-up, the Awassi has the capacity to return higher levels of income provided that its nutritional requirements are met and management and health conditions are improved.

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Discussion

A. Al-Rawi
Do you think there is any antagonistic relationship between fitness trait and production traits?

O. Gursoy
No, I don't think that there is an antagonistic relationship between fertility and milk and meat production.

Comparison of the Performance of Turkish and Syrian Strains of Awassi Ewes at Two Levels of Nutrition

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Abstract

Milk yields and lamb growth rates of two strains of Awassi ewes were compared at feeding levels that provided the energy and protein requirements for ewes producing 2 kg (high = H) or 1 kg (low = L) of milk/day. The two strains were: 40 selected ewes imported from Ceylanpinar State Farm in Turkey (T) and 40 unselected ewes from ICARDA's flock at Tel Hadya station (S). In weeks 1-4 of lactation the lambs were suckled continuously. In weeks 5 and 6 the lambs were suckled during the day and the ewes were milked after the lambs had been separated for 12 hours at night. At the end of week 6 the lambs were removed and the ewes milked twice daily by hand. Milk yield was recorded at the morning and evening milkings on 1 day/week. Liveweights of the ewes after lambing were S=49 kg and T=53 kg. There were no differences between the strains in growth of lambs during the suckling period, or from weaning until 14 weeks of age. Milk yields between weeks 7 and 14 were significantly affected by both strain and feeding level with mean daily yields of 1.1, 0.9, 1.4 and 1.1 kg for treatments SH, SL, TH and TL, respectively. The coefficiants of variation for milk yield from weeks 7 to 14 were 38, 41, 26 and 19% for treatments SH, SL, TH and TL, respectively, indicating that the variation in individual yield was higher in the unselected Syrian ewes.

Introduction

There are approximately 1 million Awassi sheep in southern Turkey. Selection for milk yield in Awassi sheep is centered on the Ceylanpinar State Farm, where selection flocks were started with 50 exceptional ewes, obtained by screening 400 commercial flocks in five provinces, and 55 exceptional ewes from the Ceylanpinar Farm itself. In March 1991, ICARDA purchased 40 ewes, aged 2 years, and 2 rams from the Ceylanpinar flock. In 1992 these ewes and 40 ewes selected at random from the 2-year-old ewes in the flock at ICARDA's Tel Hadya station in northern Syria were compared using two levels of nutrition in lactation.

The ewes in the ICARDA flock are typical of well-managed flocks in northern Syria. The flock was started in 1979 with ewes purchased from the Wadi el Azeb Sheep and Range Centre, which had obtained ewes from Bedouin flocks in the northwestern part of the Syrian steppe. No ewes have been brought into ICARDA's flock since 1985, although a small number of rams are purchased occasionally from El Kraim Station, Selamieh.

Design

The ewes of the Turkish (T) and Syrian (S) strains were blocked for weight after lambing and allocated at random to high (H) and low (L) nutritional treatments, which were defined as the metabolizable energy requirements for ewes producing 2 and 1 kg of milk per day. These levels were chosen on the basis of the expected peak yields of the two strains. Gursoy (Univ. of Çukurova, pers. comm.) found peak milk yields of 1.9 and 2.1 kg/day in 1988 and 1989 in 50 control ewes, representative of the main flock of Turkish strain ewes at Ceylanpinar State Farm. The peak yield of the better ewes in the ICARDA flock is 1 kg/day. At the end of week 14 of lactation, the feeding levels were reduced.

Management

The ewes were synchronized for oestrous, using Cronogest sponges, and mated to rams of the same strain. The mean mating date for the first cycle was 9 September 1991. Three ewes were mated at the second cycle. Ewes were managed as one group in pregnancy. Initially, they grazed stubble with supplementation to maintain their weights. From 6 weeks before lambing, they were fed individually according to ARC (1980) requirements, with feeds adjusted to their initial weights. Daily feed for a 50-kg ewe was 700 g (fresh weight) cereal straw, 120 g cottonseed cake (csc) and 405 g barley grain at 6 weeks before lambing, increasing to 595 g in the week before lambing. After lambing, the four treatment groups were managed separately. Individual feeding levels were adjusted on the basis of weight on the day after lambing. From lambing until 10 May, daily feed allowances for 50-59 kg ewes were 510 g (fresh weight) vetch hay, 150 g csc and 1470 g barley grain at level H and, at level L, 770 g cereal straw, 150 g csc and 770 g barley. Each day the ewes were grazed on very poor pasture from 0900 to 1700 hours, but it was considered that grazing made no significant contribution to feed intake. The calculated metabolizable energy (ME) levels were 22.85 and 15.05 MJ at levels H and L respectively.

On 10 May, intakes were reduced to 260 g vetch hay, 70 g csc and 1180 g barley (level H) and 1000 g straw, 110 g csc and 340 g barley (level L). On 7 July, feeding was drastically reduced to assist the ewes to dry off.

After lambing, the management of lambs and of milking was typical of flocks specializing in milk production in Syria. The lambs remained with the ewes continuously for 4 weeks. This was followed by 2 weeks of partial suckling, in which the lambs were removed at 2000 hours and offered creep food in separate pens. The ewes were hand milked at 0800 hours and the lambs were then returned to spend the day with their mothers.

Individual milk yields were recorded weekly, starting in week 5. In weeks 5 and 6, there was only one milking; subsequently, morning and evening yields were recorded each Thursday. Initially, yield was measured volumetrically to the nearest 10 g but, from week 10, a balance accurate to 1 g was used. In addition the total yield of each treatment group was recorded at each milking.

Results

Results were analyzed from 18, 14, 15 and 17 ewes on treatments SH, SL, TH and TL, respectively.

Lamb Growth

There were five pairs of twins from the Turkish and only one from the Syrian ewes, which resulted in significant differences in birth weights between strains (Table 1). Each ewe suckled only one lamb. Although the Turkish lambs had slightly higher growth rates, in the period of full suckling (weeks 1-4), the differences were not significant. When the period of partial suckling in weeks 5 and 6 of lactation was included, growth rates were very similar but showed a significant effect ($P > 0.05$) of feeding level of the ewe. The growth of lambs from weaning at 6 weeks until 14 weeks was not affected by treatment. The overall growth from birth to 14 weeks was higher ($P > 0.05$) in Turkish lambs but the weight at 14 weeks, although higher in Turkish lambs, was not significantly greater than in Syrian lambs.

Feed Intakes of Ewes

There were few refusals of feed after the second week of lactation. Mean intakes of metabolizable energy (MJ/day) from lambing until week 14, when feeding level was changed, and from weeks 15 to 21 were SH 21.2 and 17.0, SL 14.5 and 11.0, TH 21.3 and 17.3 and TL 14.7 and 11.2, respectively.

Table 1. Lamb weights and daily gains at two feeding levels.

	Syrian		Turkish		Significance	
	H	L	H	L	Strain	Level
Birth weight (kg)	4.7	4.8	4.5	4.2	*	ns
Daily gain (g)						
Weeks 1-4	280	280	320	285	ns	ns
Weeks 1-6	280	265	310	270	ns	*
Weeks 7-14	250	255	270	280	ns	ns
Weeks 1-14	260	260	285	275	*	ns
Wt. at 14 wk (kg)	29.9	29.9	31.8	30.3	ns	ns

Weight Changes of Ewes

There was a difference between the strains of 4 kg in the weights of the ewes after lambing (Table 2), but at no stage did strain have a significant effect on weight change. Before the lambs were weaned at 6 weeks after lambing, ewes on the low level of feeding lost significantly more weight than those on the high level (110 vs. 15 g/day). There were no significant differences between treatments in the gains made in weeks 7 to 14. When feed intake was reduced at the end of week 14, weight declined again and the losses were significantly greater at the lower level of feeding.

Table 2. Liveweight and weight changes of ewes.

	Syrian			Turkish		Significance	
	H	L		H	L	Strain	Level
Weight after lambing (kg)	49	49		53	53	***	ns
Change (g/day)							
Weeks 1-6	0	-105	-90	-30	-115	ns	***
Weeks 7-14	200	170	-90	185	155	ns	ns
Weeks 15-21	-15	-90	-90	- 5	-105	ns	***

Milk Yields

Milk yields were not estimated in the full suckling period. During the period of partial suckling in weeks 5 and 6, milk production at the morning milking was significantly lower at the lower level of feeding (Table 3). In the first period of twice daily milking (weeks 7 to 14), there was a significant difference ($P > 0.01$) in yield between the strains, with the Turkish ewes producing 25% more milk than the Syrian. The 16% difference in yield between feeding levels was close to significance ($P > 0.06$). In weeks 15 to 21, when energy intake reduced by 20% at level H and 24% at level L, the difference between the strains declined to 14% and was not significant. Over the whole period from weeks 7 to 21, the Turkish strain produced 22% more milk ($P > 0.01$). There also was a significant effect of feeding level ($P > 0.05$).

Table 3. Mean milk yields (g/day) of Syrian and Turkish ewes.

	Syrian		Turkish		Significance	
Weeks	H	L	H	L	Strain	Level
5 and 6	580	445	660	420	ns	***
7 - 14	1045	935	1370	1140	**	ns
15 - 21	515	400	615	460	ns	**
7 - 21	800	685	1015	825	**	*

There were large variations in milk yield between ewes in each treatment (Table 4). The coefficient of variation for yield from weeks 7 to 14 was higher in the Syrian ewes than in the Turkish, indicating that the variability in yield between individuals was higher in unselected Syrian ewes. Although the ranges of individual yield were large, no individual yield was 3 standard deviations above the treatment mean. The highest yields of individual ewes on treatments SH and TH were, however, more than 2 standard deviations above the mean.

Conclusions

Selected Turkish ewes were 4 kg heavier after lambing than unselected Syrian ewes. Growth rates of lambs did not differ between the strains. Milk yields during the period of hand milking, from 7 to 21 weeks of lactation, were 22% higher in Turkish than in Syrian ewes. There were large variations in individual yields in both strains. Two ewes had mean yields more than 2 standard deviations above their treatment mean.

Table 4. Variation in milk production in weeks 7 to 14.

	Syrian		Turkish	
	H	L	H	L
Number of ewes	18	14	15	17
Mean (g/day)	1045	935	1369	1142
SE	93	102	92	52
CV	38	41	26	19
Individual yields (g/day)				
Highest	2055	1667	2286	1508
Second	1701	1466	1723	1443
Third	1281	1279	1665	1396
Lowest	206	435	625	775

Reference

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Discussion

N. Haddad
I notice that selected Turkish ewes respond better to high feed than the local ewes; why and what benefit might this have?

F. Bahhady
Different grazing and feeding trials conducted at Tel Hadya included ewes of the same age and treated under the same management. These ewes showed big variation between individuals in milk yield. The Turkish strain was selected for milk production, their milk yield was increased and subsequently they responded to feed intake more than the Syrian local. The main benefit, in my view, of selected or improved Awassi is to introduce them to farmers who can produce enough feed to meet their need.

A. Qrunfuleh
Why was a comparison not made between the selected Turkish Awassi and selected Syrian Awassi, especially as we now have improved flocks of Syrian Awassi at Hama Research Center and Al-Kreem Center?

F. Bahhady
The ICARDA flock in Tel Hadya was established in 1979 by purchasing 100 ewes from Wadi Al-Azeb. In 1985 an additional 30 ewes were purchased from Aleppo Governorate. A high variation in milk production between the ewes under different nutrition and management systems was found. Therefore, ICARDA requested the purchase of 40 uniform improved ewes, which were available at Hama Research Center, to compare them with the flock in Tel Hadya. However, the request was turned down and therefore we got the approval of the Ministry of Agriculture and Agricultural Reform to import 40 improved ewes from Turkey, which we used in this trial.

المناقشة

تأثير الفطام المبكر على إنتاج الحليب ونمو المواليد

فيصل توفيق عواوده
مركز إقليمي الرمثا
المركز الوطني للبحوث الزراعية ونقل التكنولوجيا ، عمان ، الاردن

محفوظ أبو زنط

اعداد النعاج والحملان المستخدمة في التجربة قليل وبالتالي من الصعب التوصية للمزارع بتبني هذه الممارسات . كما أن العائد للنعجة الواحدة يبلغ دينار واحد فكيف نقنع المزارع بجدوى هذه الممارسة ؟

فيصل عواوده

- دينار واحد للنعجة لا بأس .
- أجريت التجربة في أربعة مواقع وبالتالي هذه النتائج وما تبعها من تجارب على نفس الموضوع تشير إلى أن هذه النتائج يمكن الاعتماد عليها .

Economides, S. and I. Antoniou. 1989. The effect of suckling regime on the quantity and quality of marketable milk and performance of lambs. Technical Bulletin 107. Agricultural Research Institute, Nicosia.

Hadjipanayiotou, M. and A. Louca. 1976. The effects of partial suckling on the lactation performance of Chios sheep and Damascus goats and the growth rate of lambs and kids. Journal of Agricultural Science, Cambridge 87:15-20.

Kassem, M. 1978. Effect of suckling regime on milk production and weight of lambs in Awassi sheep. M.Sc. Thesis, University of Mosul, Iraq.

Latif, F.A., M.N. Al-Saigh, M.B. Sial and I.T. Kadim. 1982. Effect of plane of nutrition and weaning weight on the performance of male Arabi lambs. Tropical Agriculture (Trinidad) 59(4):327-328.

Lawlor, M.J., A. Louca and A. Mavrogenis. 1974. The effect of three suckling regimes on the lactation performance of Cyprus fat-tailed, Chios and Awassi sheep and the growth rate of lambs. Animal Production 18:293-299.

Louca, A. 1972. The effect of suckling regime on growth rate and lactation performance of the Cyprus Fat-tailed and Chios sheep. Animal Production 15:53-59.

Louca, A., A. Mavrogenis and M.L. Lawlor. 1975. The effect of early weaning on the lactation performance of Damascus goats and the growth rate of the kids. Animal Production 20(2):213-218.

الحليب واللحم ، حيث أن زيادة ١ كغم وزن حي تحتاج إلى ٢ر٤ - ٥ر٧ كغم حليب .

٢- تبين من الدراسة أن النعجة الواحدة تحت هذا النظام أعطت دخل إضافي مقداره ٢٠٠ر١ دينار في المشاهدة الاولى و١٣٠ر٤ دينارا في المشاهدة الثانية و ٢٧٠ر٢ دينارا في المشاهدة الثالثة . مقارنة مع النعجة الشاهد .

٣- من المفضل تحت هذا النظام أن لا يتم البيع عند الفطام خاصة إذا اعتمد الوزن عند البيع، وإنما يفضل تسمين المواليد حيث تزول الفروقات بين أوزانها بل من الممكن أن تزيد أوزان مجموعة المعاملة عن أوزان المشاهدة .

شكر

أتقدم بالشكر للمهندس الزراعي جهاد كرادشه لمساعدته في تنفيذ التجربة في منطقة مأدبا وللمهندس الزراعي رائد الشومان لمساعدته في تنفيذ التجربة في الشمال .

المصادر

التميمي ، كاظم توفيق صخي (١٩٨٣) تأثير أنظمة مختلفة من الفطام ومستويات التغذية اللاحقة على أداء حملان أغنام العرابي وإنتاج أمهاتها من من الحليب .
رسالة ماجستير كلية الزراعة - جامعة البصرة .

الحسناوي ، إنزار دايخ مطلق (١٩٨٦) تأثير عمر الام ونظام الرضاعة ومستويات التغذية اللاحقة على أداء الحملان وأمهاتها في أغنام العرابي .
رسالة ماجستير كلية الزراعة - جامعة البصرة .

وقد يعزى التفاوت في إنتاج الحليب بين مجموعتي المعاملتين في كلتا المشاهدتين إلى اختلاف أسلوب العزل للمواليد . حيث كان العزل يتم في المشاهدة الثانية صباحا والحلب مساءا . بينما كان العزل في المشاهدة الثالثة يتم مساءا والحلب صباحا ، إضافة إلى الاختلافات الاخرى المتعلقة بكل قطيع من حيث الادارة والتغذية . ولم يتم تسجيل إنتاج الحليب بعد الفطام .

في المشاهدة الثانية كانت أوزان الفطام ١٥ر٧ كغم للشاهد و ١٥ر٩٣ كغم للمعاملة ولم تكن الفروقات معنوية ، بينما كانت الزيادة الوزنية المكتسبة للمعاملة أعلى منها للشاهد وبفرق معنوي ، حيث بلغت ٣ر٧٠ كغم للشاهد و٤ر٩٣ كغم للمعاملة . وكان معدل الزيادة اليومية لمجموعة المعاملة أعلى منها في الشاهد ، حيث بلغت ١٢٦ر٤ غم/ اليوم مقارنة ب ٩٤ر٨ .

وكان وزن الفطام في المشاهدة الثالثة ١٦ر٤٠ كغم لمجموعة الشاهد و ١٣ر٦٩ كغم لمجموعة المعاملة وهكذا كانت الفروق معنوية . وكان معدل الزيادة اليومية ١٥٥ر٥غم/ اليوم للشاهد و ١٠٠ر٥غم/ اليوم للمعاملة . وهذا يتفق مع نتائج الدراسات السابقة .

أما أسباب تفوق مجموعة المعاملة في النمو على مجموعة الشاهد في المشاهدة الثانية فيعود إلى أسلوب العزل حيث كانت المواليد تبقى مع أمهاتها ليلا وتعزل صباحا، وإلى تدني إنتاج الحليب في القطيع مما كان للأعلاف المركزة المقدمة لمجموعة المعاملة تأثير أكبر على نمو مواليدها .

التوصيات

١- ينصح باتباع نظام الفطام التدريجي (الرضاعة المحددة) على أن يتم الفطام الكامل على عمر لا يتجاوز شهرين . حيث يؤدي ذلك إلى الحصول على الزيادة في الدخل من الحليب التجاري ويأخذ بعين الاعتبار أن تستخدم العمالة المتوفرة في المزرعة . كذلك يأخذ بعين الاعتبار أسعار

جدول رقم (٣) . تاثير معاملة الفطام على نمو المواليد وإنتاج الحليب وذلك في مشاهدة على أغنام المربي في موقعين في منطقة مادبا في وسط الاردن .

البيـــــان	المزارع الاول المشاهدة الثانية الشاهد	 المعاملة	المزارع الثاني المشاهدة الثالثة الشاهد	 المعاملة
عدد المواليد الداخلة بالدراسة	٢١	٢٢	٢٣	٢٣
متوسط الوزن عند البداية كغم	١٢	١١	١٠ر٢٦	٩ر٦٧
متوسط الوزن عند الفطام (كغم)	١٥ر٧	١٥ر٩٣	١٦ر٤٠	١٣ر٦٩
مقدار الزيادة الكلية المكتسبة (كغم) للرأس	٣ر٧	٤ر٩٣	٦ر٢٢	٤ر٠٢
متوسط العمر عند بداية الدراسة يوم	٢١	٢١	٢١	٢١
متوسط عمر الفطام	٦٠	٦٠	٦١	٦١
كمية الحليب المنتجة للمجموعة(كغم)حتى الفطام	-	١٨٠	-	٤٣٥ر٥
معدل الزيادة اليومية للرأس غم / يوم	٩٤ر٨٧	١٢٦ر٤	١٥٥ر٥	١٠٠ر٥
كمية الاعلاف المقدمة للمواليد/ مجموعة كغم	-	٢٦٠	-	٢٦٠

جدول رقم (٢) . تاثير المعاملة على نمو العبر قبل وبعد الفطام وذلك في مشاهدة الفطام المبكر التي نفذت على أغنام المربي في قرية قاع في شمالي الاردن .

البيان	مجموعة المعاملة	مجموعة الشاهد
عدد العبر	٩	١١
متوسط الوزن عند بداية الدراسة	١ر٨	١٢ر٩ N.S
متوسط الوزن عند عمر الفطام	١٦	٣ر٢٠ (*)
متوسط عمر الفطام	٦٢	٨٣
معدل الزيادة اليومية غم/للرأس/حتى الفطام	١٢٩	٥ر١٣٤
متوسط الوزن على عمر ١٢٩ يوماً كغم	٠٥ر٢٦	٤٥ر٢٧ N.S
مقدار الزيادة الكلية الوزنية للرأس الواحد كغم	٩٥ر١٧	٣٢ر١٨ N.S
معدل الزيادة اليومية للرأس الواحد من البداية وحتى عمر ١٢٩ يوما غم/ للرأس	٢ر١٦٦	٦ر١٦٩

(*) فرق معنوي (P>O.05)

كانت تحت نظام الرضاعة المستمرة .

كان وزن المواليد عند بداية الدراسة (على عمر ثلاثة أسابيع) أعلى لمجموعة الشاهد ، ولكن الفرق كان غير معنوي ، كذلك كان وزن الفطام للشاهد أعلى عنه من المعاملة ٢٦ر٢٠ و ٤٢ر١٥ على التوالي والفرق معنوي . والاختلاف في وزن الفطام يعود إلى الفرق في عمر الفطام ، حيث كان العمر ٦٢ يوما للمعاملة وللشاهد ٨٣ يوما . وكذلك يعود إلى تأثير المعاملة نفسها . وكان معدل الزيادة اليومية للرأس الواحد ٥ر١٧٢ غم/ اليوم لمجموعة الشاهد و٢٤ر١٧٠ لمجموعة المعاملة. وهذا يتفق مع النتائج التي تتصل إليها كثير من الباحثين ، ومنهم : التميمي (١٩٨٣) ، قاسم (١٩٧٨) ، و(Hadjipanayiotou and Louca 1976).

في هذه الدراسة تم بيع المواليد الذكور عند فطام الشاهد ، وتم البيع على أساس العدد وليس الوزن، وأسلوب البيع هذا ، من الاساليب الشائعة في الاردن . ومع ذلك فلو تركت هذه المواليد أو سمنت بعد الفطام لتلاشى فرق الوزن بين المجموعتين وهذا ما حصل مع العبر المحتفظ بها (جدول رقم ٢) حيث كان وزنها على عمر ١٢٩ يوماً ٠٥ر٣٦ كغم و ٤٥ر٣٧ كغم لمجموعتي المعاملة والشاهد على التوالي والفروق غير معنوية . وهذه النتائج تتفق مع ما وجده (Economides and Antoniou 1989) حيث وجد أن الفرق في الاوزان تلاشى على عمر ستة أشهر. وتتفق مع ما وجده كل من(Latif 1982) و(Kassem 1978) .

نتائج المشاهدة الثانية والثالثة

يبين جدول رقم (٣) متوسط الوزن للمواليد عند بداية الدراسة ووزن الفطام وكمية الحليب المنتجة تجاريا لمجموعة المعاملة والشاهد لكلتا المشاهدتين .

كانت كمية الحليب المنتجة تجاريا في المشاهدة الثانية من مجموعة المعاملة ١٨٠ كغم . وقد أنتجت من ٣٠ نعجة بينما لم ينتج الشاهد شيئا. أما مجموعة المعاملة في المشاهدة الثالثة فقد أنتجت ٥ر٤٣٥ كغم حليباً تجارياً وكذلك من ٢١ نعجة ولم ينتج الشاهد شيئا .

جدول رقم (١) . تأثير معاملة الفطام على نمو المواليد وإنتاج الحليب وذلك في مشاهدة على أغنام المربي في قرية فاع في شمالي الاردن.

البيـــان	مجموعة رقم (١) المعاملة	مجموعة رقم (٢) الشاهد
متوسط وزن المواليد عند البدايه (كغم)	٤٥ر٨	٥ر٩
متوسط وزن الفطام (كغم)	٤٣ر١٥	٢٦ر٢٠ N.S
متوسط العمر عند بداية الدراسة (يوم)	٢١	٢١
متوسط عمر الفطام (يوم)	٦٢	٨٣
عدد المواليد الداخلة في الدراسة	٢٠	١٩
مقدار الزيادة الوزنية حتى الفطام للرأس الواحد (كغم)	٩٨ر٦	٧٦ر١٠*
معدل الزيادة اليومية غم /الرأس	٢٤ر١٧٠	٥ر١٧٣
كمية الحليب المنتجة تجاريا للمجموعة (كغم) حتى فطام الشاهد	٢٥٩	-
عدد النعاج التى جفت بعد الفطام	١	-
عدد النعاج الحلابة بعد الفطام	١٦	١٧
معدل إنتاج النعجة الواحة خلال فترة الاختبار غم/يوم	٢٧٥	٥ر٢٧٠
عدد أيام الحلابة بعد فطام الشاهد	٧٤	٧٤
إنتاج الحليب الكلي للنعجة الواحدة (المباع قبل وبعد الفطام) (كغم)	٣ر٣٣	٠١ر٢٠
الاعلاف المقدمة للمواليد كغم/للممجموعة	٤٠٠	-
عدد النعاج الملقحة بتاريخ ١١/٦/٩٢	١٢	٦

* فرق معنوي (P>O.05)

المشاهدة الثانية والثالثة :-

اتبع نفس الاسلوب في التنفيذ من حيث البدء بالفطام التدريجي على عمر ثلاثة أسابيع . وكان الفطام النهائي لكلتا المجموعتين وفي كلتا المشاهدتين على عمر شهرين، باستثناء المشاهدة الثانية حيث كان العزل يتم صباحا والحلب مساءا وتترك المواليد مع أمهاتها ليلا .

سجلت أوزان المواليد عند بداية الدراسة وعند الفطام وسجلت كميات الحليب المنتجة من كل مجموعة حتى الفطام .

قدمت للمواليد أعلاف مركزة في كلتا المشاهدتين لمجموعتي المعاملة كما ذكر في المشاهدة الاولى .

النتائج والمناقشة

نتائج المشاهدة الاولى

يبين جدول رقم (١) متوسطات وزن المواليد عند بداية الدراسة ووزن الفطام ومعدل إنتاج الحليب للنعجة الواحدة .

أعطت مجموعة المعاملة (١٦ نعجة) حليبا مقداره ٢٥٩ كغم من بداية الدراسة وحتى فطام الشاهد بمعدل (١٩ر١٦ كغم) للنعجة الواحدة ، في حين لم يتم الحصول على أي كمية من الحليب التجاري من مجموعة الشاهد .

بعد فطام الشاهد لم يلاحظ أي تأثير للمعاملة على إنتاج الحليب أو على طول موسم الحلابة . وكان عدد أيام الحلابة في كلتا المجموعتين بعد فطام الشاهد ٧٤ يوماً ومتوسط إنتاج النعجة الواحدة ٢٧٥ غم/ اليوم و ٥ر٢٧٠ غم/ اليوم لمجموعة المعاملة والشاهد على التوالي . وهذه النتائج تتفق مع ما وجده (Economides and Antoniou 1989) و(Louca et al. 1975) و (Hadjipanayiotuo and Louca 1976) . وقد أشاروا إلى أن النعاج التي كانت تحت نظام الرضاعة المحدّدة تعطي حليبا أكثر بعد الفطام من النعاج التي

أسابيع) والفطام الكامل على عمر شهرين ، على إنتاج الحليب التجاري قبل وبعد الفطام ، وعلى نمو المواليد ، ومقارنة ذلك مع النظام التقليدي المتبع لدى المزارع والذي يفطم المواليد دفعة واحدة وعلى عمر يتجاوز الشهرين.

المواد وطريقة العمل

أجريت ثلاث مشاهدات على أغنام المزارعين ، واحدة في الشمال (قرية فاع) والثانية والثالثة في الوسط (مادبا) .

المشاهدة الاولى :-

تم إختيار ٣٤ نعجة مع مواليدها وعددهم ٣٩ مولودا. قسمت المواليد - بعمر ثلاثة أسابيع- إلى مجموعتين : الاولى المعاملة (٢٠ مولودا) والثانية شاهد (١٩ مولودا) ، وقد روعي في التوزيع العمر وحالة الولادة إذا كانت مفردا أو توأماً .

كانت مجموعة المعاملة تعزل عن أمهاتها مساء وتحلب الامهات صباحا ، وبعد ذلك تبقى المواليد مع أمهاتها حتى المساء ، واستمر الوضع على هذا المنوال إلى أن فطمت هذه المجموعة على عمر شهرين قبل الفطام الكامل بأسبوع ، كانت ساعات العزل تزداد يوما بعد يوم ، مجموعة الشاهد تركت تحت نظام المزارع حيث تم الفطام على عمر ٨٣ يوماً .

إنتاج الحليب لمجموعة المعاملة كان يسجل يوميا كإنتاج كلي للمجموعة بعد الفطام. في الشهر الاخير من إنتاج النعاج تم تسجيل إنتاج الحليب لكل مجموعة وكذلك سجلت معلومات عن عدد النعاج الحلابة والجافة والملقحة وذلك لدراسة تأثير نظام الفطام على إنتاج الحليب بعد الفطام وعلى طول موسم الانتاج .

قدمت خلطة مركزة للمواليد مجموعة المعاملة مكونة من ٦٤٪ شعير ، ٢٠٪ نخاله، ١٥٪ فول صويا و ١٪ أملاح معدنية وفيتامينات ، وتم التدرج في تقديم الاعلاف المركزة ، كما تم تطبيق برنامج صحي وقائي لمواليد كلتا المجموعتين .

ووجد الباحثون (Lawlor et al . 1974) في دراسة لهم على الاغنام ، بأن فطم المواليد كليا على عمر ٤٨ ساعة كان له تأثير عكسي على إنتاج الحليب الكلي لفترة ١٥٠ يوماً حلابة ، وبدون تأثير معنوي على إنتاج الحليب التجاري .

وفي دراسة ل(Louca et al .1975)على الماعز الشامي ، وجدوا أن الفطام على عمر ٣٥ يوماً زاد من الحليب التجاري المنتج لكنه أثر عكسيا على نمو المواليد مقارنة مع الفطام على عمر ٧٠ يوماً .

وفي دراسة لمقارنة تأثير نظام الرضاعة المحددة مع الرضاعة المستمرة على إنتاج ونمو المواليد وجد (Hadjpanayiotou and Louca 1976) أن كمية الحليب التجاري المنتجة على فترة ٣٥و٧٠ يوماً كانت أعلى وبشكل معنوي في نظام الرضاعة المحددة مقارنة مع نظام الرضاعة المستمرة . ولم تكن هنالك اختلافات معنوية في كمية الحليب الكلي المنتج في نفس الفترات . وكان نمو المواليد حتى الفطام لعمر ٣٥ يوماً في نظام الرضاعة المحددة أقل منه في نظام الرضاعة المستمرة ، ولكن بعد الفطام وحتى عمر ١٢٠ يوماً كان النمو متشابة والفروقات في الوزن النهائي غير معنوية .

وجد (الحسناوي Kassem 1978, 1986) أن نظام الرضاعة ليس له تأثير على إنتاج الحليب بعد الفطام ولا على طول موسم الانتاج ، وكما أن الفرق في أوزان المواليد يتلاشى مع تقدم العمر. وفي دراسة للتميمي (١٩٨٣) وجد أن نمو الحملان المفطومة على عمر ٤٥ يوماً كان أقل من نمو الحملان المفطومة بعمر ٨٧ يوماً ، ولكن الفرق زال على عمر ستة أشهر وكانت الاوزان النهائية متشابهة .
يمكن اتباع نظام الرضاعة المحدد والفطام الكامل على عمر٤٢ يوماً دون أن يؤثر نظام الرضاعة على وزن التسويق للحملان ، كما أنه يعطي كميات أكبر من الحليب التجاري دون التأثير على إنتاج الحليب بعد الفطام . وقد توصل إلى ذلك (Economides and Antoniou 1989) في دراسة لهما لمقارنة تأثير نظام الرضاعة المستمرة (٢٤ ساعة) مع الرضاعة المحددة (١٢ ساعة أو٨ ساعات).
تهدف هذه الدراسة إلى معرفة تأثير الرضاعة المحددة بدءا من عمر (٢

للمعاملة و ٩٤٫٨٧ للشاهد . وفي المشاهدة الثالثة ١٠٠٫٥ للمعاملة و ١٥٥٫٥ للشاهد.

كان وزن العبر (الاناث بعمر سنه) المشاهدة الاولى على عمر ١٢٩ يوما ، ٢٧٫٠٤٥ كغم للشاهد و ٢٦٫٠٥ كغم للمعاملة .

أعطت مجموعة المعاملة زيادة معنوية في إنتاج الحليب مقارنة بمجموعة الشاهد ، حيث أعطت زيادة مقدارها ٥٩ ، ١٨٠ و ٢٤٥٫٥ كغم من الحليب وذلك لكل من المشاهدات الاولى والثانية والثالثة على التوالي .

المقدمـــــــه

يتحقق العائد الاقتصادي لمربي الاغنام من بيع المواليد والحليب . تتفاوت الاهمية الاقتصادية لهذين المنتجين في الاردن حسب السنة والموقع . أما الناتج من الصوف فهو أقل قيمة إقتصادية من اللحم والحليب . ويصنع حليب الاغنام إلى أشكال مختلفة أهمها الجبنة البيضاء . لذا هدفت دراسات عديدة للحصول على كميات أكبر من حليب النعاج وذلك باتباع أنظمة فطام مختلفة بحيث لا تؤثر على نمو المواليد .

توجد طريقتان للحصول على كميات إضافية من الحليب مرتبطتان بأنظمة الفطام، الاولى باتباع الفطام المبكر على أعمار صغيرة جدا لا تتعدى ٣ - ٧ أيام . حيث توضع المواليد على بدائل الحليب . أما الطريقة الثانية فتتم باتباع أنظمة رضاعة مختلفة حيث تترك المواليد مع أمهاتها لفترة تتراوح ما بين ٨ - ١٢ ساعة في اليوم، ثم تعزل بقية اليوم حيث تحلب النعاج . ويبدأ تطبيق هذا النظام على عمر ثلاثة أسابيع ويستمر حتى الفطام النهائي بعمر ٤٥- ٦٠ يوما .

تتفاوت نتائج الدراسات حول تأثير أنظمة الفطام المختلفة على إنتاج الحليب ونمو المواليد . فمثلا وجد(Louca 1972) في دراسة على الاغنام الكيوس ، أن الفطام على عمر ثلاثة أيام كان له تأثير إيجابي ومعنوي على كميات الحليب المنتج .

تأثير الفطام المبكر على إنتاج الحليب ونمو المواليد

فيصل توفيق عواوده
المركز الوطني للبحوث الزراعية ونقل التكنولوجيا
عمان - الاردن

الملخص

نفذت ثلاث مشاهدات على قطعان المربين ، واحدة في الشمال واثنتان في الوسط لمعرفة أثر نظام الفطام المبكر على إنتاج الحليب للنعاج وعلى نمو المواليد (قبل وبعد الفطام) ، مقارنة بالنظام التقليدي لدى المربين ، والذي يعتمد على الرضاعة المستمرة لعمر يزيد أحيانا عن ثلاثة أشهر . اشتملت كل مشاهدة على مجموعتين : الاولى مجموعة المعاملة ، حيث بدء بتحديد فترات الرضاعة على عمر ثلاثة أسابيع وتم الفطام النهائي على عمر شهرين . المجموعة الثانية : تركت تحت نظام المربي حيث يتم الفطام بعمر ثلاثة أشهر. كانت أعداد المواليد المستعملة ٣٩ ، ٤٢، ٤٦ للمشاهدة الاولى والثانية والثالثة على التوالي .

بلغ الوزن عند الفطام في المشاهدة الاولى ١٥ر٤٣ كغم للرأس مقارنة ب ٢٠ر٢٦ للمعاملة . وفي المشاهدة الثالثة ١٦ر٤٠ مقارنة ب ١٢ر٦٩ كغم للرأس . أما في المشاهدة الثانية فكان وزن الفطام متقارب حيث بلغ ١٥ر٧٠ كغم للشاهد مقارنة ب ١٥ر٩٣ للمعاملة .

بلغت الزيادة اليومية (غم/ اليوم/ للرأس) في كل من المعاملة والشاهد على الشكل التالي :

المشاهدة الاولى ١٧٠ر٩٤ للمعاملة و ١٧٣ر٥٩ للشاهد . المشاهدة الثانية ١٢٦ر٤

The Effect of Early Weaning on Milk Production and Growth Rate of Awassi Lambs

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Abstract

Three demonstrations were conducted on owners' flocks, one in the north of Jordan and two in central Jordan, to compare the effect of early weaning with a traditional regime on marketable milk yield and on the growth rate of lambs. Two groups were used in each demonstration: treatment and control. Lambs in treatment groups in demonstration 1 and 3 received restricted suckling at 21 days of age by separation from their dams daily in the evening; they joined them after the morning milking. In the second demonstration, milking was performed in the evening and lambs were separated in the morning. The control group was managed according to the owner's system. Groups 1, 2 and 3 contained 39, 43 and 46 lambs, respectively. Weaning weight was 15.4 and 20.3 kg for the control group and 16.0 and 13.7 kg for the treatment group for demonstrations 1 and 3, respectively. In the second demonstration, weaning weight was 15.7 and 15.9 kg for the control and the treatment groups, respectively. Daily gain was 170.9 and 173.6 g head^{-1} day^{-1} for demonstration 1, 126.4 and 94.9 g head^{-1} day^{-1} for demonstration 2, and 100.5 and 155.5 g head^{-1} day^{-1} for demonstration 3 for the treatment and control groups, respectively. Ewe lambs kept in the flock had a body weight at 129 days of age of 27.5 and 26.1 kg for control and treatment groups, respectively. The treatment groups produced more commercial milk than the control group: 259, 180 and 435.5 kg in demonstrations 1, 2 and 3, respectively.

مرة . وكذلك فإن المعاملة تجعل السكريات المعقدة في بنية جدر خلايا الاتبان متاحة لميكروبات الكرش وبالتالي فإن نسبة التحسين هي عالية وإقتصادية جدا .

بهاء الراوي

ماذا بشأن تعبئة اليوريا في قناني وتوزيعها على المزارعين لاغراض معاملة التبن باليوريا ؟

عبد الرحمن قرنفلة

قد يكون هناك صعوبة في نقل محلول اليوريا بالماء . لان ذلك سوف يؤدي إلى زيادة تكاليف المعاملة نتيجة أجور نقل المحلول . لذلك يفضل أن تجري عملية حل أو إذابة اليوريا في الماء في حقل المزارع أو مربي الحيوان وحيث ستجري المعاملة .

د. تيم تريتشر

هنالك حالات محدودة جدا في العالم أمكن نقل هذه التقنية إلى المزارع في الدول النامية . والصين هي إحدى هذه الدول . ما هي برأيك الصفات التي تتوفر في سوريا لجعل نقل هذه التقنية للمزارع أمرا ممكنا ؟ أرغب بأن أعرف المشاكل التي يمكن أن تنشأ تحت الظروف المختلفة . إذ أن تقنية أل FAO في تركيا لم يتم تبنيها من قبل المزارعين مالكي القطعان الكبيرة لانها تحتاج إلى عمالة كبيرة .

عبد الرحمن قرنفلة

تم تنفيذ عدد كبير من التطبيقات الحقلية لدى المربين في سوريا حول هذه التقنية واستخدمت طرق مختلفة . منها المعاملة تحت ظروف التخزين التقليديه للتبن لدى المزارع وكانت النتائج جيدة ونحن نتابع بالتعاون مع الارشاد الزراعي نشر هذه التقنيات . وفي سوريا يمكنك أن تجد عدد من المزارعين يقومون بمعاملة الاتبان بأنفسهم .

على المعاملة ؟ وهل يمكن رفع أو تحسين القيمة الغذائية لاتبان البقوليات ؟

عبد الرحمن قرنفله

- ليس هناك محاذير من استعمال البلاستيك الشفاف . والهدف من التغطية هو منع تسرب غاز الامونيا المتحرر من اليوريا . ومن الناحية العملية لا بد من توفير الحرارة الجوية العامة لتسريع تحرر الامونيا من اليوريا .
- لا أرى ضرورة لمعاملة أتبان البقوليات باليوريا نظرا لان أتبان البقوليات تحتوي بطبيعتها على نسبة عالية من البروتين مقارنة مع أتبان النجيليات (قمح وشعير).

أحمد الراوي

ما هي الميكانيكية أو الهدف من إضافة اليوريا ؟

عبد الرحمن قرنفلة

إن التأثير يعود لتفاعل غاز الامونيا المتحرر من اليوريا مع المكونات الاساسية للتبن . إذ أن القلويات لها تأثير على الخلايا وبالتالي تحطم جدرها إضافة إلى ارتباط الآزوت بالبنية الكيميائية للتبن .

أما استعال غاز الامونيا فقد استخدام إلا أنه يحتاج إلى تجهيزات خاصة ويد فنية خبيرة .

محفوظ أبو زنط

من المعروف أن القيمة الغذائية للتبن متدنية جدا ولذلك لا يتوقع من كل هذه المعاملات نسبة عالية من التحسين . ولذلك لا مبرر لمعظم هذه الممارسات والافضل البحث عن وسائل أخرى لتحسين غذاء الحيوانات ؟

عبد الرحمن قرنفلة

إن المعاملة تؤدي إلى رفع معامل هضم الاتبان ورفع محتواها من الآزوت ورفع كمية المأكول منها ٢٠-٤٠٪ . إضافة إلى أن محتوى التبن من البروتين يرتفع ٥ر٢

مناقشه

أثر التغذية على التبن المعامل باليوريا على إنتاجية النعاج والحملان

عبد الرحمن قرنفلة ولؤي لبان
مديرية البحوث العلمية الزراعية - دوما - دمشق - سوريا

فيصل توفيق

ما هو محتوى التبن المعامل باليوريا من النتروجين في بداية ونهاية الدراسة ؟ وهل انخفضت نسبة النتروجين بعد كشف الكومة ؟

عبد الرحمن قرنفله

لم أقم بدراسة محتوى التبن من النتروجين . وهناك بعض التجارب في مصر أشارت إلى أن التبن المعامل يفقد جزءا من محتواه من البروتين بعد فترات زمنية متوالية من كشف الكومة . وفي كل الحالات يمكن أن تكشف الكومة من أحد أطرافها وتسحب الكمية اللازمة يوميا ويغلق الغطاء بشكل بسيط .

حسين صالح

هل يمكن استخدام سلفات الامونياك بدل اليوريا ؟

عبد الرحمن قرنفله

استخدم الامونياك في عدد من الدول لتحسين القيمة الغذائية للتبن وخاصة في المغرب . وفي سوريا تم استخدام ماءات الامونيوم بنجاح في هذا المجال .

محمد عبابنه

هل هناك محاذير من استعمال البلاستيك الشفاف وهل هناك أثر لاشعة الشمس

٠.٧٠٠ تين معامل باليوريا X ٢.٠٤ = ١.٤٢ ل.س

٦.٨٤

قيمة (١)كغ من خلطة التجربة = ٣.٩٠ ل.س

الفارق بين سعر الخلطتين ٧.٧٥ - ٦.٨٤ = ٠.٩١ ل.س

* هذا يشير الى وجود فارق في قيمة ما تناوله الرأس الواحد باليوم من نعاج الشاهد ونعاج التجربة قدره (٠.٩١)ل.س .

إضافة إلى أن قيمة الزيادة الوزنية تساوي ١.٥ ل.س باعتبار قيمة ١ كغ وزن حي = ١٠٠ ل.س وكان فارق الزيادة الوزنية للنعجة ١٥ غ/يوم .

أما قيمة الزيادة في انتاج الحليب فكانت (٢.٤) ل.س حيث كان فارق الزيادة بانتاج الحليب بين نعجة الشاهد ونعجة التجربة (١٢٠ غ / يوم) وكان متوسط سعر (١) كغ حليب ٢ ل . س .

وبذلك تكون قيمة الربح =

٠.٩١+١.٥+ ٢.٤ = ٤.٨١ ل.س لكل رأس.

علما أن قيمة (١)كغ من خلطة الشاهد بلغت (٥) ل.س .

وقيمة (١) كغ من خلطة التجربة بلغت (٣.٩) ل.س .

الفارق ٥ - ٣.٩ = ١.١٠ ل.س .

أي أنه في حال تساوي وزن حيوانات التجربة مع حيوانات الشاهد وانتاجيتهما من الحليب في نهاية التجربة . فان هناك وفرا في قيمة الاعلاف يعادل ١.١٠ ليرة سورية لكل ١ كغ من العلف .

ملحق رقم (١)

التحليل الاقتصادي :

أ- تكاليف المعامله باليوريا ل ٤ طن من التبن .

قيمة البلاستيك الارضي ٢ X ١٢ = ٣٦م٢ = ٨.٢٨ كغ X ٥٣ ل س = ٤٣٨.٨٤

قيمه البلاستيك المستعمل للتغطيه :١٦ X ٧ =١١٢ م٢ = ٢٧.٥٦كغX١٠٠ل س= ٢٧٥٦

٢١٩٤.٨٤

يستخدم البلاستيك ٤ مرات :

٣١٩٤.٨٤/٤	= ٧٩٧.٧١ ل.س
قيمة اليوريا المستخدمة ١٦٠كغX٤.٩	= ٧٨٤ ل.س
أجور يد عاملة	= ١٨٠ ل.س
تكاليف متفرقة	=٤٠٠ ل.س
تكاليف معاملة ٤ طن	٢١٦٢.٧١

تكاليف معاملة ١ كغ تبن = ٠.٥٤ ليرة سورية .

قيمة ١ كغ تبن معامل باليوريا ١٥٠ + ٠.٥٤=٢.٠٤ ل.س

٢ - قيمة خلطة الشاهد :

٠.٥٠٠ كغ علف مركز	X٩.٠٠	=٤.٥ ل.س
٠.٥٠٠ كغ نخاله	X٥.٠٠	=٢.٥ ل.س
٠.٥٠٠ كغ تبن خام	X١.٥	=٠.٧٥ ل.س
قيمة (١) كغ من خلطة الشاهد		= ٥ ل.س

٣ - قيمة خلطة التجربة :

٠.٣٥٠ كغ علف مركز	X ٩.٠٠	= ٣.١٥ ل.س
٠.٣٥٠ كغ نخاله	X ٥.٠٠	= ١.٧٥ ل.س
٠.٣٥٠ كغ تبن خام	X ١.٥٠	= ٠.٥٢ ل.س

جدول رقم (٢) . بعض المعلومات والنتائج المتحصل عليها من الحملان المشمولة في تجربة التغذية على التبن المعامل باليوريا.

البيانــــــــــات	الحملان الشاهد	الحملان الشاهد
عدد الحملان الداخلة في التجربة	٢٥	٢٥
متوسط وزن الحمل في بداية التجربة / كغم	٩.٢٨	٨.٥٣
متوسط وزن الحمل في نهاية التجربة / كغم	١٩.٣٨	١٧.٨١
مدة التجربة / يوم	٦٠	٦٠
متوسط الزيادة الوزنية للحمل الواحد خلال التجربة / كغم	١٠.١	٩.٢٨
معدل الزيادة الوزنية اليومية للحمل /غم / اليوم	١٦٨	١٥٥

جدول رقم (١) . بعض المعلومات والنتائج المتحصل عليها من النعاج المشمولة في تجربة التغذية على التبن المعاملة باليوريا.

البيانـــــات	نعاج التجربة	نعاج الشاهد
عدد النعاج الداخلة في التجربة	٢٥	٢٥
متوسط وزن النعجة في بداية التجربة / كغم	٤٨.٨٤	٥٠.٣٢
متوسط وزن النعجة في نهاية التجربة / كغم	٥١.٠٨	٥٢.٤٤
مدة التجربة / يوم	٦٠	٦٠
متوسط الزيادة الوزنية للنعجة خلال مدة التجربة (كغم)	٢.٢٤	٢.١٢
معدل الزيادة الوزنية اليومية للنعجة الواحدة (غم/يوم)	٣٧	٥٢
متوسط الادرار اليومي للحليب للنعجة الواحدة بعد فطام حملانها (غم / يوم)	٤٦٠	٥٨٠

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النتائج والمناقشه

يتضمن الجدولان ١و٢ النتائج التي تم الحصول عليها من خلال وزن النعاج ووزن الحملان وقياس كمية الادرار اليومي للنعجه بعد فطام الحملان . حيث بلغت الزياده الوزنيه اليوميه للنعجه ٥٢ غ/ يوم/لمجموعه التجربه و٣٧ غ/ يوم/ لمجموعة الشاهد. أما متوسط الادرار اليومي للحليب فقد بلغ ٥٨٠ غ/يوم / للنعجه في مجموعة التجربة و٤٦٠ غ/يوم/ للنعجه في مجموعة الشاهد . وهذا يشير إلى الاثر الايجابي للتبن المعامل باليوريا على زيادة وزن النعاج وعلى كمية الحليب المنتج . حيث تبين أنه أدى إلى زيادة يومية في إنتاج الحليب للنعجة الواحدة ١٢٠ غم أو ما نسبته ٢٦٪ .

أما بالنسبه لتبدل متوسط وزن الحملان في نهاية التجربة فقد كانت الفروق في متوسط الزيادة الوزنية اليومية للحمل غير مؤكدة احصائيا حيث بلغت لحملان التجربة ١٥٥ غ / يوم بينما كانت لحملان الشاهد ١٦٨ غ / يوم .

ومن دراسة النتائج السابقه يتضح أثر معامله التبن باليوريا على الزيادة الوزنية اليومية للنعاج الوالدة وكذلك على زيادة كمية الادرار اليومي من الحليب . وهذا يؤكد ارتفاع القيمة الغذائية للتبن المعامل باليوريا حيث تم استبدال ٣٠٪ من الاعلاف المركزة بالتبن المعامل باليوريا بنسبة كل ٢ كغ تبن معامل تعادل ١ كغ علف مركز من الناحية الغذائية .

وعند إجراء التحليل الاقتصادي لاستعمال التبن المعامل في اليوريا في تغذية النعاج والحملان (ملحق رقم ١) تبين أن الربح المتحصل عليه في حالة تغذية النعاج على التبن المعامل قد بلغ ٤٫٨١ ليرة سوريه لكل رأس ولقد تبين أنه في حالة تساوي وزن الحيوانات المعاملة مع حيوانات الشاهد وكذلك تساوي إنتاجيتهما من الحليب . فإن هنالك وفرا يبلغ ١٫١ ليرة سورية لكل ١كغم من العلف المركز الذي يقدم للحيوانات . مما يشير الى الاهمية الواضحة لاستعمال التبن المعامل باليوريا في خفض تكلفة الانتاج آخذين بعين الاعتبار أن الاعلاف المركزة في مجملها مستوردة بينما التبن هو من إنتاج المزرعة .

المواد وطريقة البحث

تم تنفيذ التجربة في مزرعة أحد مربي الاغنام بمحافظة حماة خلال الفترة من ٢٩/١٢/١٩٩١ وحتى ٢٩/٢/١٩٩٢.

نفذت التجربة على النعاج والحملان ، حيث تم إختيار ٥٠ نعجة قسمت إلى مجموعتين متجانستين في الوزن والعمر، كل مجموعة تتكون من ٢٥ نعجة ، كذلك تم اختيار ٥٠ حملا متجانسة بالوزن والعمر قسمت هي الاخرى إلى مجموعتين .

تمت التغذية على العليقتين التاليتين :

- غذيت حيوانات الشاهد خلال فتره التجربة على عليقة تتكون مما يلي :

  ٥٠٠غ/رأس/يوم علف مركز

  ٥٠٠غ /رأس/يوم نخالة قمح

  ٥٠٠غ/رأس /يوم تبن خام

- أما حيوانات التجربه فقد غذيت على العليقة التي تتكون مما يلي :

  ٢٥٠غ /رأس /يوم علف مركز

  ٢٥٠غ /رأس /يوم نخاله قمح

  ٢٥٠ غ/ رأس /يوم تبن خام

  ٧٠٠ غ/ رأس /يوم تبن معامل باليوريا

حيث استبدل حوالي ٣٠٪من الاعلاف المركزه في العليقة الاولى بالتبن المعامل باليوريا .

وأضيف إلى علائق المجموعتين المعادن والفيتامينات بعدل ٢٠ غرام /يوم / رأس.

أخذت أوزان الاغنام والحملان قبل البدء في التجربة وعند إنتهائها ، كما أخذت أوزان كميات الحليب المنتجة من الاغنام الداخلة في التجربة .

فمحتوى تبن الارز من الرماد أعلى ب ٣ أمثال محتوى تبن المحاصيل الاخرى ، وهذا يعود اساسا الى محتواة من السيلكا التي تؤثر سلبا على مستوى هضم السكريات المتعددة في الكرش . وبشكل عام يعتبر التبن فقيرا بمحتواه من المعادن .

ويمكن تحسين القيمة الغذائية للتبن بطرق مختلفة تشتمل على طرق فيزيائية عن طريق التقطيع والطحن الخشن (Owen 1979) . إلا أن هذه الطرق مكلفة إقتصاديا (نور عبد العزيز ١٩٨٠) . وهنالك الطرق الميكروبيولوجية باستعمال بعض أنواع الفطور . والبكتيريا . أما الطرق الاكثر شيوعا فهي الطرق الكيمانية، حيث ثبت بأنها الاكثر كفاءة في تحسين القيمة الغذائية للتبن . وهي تشتمل على معاملة التبن عن طريق المعاملة الجافة والمعاملة الرطبة بالنقع بماءات الصوديوم أو المعاملة بالامونيا حيث يمكن استخدام الامونيا الغازية أو الامونيا السائلة لهذه الغاية (Mason et al . 1988 ; Sundstol et al.1987)

والطريقة الاكثر شيوعا وبساطة هي معاملة التبن باليوريا . ولقد استعملت اليوريا منذ مدة طويلة في علائق الاغنام تراوحت من ٢٥-٧٥٪ من الأزوت الكلي في العليقة . ويمكن أن تصل النسبة الى ٩٠٪ (Perkins et al. 1962) .

وقد وجد (Gallup et al .1952) أن هناك العديد من العوامل التي تؤثر على استجابة الحيوان لاضافة اليوريا ومن هذه العوامل : نسبة البروتين في العليقة . كمية اليوريا المستخدمة . نوع وكمية الاعلاف المالئة في العليقة ونوع وكمية الكربوهيدرات المتاحة في العليقة .

وفي دراسة قام بها (Labban 1992) تبين أن معاملة تبن الشعير باليوريا قد أثر وبشكل واضح على البنية الكيميانية للتبن .

كميات محدودة من الاعلاف المركزة كالشعير الحب وكسبة القطن عند التغذية على التبن الخام .

يعتمد التركيب الكيميائي للتبن على عوامل عديدة منها نوع النبات وصنفه ، مرحلة النمو ، نوع وكمية السماد المضاف والعوامل الجوية السائدة وظروف التخزين ، وفي دراسة أجراها (Labban, 1992) على مجموعة من أصناف الشعير المزروعة في سوريا أظهرت تباينا واضحا بين هذه الاصناف في التركيب الكيميائي للتبن ، حيث تشير النتائج الى أن التباين كان أكبر ما يمكن في كيمة الرماد الموجودة فيه .

تتكون البنية الكيمائية للتبن بصورة أساسية من السكريات المتعددة ، اللجنين ، البروتين والمعادن. فالسكريات المتعددة تتألف من السيليلوز والفتيك ، ويشكل السيليلوز وازايلوز أكبر نسبة من بين هذه السكريات . هذا بالاضافة إلى سكريات أخرى مثل المانوز - الغالاكتوز - ولكن بنسب بسيطة . أما اللجنين فيساهم بنسبة كبيرة في التركيب الكيميائي للتبن ويتألف من مركبات حلقية متجمعة في صورة بوليميرية من وحدات الفينول بروبان. وللجنين أثر مثبط على الكائنات الحية الدقيقة في الكرش ويعمل كحاجز طبيعي بين الانزيمات المفرزة من هذه الكائنات والسكريات البسيطة المتاحة في جدر الخلايا . ويعتبر محتوى التبن من البروتين الخام منخفضا (يترواح بين ٣٠-٦٠ غ / كغ مادة جافة) ويحدد ذلك عوامل متعددة مثل الصنف ، التسميد ، النوع ومرحلة الحصاد.

والمعروف ان الكائنات الحية الدقيقة المحللة للسيليلوز تحتاج إلى وفرة النتروجين من مصادر آزوتية غير بروتينية NPN . ومن هنا تأتي أهمية إضافة مصدر آورتي للتبن . هذا ووجد أن الحد الادنى من الاحتياجات الآزوتية في المواد المالئة عند استخدامها بمفردها بكميات ضئيلة يزيد من هضم السيليلوز والمادة الجافة المأكولة ، مع ملاحظة أنه في بعض الحالات التي لا تستجيب لزيادة النتروجين يكون ذلك نتيجة تداخل عملية /lignification/ كعامل محدد مثل ما يحدث مع تبن القمح والشعير (نور عبد العزيز ١٩٨٠). ويعتمد محتوى التبن من المعادن بصورة رئيسية على العمليات الزراعية وعلى نوع المحصول ،

لا تحصل على احتياجاتها الغذائية لتحقيق إنتاج جيد نظرا لانعدام إمكانية التوسع بالمساحات المزروعة بالاعلاف وتدهور بيئات المراعي الطبيعية .
ونتيجة لذلك تنفق الدول العربية مبالغ كبيرة بالقطع النادر لاستيراد حاجة الثروة الحيوانية من المواد العلفية ، بسبب حدة الطلب على المنتجات الحيوانية وارتفاع عدد الحيوانات. وهذا الواقع يؤكد أهمية البحث عن مصادر علفية محلية بديلة كالمخلفات الزراعية والاعلاف غير التقليدية واستخدامها في تغذية الحيوان .

يشكل القش موردا علفيا هاما للثروة الحيوانية في منطقة عمل مشروع المشرق ، إذ ينتج بكميات كبيرة ، وتتغذى عليه الحيوانات في الفترة التي تلي حصاد القمح والشعير والواقعة ما بين شهري أيار وايلول . كما أنه يدخل بنسب كبيرة في علائق الاغنام خلال فصل الشتاء كذلك بعد تقطيعه وتحويله الى تبن حيث يشكل المصدر الغذائي الوحيد للأغنام خلال هذا الفصل .

أظهر المسح الحقلي الذي أجري في سوريا أن إنتاج الجمهورية العربية السورية من تبن القمح والشعير قد بلغ ٤١٣٦ ألف طن /عام ١٩٩٢ . ورغم أن التبن يشكل جزءا من الانتاج الزراعي الذي نال نصيبا من تكاليف الانتاج وحظي بنصيب من الجهد والعمليات الزراعية المختلفة . إلا أن جزءا كبيرا منه يهدر عن طريق الحرق في أرضه أو تركه دون جمع . وتشكل هذه الكميات مصدرا علفيا هاما يمكن الاعتماد عليه في تغذية المجترات خلال فترات شح الغذاء ، خاصة إذا ما تم رفع قيمته الغذائية .

الاستعراض المرجعي

يستخدم التبن بشكل تقليدي في تغذية الاغنام حيث يقدم للحيوانات بصورته الخام بعد تقطيعه ميكانيكيا إلى قطع بأطوال ٣-٥ سم . وعلى هذه الصورة يعتبر من الناحية الغذائية مادة مالئة وظيفتها خلق احساس بالشبع لدى الحيوان. وتنخفض أوزان الحيوانات عندما تتغذى فقط على القش . ويدرك بعض المربين بأن القيمة الغذائية للتبن الخام منخفضة . لذلك يعمدون الى تقديم

أثر التغذية على التبن المعامل باليوريا على إنتاجية النعاج والحملان

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الملخص

تمت مقارنة عليقتين استعيض في إحداهما ب ٧٠٠ غم من تبن الشعير المعامل بنسبة ٤٪ من اليوريا، عوضا عن ٣٠٪ من الاعلاف المركزة . وذلك بتقديمهما لمجموعتين من النعاج كل منهما تتكون من ٢٥ نعجة ، ومجموعتين من الحملان كل منها تتكون من ٢٥ حملا. تم رصد أوزان النعاج والحملان في بداية التجربة وفي نهايتها ، كما تمت دراسة كميات الحليب المنتجة من كل نعجة بعد فطام المواليد عند عمر شهرين . تبين تفوق أوزان المجموعة التي غذيت على التبن المعامل باليوريا بمتوسط قدره (١٥غ /نعجة/يوم) على أوزان أفراد المجموعة الثانية . كما تفوق إنتاج الحليب لافراد المجموعة التي غذيت على التبن المعامل بمتوسط قدره (١١٠غم/نعجة/يوم) عن إنتاج أفراد المجموعة الثانية . أما بالنسبة للحملان فلم تكون الفروق في الزيادة الوزنية ذات دلالة إحصائية .

إن معاملة التبن باليوريا أدت إلى انخفاض تكاليف التغذية بالاضافة الى زيادة في إنتاجية النعجة من اللحم والحليب .

مقدمة

تؤكد الدراسات أن معدلات استهلاك المواطن العربي من البروتين الحيواني هي دون المتوسط العالمي . ويعود ذلك الى انخفاض مستويات انتاج الحيوانات بفعل عوامل متعددة . إذ أنه من الثابت علميا أن الثروة الحيوانية في المنطقة العربيه

Effect of Urea-treated Straw on Milk Production of Ewes and Meat Production of Lambs

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Abstract

Fifty Awassi ewes and 50 lambs were divided into two groups and fed on two different rations for 60 days, where 30% of the concentrates were replaced by 700 g of urea-treated straw. The initial and final weights were measured. The milk produced was measured after the lambs were weaned at 2 months of age. The average daily weight gain of lambs in the group fed urea-treated straw was higher by 15 g/day. The milk production of ewes under treatment was higher by 110 g ewe^{-1} day^{-1} compared with the control group. Feeding on urea-treated straw resulted in a significant reduction in cost of feed and more meat and milk.

Technology Transfer and Socioeconomics

Economic Analysis of Fertilizer Use in Barley Production: A Case Study in Rain-fed Areas of Iraq

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Abstract

In efforts to increase agricultural productivity in rain-fed areas, Iraqi researchers have promoted two technological packages consisting of components such as variety, fertilizer and planting method. Two varieties, Jazera 1 and a local black, were used with a seeding rate of 120 kg/ha and a fertilizer rate of 160 kg/ha. Two technological packages, "full-package" and "farmer-package," were included and compared with conventional farming. This study was conducted to economically analyze the responsiveness of the two varieties to fertilizers. The improved variety (Jazera 1) was more responsive to fertilizer than the local variety under both technological packages. As a result, return to investment on fertilization was higher for the Jazera variety. Accordingly, this positive interaction between fertilizer and the Jazera variety will enhance the diffusion of both technologies, since the adoption of one component is expected to accelerate the adoption of the other one. These findings are further supported by statistical tests of paired observations of net returns.

Introduction

Population and income growth are expected to cause major long-run increases in demand for agricultural products. To meet this growing demand, annual food and feed-grain production must increase from its current level. This critical situation, however, relates directly to the long-run capacity for greater domestic agricultural output. The main option for increasing output is through greater use of capital inputs such as fertilizers, insecticides, pesticides and machinery (Lu *et al.* 1979).

Fertilizers have contributed the most to output growth in many countries. This is mainly due to the fact that yield-increasing varieties are almost invariably associated with high levels of fertilizer use. In the United States, for example, the introduction of high-yielding crop varieties is closely associated with the growth in fertilizer use (Hayami and Ruttan 1985). In connection with the complementarity between fertilizer input and the development of new crop varieties, Iraqi researchers have conducted several pilot studies on barley fertilization in limited-rainfall areas of Northern Iraq. The main objective of this paper is to economically analyze the impact of fertilizer use on net returns to farmers. In addition, rate of return to investment on fertilization is calculated and compared for different varieties and various technological packages.

Data and Procedure

Agronomists conducted pilot studies on farmers' fields in 1991/92 to demonstrate the importance of fertilizer use in increasing barley production in rain-fed areas of limited rainfall (200-350 mm). These studies included 10 areas in the northern region of Iraq. Two varieties, Jazera 1 and local black, were used with a seeding rate of 120 kg/ha. The fertilizer rate was 160 kg/ha of N-P-K (27-27-0). Two technology scenarios (practices) were included: the "full-package" technology, which involves the introduction of new machinery, and the "farmer-package" technology, which involves improving the use of farmer's own machinery. Yield data of these alternative treatments are presented in Table 1.

The yield observations were converted to net returns (= total revenue − total cost). To do so, enterprise budgets for barley were developed for each treatment under different varieties and various practices. The resulting net return observations are presented in Table 2. However, the means, standard deviations and coefficient of variations are summarized and presented in Table 3, which shows that the net return of both varieties increased as a result of fertilization for both the full-package and the farmer-package technologies, compared with the conventional production of barley. This result supports the conclusion that package technology will enhance the diffusion of both fertilizer and improved varieties.

Results

Return to Investment of Fertilizer

Return to investment of fertilizer measures the profitability of barley production due to fertilizer use (Kay 1981). Estimated values of return to investment of fertilization (Table 4) indicate that the return varies with respect to area, variety and technology.

Table 1. Yield (t/ha) of two barley varieties under different farming practices, northern Iraq, 1991/92.

Area	Full package				Farmer package			
	JF+	JF-	LF+	LF-	JF+	JF-	LF+	LF-
Tel-Asmar	1.7	1.4	1.8	0.8	2.1	1.0	1.9	0.8
Tel-Atia	1.1	0.5	1.1	0.5	1.8	0.6	1.3	0.6
Muslatan	1.1	0.3	0.9	0.2	0.9	0.3	0.8	0.2
Baage	0.8	0.7	0.7	0.7	0.8	0.7	0.8	0.7
Ein-Talawi	1.1	0.7	1.0	0.6	1.3	0.4	1.2	0.6
Khreeze	1.9	1.2	1.7	1.2	1.1	1.1	0.8	0.6
Hakna	1.9	0.6	0.9	0.4	2.1	1.1	1.3	1.0
Tel-Fares	0.6	0.6	0.7	0.6	0.5	0.4	0.5	0.4
Ein Al Husan	2.3	0.9	1.8	1.2				
Al-Fatsa	1.2	1.2	1.4	1.2				
Mean	1.4	0.8	1.2	0.7	1.3	0.7	1.1	0.6
2 SD	0.54	0.35	0.43	0.35	0.61	0.33	0.44	0.23

† JF+ = Jazera variety with fertilizer; JF- = Jazera variety without fertilizer; LF+ = local black variety with fertilizer; LF- = local black variety without fertilizer.

Table 2. Net returns† (ID/ha) of two barley varieties under different farming practices, Northern Iraq, 1991/92.

Area	Full package‡				Farmer package			
	JF+	JF-	LF+	LF-	JF+	JF-	LF+	LF-
Tel-Asmar	3405	2737	3537	1675	4277	1939	3767	1675
Tel-Atia	2091	1041	2131	1019	3513	1239	2491	1195
Muslatan	2183	543	1743	487	1839	519	1679	479
Baage	1527	1335	1455	1367	1599	1359	1615	1399
Ein-Talawi	2239	1439	2079	999	2519	839	2399	1119
Khreeze	3743	2479	3423	2359	2279	2175	1655	1247
Hakna	3751	1199	1689	785	4285	2239	2687	1959
Tel-Fares	1287	1199	1487	1093	1073	877	895	795
Ein-Alhusan	4575	1735	3639	2359				
Al-Fatsa	2447	2359	2721	2373				

Table 3. Mean, SD and CV for net returns of different barley varieties under different farming practices.

	Full package			Farmer package		
Variety and fertilizer†	Mean	SD	CV‡ (%)	Mean	SD	CV (%)
Jazera (F+)	2724.9	1079.4	39	2673.1	1222.7	46
Jazera (F-)	1606.7	707.6	44	1398.4	653.2	47
Local (F+)	2390.5	870.2	36	2148.6	879.1	41
Local (F-)	1451.7	703.0	48	1233.6	466.7	38
Conventional	1476.9	687.3	46	1008.7	854.6	85

‡ Variables are as defined in Table 1.
‡ CV = (SD/mean) x 100.

Under both full and farmer packages, the Jazera variety has greater return to investment of fertilizer than the local variety. This result suggests that the Jazera variety is more responsive to fertilizer than the local variety, and thus it is more profitable. Profitability is the most important determinant of the rate of diffusion. Griliches (1976) indicates that hybrid corn diffused more rapidly in areas where it was more profitable than in areas where it was less so. Accordingly, the profitability of the Jazera variety as shown in Table 4 is expected to enhance its diffusion in the region.

Testing for Significant Differences

To statistically test the differences between net returns of alternative treatment, a t-test of paired observations was used (Neter *et al.* 1989). A comparison of calculated values with Table 5 values, at appropriate degrees of freedom and specified levels of significance, shows that differences in net returns due to fertilizer are significant at the 1% level for both varieties and under the two packages. Fertilization makes the net returns of the Jazera and local varieties under the two packages significantly higher (at 1%) than the net return of barley under the conventional practice.

Table 4. Return (ID/ha) to investment of fertilizer in barley production under different varieties and alternative practices.

Area	Full package		Farmer package	
	Jazera	Local	Jazera	Local
Tel-Asmar	33.4	93.1	116.9	104.6
Tel-Atia	52.5	55.6	113.7	64.8
Muslatan	82.0	62.8	66.0	60.0
Baage	9.6	4.4	12.0	10.8
Ein-Talawi	40.0	54.0	84.0	64.0
Khreeze	63.2	53.2	5.2	20.4
Hakna	127.6	45.2	102.3	36.4
Tel-Fares	4.4	19.7	9.8	5.0
Ein-Al-Husan	142.0	64.0	9.8	5.0
Al-Fatsa	4.4	17.4	9.8	5.0
Average	55.9	46.9	63.7	45.7

Table 5. The t-test and levels of significance for paired observations of net returns of barley with and without fertilizer.

Variety and fertilizer†	Full package		Farmer package	
	t-test§	α level	t-test	α level
JF+ / JF-	3.62	0.01	3.749	0.02
LF+ / LF-	5.63	0.01	3.83	0.01
JF+ / Conventional	3.95	0.01	5.49	0.01
LF+ / Conventional	4.76	0.01	4.48	0.01
JF+ / LF+	1.50	ns‡	2.69	0.05

‡ Variables are as defined in Table 1.

‡ ns = not significant.

§ Table value for:
$t(\alpha=0.01, df=9)=3.250$; $t(\alpha=0.05, df=9)=3.250$; $t(\alpha=0.01, df=7)=3.499$; $t(\alpha=0.05, df=7)=2.365$.

Although the Jazera variety is more responsive to fertilizer than the local variety, differences between the net returns of these varieties are not significant under the full-package technology. However, these differences are significantly different from zero at the 5% level under the farmer-package technology.

A similar test was conducted to demonstrate statistical differences due to package type. Net returns of the Jazera variety are not significantly different between the full and farmer packages. Similarly, the differences of net returns of the local variety were not significant with respect to package type. However, earlier analysis showed that coefficients of variation of net returns were lower for the full-package (see Table 3). This may suggest that the full-package technology is less risky than the farmer-package technology. Since risk and uncertainty about a new diffusion exist, the full-package technology would have a faster rate of diffusion than the farmer-package. On this matter, Kebede *et al.* (1990) argue that adoption of agricultural production technologies in developing countries is influenced by economic and social factors as well as by physical and technical aspects of farming and the risk attitude of farmers.

Conclusions

One of the necessary conditions for productivity growth is the development and diffusion of land-saving technologies (Kebede *et al.* 1990). High-yielding crop varieties are essentially an input designed to facilitate the substitution of fertilizer for land. Agricultural research designed to produce and improve an economically viable and ecologically adaptable technology continues to be a critical link in the agricultural development process in many countries.

This study was designed to economically analyze the responsiveness of different barley varieties to fertilizers under alternative technologies. Results reveal that the improved variety (Jazera 1) is more responsive to fertilizer than the local variety under both technological packages considered. As a result, return to investment on fertilization is higher for the Jazera variety. Accordingly, this positive interaction between fertilizer and the Jazera variety will enhance the diffusion of both technologies, since the adoption of one component is expected to accelerate the adoption of the other one. However, because of capital scarcity, especially for small farmers, and risk considerations, farmers are rarely in a position to adopt a complete package (Byerlee and de Polanco 1986). Components initially adopted will be those that provide the highest rate of return on total capital expenses. This would also suggest the potential adoption of fertilizer and the Jazera variety as a result of their high dividends.

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Discussion

N. Mona

How do you classify the Iraqi farmers in terms of risk for applying fertilizer on barley?

K. Shideed

Attitudes of Iraqi farmers to risk have not been empirically investigated. However, the literature has established that farmers are generally risk averse. This means that there is trade-off between variance and mean, since fertilizers are highly profitable, it is expected that their adoption will be enhanced in the region.

The Mashreq Project Approach to Technology Transfer: Strategy and Practice

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Abstract

The Mashreq Project approach to technology transfer incorporates multidisciplinary teams using a problem orientation and participatory approach within the context of a multinational network of researchers. This paper reviews that orientation and organization, and provides an account of the project activities during its first 3 years in the three participating countries. Several observations on setting priorities and targeting activities are made and suggestions are given for their implementation.

Introduction

The objective of the Mashreq Project is to transfer improved agricultural technologies developed by national research programs to farmers and sheep owners in the 200-350 mm average annual rainfall zones of Syria, Jordan and Iraq. Although concentrating on the transfer of available technology, the project also supports technology generation if this is determined to be needed for the improvement of barley and sheep productivity in the project area.

The project strategy is to use a generalized farming systems approach which involves farmers, extensionists, and researchers working together to find practical solutions to production problems faced by farmers. Effective cooperation among these three participating groups is achieved through organized teams and activities, including an emphasis on training and information sharing.

Mashreq Project participating scientists and institutions have worked together to develop a technology transfer strategy specifically tailored to meet the stated objectives of the project. The evolution of the strategy began with the Project Document and has continued during the first three years of project implementation. The guiding principles are plans and activities allowing considerable flexibility and high levels of interaction among participants with mechanisms built in to provide the information necessary to monitor progress, measure success, and identify problems and constraints to achieving project objectives.

Strategic Components

The Project Document stresses the importance of **multidisciplinary teams**. Each participating country has contributed specialists from different disciplines to form national teams under the general responsibility of a National Project Coordinator. Each national team includes researchers and extensionists. The Project Document indicated that each national team should consist of the following disciplines: plant breeding, agronomy, soil fertility, forage production, pasture production, animal breeding, animal management and extension.

The second component of the Mashreq Project strategy is **problem orientation**. The national teams, following initial assessments of the situation in each country and within project areas within countries, have identified specific problems to be addressed. Although all three countries recognize the common problem areas of barley production, forage production, sheep nutrition and sheep fertility, each national team has identified a set of problems specific to its national circumstances and those of the farmers in the project areas. Problem definition and orientation of national project activities has given an added dimension to the individual national teams which was not originally envisioned in the Project Document. The problem-orientation component is reflected in the varied composition and annual workplans of each national team.

The third strategic component is a **multinational network** encompassing the three participating countries, ICARDA, neighboring countries, and international research organizations. After problems are identified and workplans are prepared at the national level, they are reviewed and finalized in a regional technical meeting which involves coordinators and scientists from the three countries, together with ICARDA scientists and consultants from the region. During this meeting results of previous activities are discussed in terms of overall progress toward project objectives, and regional activities for the coming year are identified and planned according to need.

The multinational network has developed through interactions among national teams, all of which share the basic Mashreq Project objectives. Network activities concentrate on information exchange, applying experience gained by one national team to the circumstances of other teams, and developing human resources through joint training and educational activities. During regional training courses, study tours and travelling workshops, personal and professional relations are established among scientists which enhance the utilization of both the information and institutional linkages generated by project activities.

ICARDA is playing a major catalytic role in establishing the multinational network. Although each national team has contributed significantly to the establishment and activities of the network, ICARDA is uniquely placed as an international center based in the region to bring together in common endeavors the institutions and scientists from diverse national research systems. The "linkage effect" created by the network has had positive impact on activity planning and implementation at both the regional and national levels of the project.

The multinational network has had considerable success in reducing the potential risks inherent in implementing a three-country, multi-institution technology transfer program. The risks and their potential for negative impact were spelled out by the Project Document, and the project participants have worked together to change the pre-project situation and thus reduce the risk factors.

The fourth strategic component is the use of a **participatory approach** to technology generation and transfer. The original Project Document correctly states that national research institutions, both alone and in cooperation with international and bilateral agencies, have developed a range of improved technologies which have the potential to increase barley, forage and livestock production. However, given the high environmental variability that characterizes the ecosystem of the project area, innovative technologies require prior validation before recommendation and large programs of dissemination. Validation must be done under the objective and subjective circumstance faced by farmers. This demands farmer participation in the process of technology identification, development, adaptation, and transfer.

Inclusion of extensionists in teams of scientists is not sufficient, and the national teams have taken special care to include the participation of farmers at all levels of the process. Early on, Mashreq Project scientists and extensionists recognized the advantages of building a three-way equal partnership among themselves and the farmers of the project area. It must be recognized that this optimal situation is an objective which has not been fully realized. But, compared with the initial baseline of the first year of implementation, there have been major advances. Initially, national participants had little experience of multidisciplinary teamwork and virtually no familiarity with participatory approaches to agricultural research and technology transfer. Moreover, the farmers themselves had not previously been directly involved in research. The project also faced problems of leadership and management responsibilities within national programs traditionally organized along formal bureaucratic lines that left little scope for participatory research and transfer activities.

Through the efforts of the Project Coordinator, the multinational committees, and the national teams, considerable progress has been made in establishing the participatory approach as a recognized alternative in generating, adapting and transferring new technologies. National project teams represent the action units for participatory activities, irrespective of the Departments to which their members belong.

The fifth component is **human resource development**. This has been alluded to as part of the multinational network activities, but it should be recognized that this responsibility is shared by the individual national teams. The basic principle followed is that the best approach to human resource development is experiential, i.e., that people learn by doing. Therefore, regional and national training and educational activities are designed in terms of subject and content to fit the needs of participants according to their workplans.

Technology Transfer Activities

The original Project Document does not present a complete program of technology transfer activities for the project to undertake. However, it does mention a number of different types of activities which can be inferred as promoting technology transfer. These include diagnostic surveys, farmer selection and targeting, on-farm researcher-managed trials, on-farm farmer-managed trials, demonstrations, monitoring on-farm trials and on-station back-up research. During its first three years of implementation the project has developed an approach to the logical ordering of these activities for individual technologies in the respective project areas.

The starting point is the recognition that the Project Document specifically states that the objective of project activities is to enhance the transfer and adoption of **technologies already developed and adapted** for improved production in the barley-livestock farming system. Although there is a recognized need to validate some technologies through back-up research and on-farm researcher-managed trials, the Mashreq Project is not expected to develop new technologies *per se*. This fact has had a heavy influence on the processual ordering of project activities with farmers.

There are a large number of alternative, and to some extent competing, approaches to integrating research, extension and farmer participation in technology transfer. The majority of them contain at least the three basic activity categories of diagnosis, testing and evaluation, and adoption and impact assessment. These categories have been used by the Mashreq Project to organize the various activities identified by the Project Document, plus a few others implied by the document but not explicitly mentioned. The logical connections among the various activities have been developed by project participants themselves during a number of periodic seminars, training courses, and workshops.

The organization of the three categories and the individual activities within them follows a schematic progression, although it is recognized by project participants that the progression is not unilineal. In fact, the project has maintained considerable flexibility in its transfer activities depending upon the level of adaptation of the various technologies, farmer and researcher identification of problems and solutions, and farmer evaluation of the technologies concerned. For the sake of simplicity, however, we have chosen to list the categories and activities in a linear fashion in Tables 1, 2 and 3.

Category I includes basic research activities in which researchers are expected to take the lead role in teams composed of both researchers and extensionists. Farmers participate particularly in the diagnosis studies conducted on-farm. Farmers and extensionists also participate in Researcher-managed On-farm Trials, but the researchers themselves must take responsibility for designing the trials, implementing them, and recording and analyzing the results.

Category II activities are all conducted on-farm and therefore the primary responsibility for them lies with the extensionists and the farmers, although researchers have a responsibility to follow these activities and utilize their results.

Category III activities involve all participants equally, although there is a necessary division of labor among them.

Tables 1, 2 and 3 present the activities undertaken in each country, by problem area and category, during the 1991/92 season. The tabulation reveals the general pattern of activities, relative emphasis and progression among the problem areas and technologies, and some of the major interrelationships among activities.

It is immediately apparent that the project has not yet undertaken any Category III activities. The reason is simply that it is too early to assess adoption and impact of technologies attributable solely to Mashreq Project activities. However, basic data to be utilized in Category III activities are now being collected and synthesized through other activities, especially diagnostic studies, on-farm trials and monitoring activities. It is expected that by the fifth year of implementation initial adoption studies can be done for barley production technologies in Syria and Jordan.

A second important observation is that there is a relative preponderance of activities in Category I relative to Category II in all three countries. There are good reasons for this. Although the Project Document stresses the transfer of existing

Table 1. Iraq workplan activities, 1991/92.

	Barley production	Forage production	Sheep feeding	Sheep reproduction
Category 1				
Diagnosis	Mosul area survey	Mosul area survey		
Back-up research (on-station)	Eval. dual purpose Eval. forage barley Eval. clipping Mult. long coleoptile Eval. barley lines	Eval. triticale strains Triticale parent incs. Mult. triticale strains Eval. pasture barley Eval. triticale lines	† Fattening study	Eval. offspring Eval. ewes Eval. rams Prod. pure and cross † Health program † Milk production Semen quality
Res. managed (on-farm)	Mult. dual barley Mult. barley lines	Forage legume rotation	† Urea straw	† Awassi rams † Estrous synchron.
Category 2				
Farmer managed (on-farm)	† Full-package barley Improved farmer pack. † Dual-purpose barley		Flushing ewes Liquid diet	
Extension	Field days	Field days	Field days	Field days TV programs

† Field day subject not covered in monitoring surveys.

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Category 2				
Farmer managed (on-farm)	† Full-package barley Improved farmer pack. † Dual-purpose barley		Flushing ewes Liquid diet	
Extension	Field days	Field days	Field days	Field days TV programs

† Field day subject not covered in monitoring surveys.

Table 3. Syria workplan activities, 1991/92.

	Barley production	Forage production	Sheep feeding	Sheep reproduction
Category 1				
Diagnosis	[Barley prod. survey]† Barley pest survey	[Al-Bab study] [Breda study†]	[Three villages] [Breda study]	[Three villages]
Back-up research (on-station)	Gamma ray treatments	Eval. pasture barley Eval. forages Eval. harvest losses	[Treated straw]	[Body condition and nutrit. on fert.]
Res. Managed (on-farm)	‡ Testing lines + fert. ‡ Testing package ‡ No-till testing	‡ Forage legume rotation Forage mixtures ‡ Ley farming Straw baling Evaluate forages	§ Urea + litter § Urea straw § Early weaning Flushing § By-products	§ Use of hormones Eval. Awassi rams § Synchronization
Category 2				
Farmer managed (on-farm)	‡ Variety + fert. ‡ Local var. + fert. ‡ Herbicide + fert. ‡ Seed rate + fert.			
Extension	Field days† Seminars†	Field days† Seminars†	Field days† Seminars†	Field days† Seminars†
Monitoring	Demonstration and researcher-managed farmers† Field day participants† Neighbors†	Field day participants† Neighbors†		
Category 3				
Adoption	[Fertilizer use]			

† Activities in brackets are non-project research. ‡ Technologies covered in farmer monitoring surveys. § Field day subject not covered in monitoring surveys.

technologies, it also recognizes that many of the technologies named in the document have not yet been validated for local environmental conditions, much less actual farm-level management conditions. In particular, most forage production, sheep feeding and sheep reproduction technologies identified in the Project Document have not been adequately validated and adapted for transfer. Therefore, they remain in the testing stage. Some farmer evaluation has nonetheless been incorporated through extension and monitoring involvement in on-station and researcher-managed on-farm work.

The particular technologies and categories within which they are found in each country is a reflection of the different farming systems, national priorities, and stage of adaptation and validation of those technologies in each country.

Once its performance is validated through on-farm research, a technology is given to farmers to use and evaluate independently (through farmer-managed demonstrations) without guidance or management input by researchers. To date this type of evaluation is being undertaken mostly for standard barley production technology in the form of various combinations of component technologies, particularly fertilizer, improved varieties, seed drills and herbicides. Farmers' judgements and acceptance information for the components, both individually and in combination, are collected and synthesized through extensive monitoring studies of demonstrators, participants in extension field days and seminars, and farmers not directly participating in the Mashreq Project.

Extensionists working in the Mashreq Project have implemented an extensive program of field days and seminars in all three countries. These activities bring farmers and researchers together and cover a range of farmer-managed demonstrations, researcher-managed trials and on-station back-up research. Farmer observations and attitudes toward the technologies shown and explained in these activities are included in the monitoring activities.

The monitoring activities have several purposes. The first and most basic is to assess farmer acceptance of the technologies that the project is validating and trying to transfer through its various activities. Acceptance is the precondition for adoption and achievement of the overall project goal of increasing productivity in the barley-livestock farming system. The second purpose is to evaluate an important assumption made by the Project Document, namely that "the adoption of the recommended technology by a large proportion of farmers, in the target areas and beyond, will be stimulated through on-farm field demonstrations involving researchers, extensionists and farmers." In fact, a key function of the monitoring work is to determine the effectiveness of the demonstration program in transferring technologies to farmers. Each national team has implemented a variety of different types of demonstrations, and the monitoring work is designed to determine which of these types is most effective in achieving an acceptable rate of farmer acceptance and adoption for particular technologies in specific recommendation domains. A corollary of this is the readjustment of target farmer groups based on relative rates of acceptance and subjective incentives for adoption. Initial targeting and demonstration farmer selection is expected to be revised as the result of monitoring the demonstration program.

The third purpose is to identify constraints faced by farmers with regard to adoption of the range of technologies offered by the project. This is an important diagnostic dimension of the monitoring activities. A number of potential constraints have been identified by the Project Document. Among these are availability and cost of technological inputs (e.g., fertilizers, improved variety seeds, recommended machinery), price differentials among various crop and livestock options, and technical back-up to farmers from both extension and research. To this list can be added the obvious importance of acceptable performance under farmer conditions of the improved technology. The monitoring studies provide evidence for determining the degree of risk embodied in these factors.

The fourth purpose is to utilize the results of the monitoring activities to identify where future emphasis should be placed in overcoming production problems. Examples of this type of result could be a relative de-emphasis on fertilizer use because of relatively high acceptance, but increased emphasis on seed rate problems and evaluation of the need for herbicides in the drier areas.

The workplan activities in each country show a significant degree of integration among categories and problem areas. This is as it should be. Integration has taken place, especially in terms of farmer participation in diagnosis, extension activities and monitoring. Thus the results of one activity are applicable across a range of problem areas and technologies. This reflects the reality of the local farming systems which integrate crop, forage and livestock production.

It should be noted that the Mashreq Project has made extensive use of previous research results with the workplans of each country. Some of these non-project studies are indicated in the workplan tables, where it can be seen that previous diagnostic research, in particular, has made an important contribution in both Jordan and Syria. In Iraq, the national project team undertook its own diagnostic study because no previous research was available.

Looking Toward the Future

Our brief review and discussion of the Mashreq Project approach to technology transfer has led us to some tentative items for discussion regarding the future directions of the project. The first item is diagnostic research in livestock production. Except in Syria, where the national program has worked extensively with ICARDA over the years in the diagnosis of sheep feeding and reproduction, there are few studies that the project has utilized in identifying and analyzing farm-level problems, constraints and incentives in sheep production. It may be helpful for priority setting and targeting in this important subject area to place a greater emphasis on farm-level diagnosis of livestock production in the future.

The second suggestion is to work toward a better integration of the forage-production work with the sheep-feeding research. Grazing management is a crucial aspect of this.

The third suggestion is to devise farmer-managed demonstrations of sheep-feeding and sheep-reproduction technologies which do not require unacceptably high levels of new management skills and technical expertise on the part of farmers. In other words, there should be a movement of technologies in these problem areas out of the hands of researchers and into the hands of farmers for the purpose of obtaining farmer evaluations based on direct experience using the technologies.

The fourth suggestion is to review progress in the barley production component demonstrations with the object of selecting a narrower range of demonstration types. Resources saved from reducing the range of different demonstrations conducted could then be devoted to implementing demonstrations in the other problem areas.

Discussion

R. Booth
It appears from your comments on partial adoption that the concept of better targeting of particular packages has emerged. Do we have the information available to better target the specific packages?

R. Tutwiler
Yes and no.

R. Booth
The best option is likely to be to demonstrate a range of options rather than to target specific packages.

Effectiveness of Mashreq Barley Demonstrations in Jordan

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Abstract

Participants in improved barley production demonstrations were monitored for the period 1989-92. Results indicate large increases in the use of full-package technology, consisting of improved variety, fertilizer, seed drill and herbicide application. Somewhat smaller increases were observed for individual components, although the total use of improved varieties and fertilizer, either in combination or as individual components, was more than double the current use level of full-package technology. The most efficient form of demonstration appears to be the full-package rather than single-component technologies. Farmers can observe the response from the full package and decide for themselves the best components to adopt to meet their needs.

Monitoring of Barley Demonstrations in Jordan

The Mashreq Project started in Jordan as in Syria and Iraq in the 1989/90 season. After 3 years of implementing a number of demonstrations and trials on farmers' fields, it was found necessary to follow up the farmers in the study area. The purpose of this process was to study the effect of technologies that the project was trying to transfer to farmers. This study would indicate to what extent farmers are accepting the practices being used on their lands by the project. The ratio of acceptance will help in adjusting the project approach if necessary, or modifying the method of performing the demonstrations. The procedures of work followed by the project in Jordan are summarized in the following.

Methodology

Farm Target

The project aims to increase the productivity of barley, pasture and sheep in marginal areas that receive 200-350 mm of annual rainfall. Therefore, the project focused on farmers who live in these areas and consider barley production and sheep as the best investment for their resources. The marginal areas in Jordan are located in three geographical regions:

1. North: the eastern side of Irbid province and the western and west-southern side of Mafraq province.
2. Central: southern areas of Amman province, particularly in Madaba area.
3. South: eastern areas of Kerak province, Tafila province and Shoubak area.

Diagnosis of Farming System in Target Area

The marginal area in Jordan includes 70% of the arable land where about 41% of the Jordanian population live. The main characteristics of the farming system in the area is the low productivity of barley, forages and red meat, and a fragile system of integration between cropping and animal production. The area is also characterized by irregular rainfall; therefore, farmers are always worried about unexpected weather. They try to select crops and practices that will produce even the minimum yield under these conditions instead of applying new methods or technology that could increase their production.

Identifying Farmers' Problems

Researchers cannot recommend a suitable technology for solving farmers' problems before defining these problems and knowing the obstacles faced by farmers at the farm level. The dominant circumstances in the farm might play a vital role in defining practices and then selecting the proper technology that will have a good potential for adoption by farmers.

The project team in Jordan has used all data available from two previous studies for diagnosis of the farming systems in the target area:

1. A farm survey implemented in 1988 by a cooperative research project between the Jordanian National Program represented by the Faculty of Agriculture at Jordan University of Science and Technology (JUST) and the International

Center for Agricultural Research in the Dry Areas (ICARDA) represented by the Farm Resource Management Program (FRMP). This survey covered 55 farmers distributed in 20 villages in the Mafraq area in North Jordan. In 1989 a complementary survey included another 59 farmers from 15 villages in addition to the 1988 villages.

2. A comprehensive farm survey conducted in 1989 by Dr N. Khaldi of the International Food Policy Research Institute (IFPRI). This survey was executed by the Jordanian National program on 454 barley and wheat farmers all over Jordan. The Mashreq Project focused on the sample of farmers living in the marginal zone; they comprise 75.9% of the total sample.

The total number of barley farmers covered in this survey was 334, distributed in north, central and south Jordan.

The results of analysis indicated that the major problem of farmers in marginal areas is the low productivity of barley grain and other feedstuff. This problem led to a shortage in red meat and obliged Jordan to import most of its meat requirement. If we look for the reasons that created the low productivity problem, it will be found that it might be due to the farmers themselves since they still use conventional practices in barley cropping. Because they rely completely on farming, they do not try to increase their production either by investing more inputs or by initiating new practices that could be more profitable.

Barley Demonstrations

The Mashreq Project has proposed a plan to solve the problem of low productivity of barley based on the results of research conducted by the National Program and cooperative research projects with some international centers. These results enabled the project team to define the most suitable farming practices for barley production. All these practices and technologies, which led to a significant increase in barley grain and straw, were called a full-package technology. These technologies should have the following characteristics: be applicable by farmers; be available at reasonable cost; should not require unreasonable changes in farming system, and should solve farmers' problems.

The full-package inputs include the following practices:

- Land preparation by using a chisel plow
- Seed bed preparation by duck-foot plow
- Early sowing before rain
- Sowing by seed drill
- Using a seed rate of 70 kg/ha

- Using an improved variety of seed such as Rum, ACSAD 176 or Deir Alla 106
- Using fertilizers at the rate of:
  - 100 kg/ha of diammonium phosphate incorporated into the soil at time of sowing
  - 50 kg/ha of urea or 150 kg/ha of ammonium sulfates, top-dressed at tillering stage if rainfall is adequate
- Using chemical herbicides for weed control if necessary.

The current study focused on only four components of this packages: improved variety, fertilizer, seed drill and chemical herbicides. These four components were demonstrated on farmers' fields either individually or as a package. The full-package practices were tested on two levels of farms:

1. Consolidated farms, where the demonstration was conducted on a large area belonging to more than one farmer. This practice enabled the machines to work more easily and encouraged farmers to cooperate and exchange information.
2. Individual farms, where improved variety, fertilizers, seed drill and herbicides were demonstrated together on a parcel of land owned by one farmer.

Other types of demonstrations (Table 1) included one or two of the above-mentioned components such as:

- Improved variety: an amount of improved barley seed was given to farmers to be grown on half of their land; a local barley cultivar was grown on the other half
- Fertilizers were applied on half of the farmers' barley field to be compared with a non-fertilized half
- Improved variety plus fertilizer: this was called a double-input demonstration since farmers could see the effect of fertilizers on both varieties. The field was divided into four parcels, two of them cropped to a local cultivar and only one fertilized. The other two parcels were cropped to an improved variety and treated the same as the local ones.

Farmers' Groups Included in the Sample

In total, 476 farmers were included in the monitoring study. The four groups comprised:

1. Farmers who cooperated with the project by implementing demonstrations on their land and sharing the management with the project team
2. Farmers who participated in the project activities by attending field days and/or seminars organized by the project

3. Farmers who owned a barley field adjacent to the demonstrations
4. Farmers who were randomly selected and not included in the above three groups.

Table 1. Distribution of barley demonstration sites by region in Jordan during three seasons, 1989/90-1991/92.

Type of demonstration	Research district					
	Karak	Madaba	Ramtha	Shoubak	Tafila	Total
Full-package practices						
Consolidated farms	16	7	4			27
Individual farms	12	16	15			43
Variety	5	1	3	1		10
Fertilizer	4	2	1	1		8
Variety + fertilizer	21	25	25	26	7	104
Total	58	51	48	28	7	192

A special questionnaire was established for the purpose of the study. Twenty-nine questions were common for the four groups, and each group had extra, special questions according to its involvement in the project.

Results

Socioeconomic Characteristics

The preliminary analysis indicates that farm income contributes 38.5% of the total family income. Although the farm-dependent farmers get more than 75% of their family income from the farm, they comprise only 33% of the whole sample. Of these, 59% own livestock, which increases their total family income compared with the other farm-dependent farmers without livestock (Table 2).

Of farmers who are not solely dependent on farm income, 49% of them have sheep, but farm production contributes, on average, only 20% of total family income.

Data on socioeconomic characteristics of the cooperating farmers were only subjected to analysis because of their importance in the sample as they were in direct contact with the project team. The average age of farmers was 51 years, average family size was 9 and the average number of family members working on the farm was 1.6 persons. Percentage of illiteracy was 20.8%, average education level was 7.4 grades, and the lowest level was 3.6 grades.

Use of Technology in Barley Farming

A combination of fertilizer and improved variety is used by farmers more than a seed drill combined with herbicides. Also, the first combination is more accepted and the average increase in acceptance is faster than for the seed drill and herbicide combination all over Jordan. This indicates that Jordanian farmers in general tend to jump a step or two in the process of adopting the full-package technology. This is evidenced by the percentage change between the technology users before and after the demonstrations. The results show that using herbicides as a weed control method in barley fields seems to lose its popularity except as a fourth component in the full-package practice.

The results of data analysis indicate that a considerable change occurred in use of technology by farmers in barley cropping between 1989 and 1992. Table 3 shows comparisons between the two years in north, central and south Jordan. In 1989 there was a high percentage of farmers using fertilizers, but the other inputs were used in low percentages. The higher percentage of technologies used was recorded in north Jordan. The use of the four components as a package was very low. Relatively low averages of using improved variety together with the seed drill may be due to the nonavailability of the drill.

Table 2. Distribution of farm income compared with farmer's interest in sheep.

	Number of sheep/ha		
Farmer	None	< 4	> 4
Dependent	64	54	39
Farm income (%)	73.4	76.8	85.5
Non-dependent	162	102	54
Farm income (%)	18.2	20.5	20.6

† Dependent = sole income derived from farm; non-dependent = income from farm and outside.

Table 3. Comparison of technology used in barley farming by different groups of farmers, 1989 and 1992.

Type of technology	Demonstration		Neighbors		Field days		Random	
	No.	%	No.	%	No.	%	No.	%
North Jordan (Ramtha and Mafraq)								
N	34		37		20		14	
Full package	3	8.8	2	5.4	1	5.0	1	7.1
Variety	11	32.3	12	32.4	7	35.0	2	14.3
Fertilizer	11	32.3	9	24.3	9	45.0	4	28.6
Seed drill	10	29.4	4	10.8	5	25.0	3	21.4
Herbicide	4	11.8	9	24.3	3	15.0	1	7.1
None	17	50.0	16	43.2	6	30.0	10	71.4
Central Jordan (Amman and Madaba)								
N	49		38		25		12	
Full package	3	6.1	0	0.0	0	0.0	0	0.0
Variety	26	53.1	1	2.6	0	0.0	0	0.0
Fertilizer	10	20.4	14	36.8	7	28.0	1	8.3
Seed drill	18	36.7	3	7.9	2	8.0	2	16.7
Herbicide	21	42.9	10	26.3	6	24.0	3	25.0
None	13	26.5	21	55.3	15	60.0	8	75.0
South Jordan (Karak + Shoubak + Tafila)								
N	92		68		35		35	
Full package	24	26.1	14	20.6	1	2.9	1	2.9
Variety	37	40.2	23	33.8	1	2.9	4	11.4
Fertilizer	45	48.9	26	38.2	3	8.6	9	25.7
Seed drill	40	43.5	24	35.3	6	17.1	7	20.0
Herbicide	37	40.2	28	41.2	13	37.1	12	34.3
None	24	26.1	31	45.6	21	60.0	20	57.1

The important column to look at in the 1992 sample is the last one (randomly selected sample) as the others were subjected to bias during selection. It seems there is a trend toward using technologies in general, but there is a clear tendency to use one component more than another. Fertilizer use in 1992 was slightly decreased in north Jordan except by farmers who attended field days. A lower average of fertilizer use also was recorded by the selected farmers in north and central Jordan. This might be due to the droughts that occurred in 1989 and 1992 and to the size of the sample, which does not represent the total number of farmers. A general tendency toward more use of technologies could be a natural result of the increase of availability.

Acceptance of Demonstration

Table 4 represents the situation with farmers before and after demonstrations on their lands. The percentage change in using all the components of the full-package is positively increased either as a package or as a single component. In 1989, 44% of the farmers sampled were using fertilizer before the demonstration, but 77% of those sampled accepted or intended to use fertilizer after having seen the effect of fertilizer in the demonstration. This indicates a change of 33.7% of the total sample, equal to 76.6% of the users. This percentage can be considered as an indication of the effectiveness of demonstrations in improving farmer acceptance of technology.

Table 4. Level of acceptance (as % of total participants) of Mashreq technologies after 3 years of project demonstrations on farmers' fields (1989 vs 1992) in Jordan (results from 192 participating farmers).

Technology	Previous practice	Post-demo acceptance	Change
Full package	17.0	39.0	+127.0
Fertilizer	44.0	77.7	+76.6
Variety	37.7	68.0	+118.0
Drill	38.8	57.7	+48.5
Herbicide	36.0	41.1	+14.3
None	36.0	20.6	-42.9

Note: Many farmers use more than one component technology, therefore column totals equal more than 192.

The results show a high ratio of acceptance of most components of technology as well as all of them as a package. The ratio of acceptance of each component separately or combined varies from region to region, for example, between Karak and other regions. However, the effectiveness of the program was indicated by the percentage change in Karak, which was less than in other regions. This could be due to the high adoption rate in Karak before the last season of demonstrations. The adoption rate might be increased after only one or two years of the project's start.

Conclusions and Recommendations

The most efficient use of the project resources to achieve an adoption of barley production technologies is to implement only full-package demonstrations. This recommendation is applicable in north and central Jordan and at least in the Karak region in the south. The most convenient demonstrations in Shoubak and Tafila are those consisting of fertilizers and improved variety.

We conclude from the results that herbicides are applied only as a fourth component in full-package practices, and if farmers have the choice of dropping one of the four components, it will be herbicides.

Minimizing demonstrations of a component that is already practised by farmers is preferable and might improve the technology transfer process among participating farmers.

Effectiveness of Mashreq Project Demonstrations in Syria

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Abstract

The Mashreq Project in Syria aims to transfer available technology to farmers in the 200-350 mm average annual rainfall zones. During the 1990/91 and 1991/92 cropping seasons, the project scientists conducted 52 demonstration trials in farmers' fields throughout the rtarget areas in Syria. In addition to the on-farm activities, the project activities included monitoring farmers to follow up on the process of adoption of new technology. A sample of 163 farmers was selected during both seasons, which included farmers collaborating in the project, farmers from the neighborhood who were aware of the Mashreq Project activities, and farmers who did not know about the project. Analysis of the 1990/91 survey indicated that farmers participating in the project did so to acquire scientific and practical knowledge and experience. In 1991/92 the demonstration program focused on barley production packages and survey results indicated that the demonstration program in Syria has been effective in improving the rate of acceptance. Adoption of new technology is still in its early stages, but the primary indicators are positive and encouraging.

Introduction

Barley is the most widely grown cereal crop in Syria and ranks first in terms of total sown area. Barley is predominant in environments receiving between 200 and 350 mm of rainfall. Both the barley grain and straw are utilized as feed for livestock, especially sheep, and thus crop and livestock management are closely interlinked. Rainfall is low and variable, so seasonal distribution of rainfall is of major importance. Because of the uncertainty of crop performance, farmers seem to be hesitant to make substantial investments in improving production.

Barley-Livestock Farming Systems in Syria

Several diagnostic surveys of barley producers in Syria have been undertaken (ICARDA 1985). The trends observed are summarized here. During the last 50 years there has been a decline in productivity. The introduction of mechanization and an increase in population have resulted in more intensive cultivation of the land and the expansion of production into more marginal areas. Land used to be fallowed for one or more years, but in many areas this is being replaced by continuous cereal cropping. The increased exploitation of the land has not been matched by increased inputs, with resulting poor soil fertility and therefore low yields. Although physical and economic responses to fertilizer application have been demonstrated in field trials, very few farmers have decided to use fertilizer. Lack of investment in inputs is further exacerbated by land tenure systems in northeast Syria where large commercial producers sharecrop the land of smaller farmers, an arrangement which does not provide an incentive for investment in soil fertility to either party.

Associated with the low levels of productivity, severe seasonal shortages of sheep feed occur. Winter and early spring are critical, and during these periods the sheep rely on supplemental feeds. Another important aspect of these systems is that many farmers are seeking off-farm employment. This probably reflects both increased opportunity for such activities and decline in profitability of farming. Whatever the reason, the relative scarcity of labor, particularly in critical seasons, may well have implications for the introduction of new farming practices.

The first stage in farming systems research emphasizes formal and informal surveys to gather information about current farmer practices and identify constraints that limit production. An extensive survey of 153 farmers in 51 villages during the 1981/82 cropping season in northern Syria, which covers about 95% of the barley-production areas in the country, has provided a wealth of information useful for planning and assessing Mashreq Project activities (Somel *et al.* 1984).

The survey followed the farmers' operations in three visits: the first visit was prior to planting, when economic information and data on production practices were collected. The second visit was during spring to make field observations on agronomy, plant physiology, pathology, entomology and to collect plant and soil samples. The third visit was after harvesting to gather information on yields, production, utilization, storage and marketing of barley. These visits were conducted by multidisciplinary teams of social and biology scientists. Table 1 presents some general descriptive information resulting from this study.

Table 1. Barley production practices in the 1981/82 season in Syria (% of 153 farmers).

	Northwest			Northeast			
	2	3	4	2	3	4	Average
No. of observations	30	24	15	21	27	36	
Cropping practices							
Fallowed the previous year	70	46	20	29	11	11	31
Continuous barley	20	38	20	57	82	86	51
Land preparation							
Plowing before fall	70	58	67	43	19	14	45
Plowing in fall	67	42	17	81	78	89	62
Plowing before and in fall	43	21	20	10	11	8	19
Planting method							
Drilling	43	21	3	52	48	36	34
Mechanical broadcasting	7	0	3	48	48	50	26
Hand broadcasting	50	79	93	0	4	14	40
Seed source							
Stocks	80	67	80	91	70	69	76
Neighbor	7	8	7	0	0	3	4
Market	17	21	10	5	0	6	10
Sharecropper	3	4	7	5	30	22	12

	Northwest			Northeast			
	2	3	4	2	3	4	Average
No. of observations	30	24	15	21	27	36	
Fertilizer use							
Phosphate in fall	50	0	0	5	0	0	9
Nitrogen in fall	50	0	0	0	0	0	9
Nitrogen in spring	37	0	0	0	0	0	6
Varieties							
Arabi Aswad	57	46	57	95	100	94	75
Arabi Abiad	50	63	53	5	0	6	30
Seed rate (kg/ha)	133	110	97	102	98	98	107
Grain yield (1981/82) (kg/ha)	698	494	376	586	283	322	460
Grain yield (long term) (kg/ha)	681	957	573	997	782	567	760
Phosphate available in soil (ppm)	6.74	7.25	7.54	4.94	4.26	5.34	6.01

Problems of Barley Production

It was possible from the diagnostic surveys to identify problems related to barley production in Syria as follows:

- Barley yields were low; the general mean during the long run was about 760 kg grain/ha, and in the drier areas it was less than 500 kg/ha
- Farmers' inputs were low; only 10% of farmers used fertilizer and these were all in high-rainfall areas
- Natural soil fertility was low; about 70% of barley-field soils that were analyzed had less than 6 ppm of available P (Olsen method)
- More than 50% of the farmers continuously grow barley in the same fields
- All barley varieties were local.

Research to Improve Barley Production

ICARDA in collaboration with national programs has worked for many years to improve barley productivity. A summary of some of these results follows.

1. To assess the biological and economic response of barley to nitrogen and phosphate fertilizers, 75 on-farm trials were conducted between 1984/85 and 1987/88 in Zones 2 and 3 of Syria. Of 75 trials, 74 produced a significant grain or straw yield response to fertilizer, either to N or P or both (ICARDA 1990). In general,
   - The importance of N increased and that of P decreased with increasing rainfall, but response to N and P applied together increased with rainfall.
   - N was more important in the lower-yielding barley-barley rotation than in a fallow-barley rotation, although not by a wide margin.
   - Initial soil status of available phosphate and mineral N influenced barley response to fertilizer.
   - Barley responded to fertilizer. Seasonal rainfall, soil type, soil fertility status and crop sequences all had important effects on crop growth.
   - The economic analysis (Mazid and Bailey 1992) shows that economic optimum fertilizer rate varies considerably with rainfall and relative prices. Fertilizer use on rain-fed barley, especially at the appropriate level, may not be risky.
2. Promising pure-line selections have been derived from Syrian landraces and tested in diverse environments of Syria (ICARDA 1989). One of these lines is Tadmor, derived from the black-seeded landrace Arabi Aswad. Another is Arta, which is derived from the landrace Arabi Abiad. ICARDA's advanced germplasm is tested in the region through international nurseries to identify promising genotypes for direct use by NARS and ICARDA. Some barley varieties were selected and multiplied in Syria through this system.

3. On-station long-term rotation trials, on-farm grazing trials, and on-farm rotation trials (ICARDA 1987) successfully demonstrated that annually sown forage legumes (vetch and lathyrus) can economically replace fallow or break a continuous barley cultivation. The profitability of doing so is substantially increased when phosphate fertilizer is used in the rotation.

Mashreq Project in Syria

The Mashreq Project concentrates on rain-fed barley, forages, pastures and livestock (mainly sheep) to transfer available technology to the farmers in the 200-350 mm average annual rainfall zones. The project will also promote effective collaboration between Syrian researchers and extension institutions to increase the adoption of the recommended technology by a large proportion of farmers in the target areas to:

- Increase productivity of barley, forage and livestock in the marginal areas receiving 200-350 mm rainfall per year
- Improve grazing management and sheep reproduction
- Reduce feed concentrate needs through using hay and straw
- Introduce forages to replace fallow
- Improve cooperation among research and extension services
- Establish a regional network.

During the 1990/91 and 1991/92 cropping seasons, the Mashreq Project in Syria conducted 52 demonstration trials distributed in the target areas (Fig. 1). The activities included plant production, livestock production and monitoring participating farmers. The work was distributed in two agricultural stability zones: Zone 2, receiving annual precipitation of 250-350 mm and not less than 250 mm during two-thirds of the related years, i.e., it is possible to have two barley seasons each 3 years; and Zone 3, receiving annual precipitation of 250-350 mm, and not less than this during half of the related years, i.e., it is possible to have one to two seasons each 3 years. The 1991/92 activities in Syria were as listed below.

Plant Production Activities

On-farm activities

Demonstration of barley production technology:

- improved barley cultivars and fertilization in Zone 2
- response of local barley to fertilization in Zone 3
- the effect of chemical weed control on barley in Zone 2.

Barley seeding rate demonstrations.

Researcher-managed on-farm studies

Testing of promising barley lines:

- promising barley lines, with fertilizer and weed control for Zone 2
- promising barley lines with fertilizer for Zone 3
- barley/forage legume rotation study (Zones 2 and 3).

No-tillage barley production trials in Zone 3.

Demonstrations of barley-triticale/forage legume mixtures.

Evaluating barley/annual medic ley farming system.

Demonstration of straw baling.

Evaluation of three most promising forage legume species from low-rainfall areas.

Back-up research

Evaluation of self-regenerating pasture barley.

Evaluation of forage legume species for low-rainfall areas.

Estimates of barley grain losses as a result of delayed harvesting.

Survey of barley pests in farmers' fields and the economics of chemical control.

Effect of gamma ray treatment on barley production.

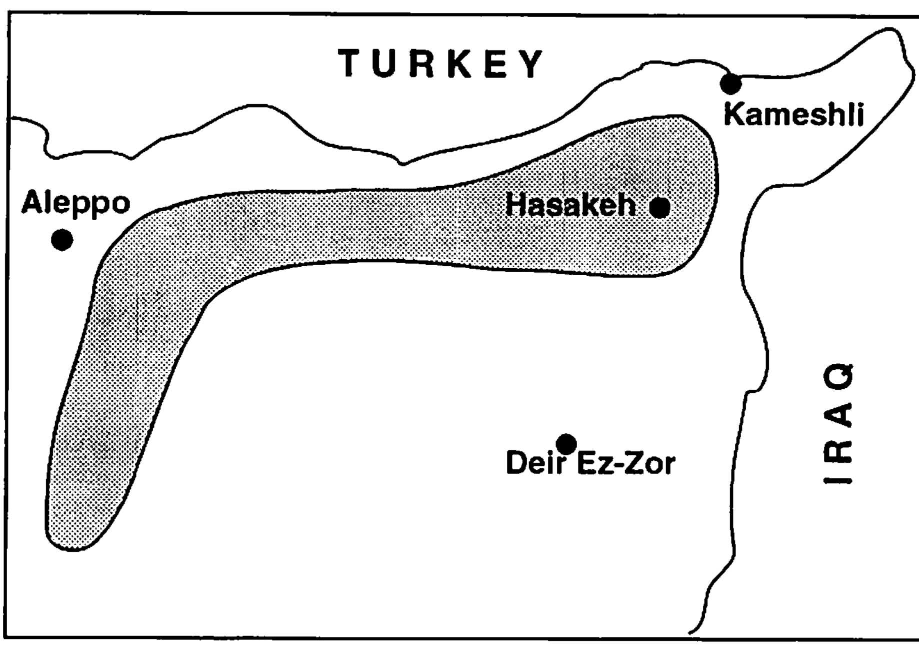

Fig. 1. Target areas of Mashreq Project in Syria.

Animal Production Activities

Demonstration on farmer's sheep flocks

Increasing fertility of Awassi sheep by hormonal treatment.
Effect of improved Awassi rams on increasing production in farmers' flocks.
Effect of flushing on increasing lamb crop in farmers' flocks.

Evaluate new technologies (researcher-managed)

Effect of early weaning on increasing the economic return for sheep owners.
Effect of urea + chicken litter blocks on sheep production.
Effect of urea-treated straw on lamb fattening.

Monitoring Participating Farmers

Monitoring and survey of participating farmers

Besides the on-farm activities and demonstration trials at the farmers' fields, Mashreq Project activities included monitoring farmers to follow up the process of new technology adoption demonstrated in the project.

A sample of 163 farmers was selected from the project area during 1990/91 and 1991/92 cropping seasons (Table 2). Fifty-two farmers collaborated in this project; 77 farmers were from the neighborhood and knew about Mashreq Project activities and 34 farmers were neighbors who did not know about the project activities. The neighboring farmers were selected randomly. Sample size was 88 farmers in the first season and 75 farmers in the second season. Mashreq Project researchers visited the sampled farmers after designing a suitable questionnaire. The first year's questionnaire was different from that of the second year, but both questionnaires emphasized new technologies applied to barley and plant production activities more than new technologies used on livestock. Interviews were during July after harvesting and disposal of the crop.

Sample Description

Statistical tests were done in four dimensions; the first dimension was participation in the project, and the sample was divided into three groups: farmers who collaborate with the Mashreq Project, neighboring farmers who have knowledge about the project activities, neighboring farmers who do not know about this project.

Table 2. Distribution of farmers sampled in northern Syria.

	Collaborators	Neighbors (participants)	Neighbors (non-participants)	Total (%)†
Provinces				
Hama	18	28	13	36.2
Raqqa	17	24	10	31.3
Hassakeh	17	25	11	32.5
Zone				
2	29	45	17	55.8
3	23	32	17	4.4
Cropping seasons				
1990/91	26	51	11	54.0
1991/92	26	26	23	46.0
Total	52 (31.9%)	77 (47.2%)	34 (20.9%)	

† Expressed as percentage of total (= 163) farmers.

The second dimension was provinces. The sample was divided into three groups: Hama farmers, Raqqa farmers and Hassakeh farmers.

The third dimension was according to agricultural stability zones: Zone 2 and Zone 3 farmers. The last dimension of the analysis was by cropping season: surveys were done in the 1990/91 and 1991/92 seasons.

The statistical analysis shows that there are no significant differences for most socioeconomic variables except education, livestock importance, need of feed and number of sheep across provinces.

Farming Practices of Barley Production

Variety

All farmers grew local varieties because of the unavailability of new ones. The promising new varieties are still under test. While the local variety Arabic Abiad predominates in the west (Hama), the local variety Arabic Aswad predominates in the northeast regions (Raqqa and Hassakeh).

Sowing methods
Manual broadcasting of the seed is most common in Hama, whereas the Harrow seeders are mostly used in the northeast (Raqqa and Hassakeh). However, it seems that the method of sowing barley has not changed during the last 10 years.

Seed rate
A tendency for increasing the seed rate has been reported. The average seed rate for the whole sample was about 155 kg/ha (with a range of 100-350 kg/ha). These figures indicate an increase of 50% over the seed rates used 10 years ago. Farmers in Zone 2 generally use higher seed rates than those in Zone 1. Farmers gave several reasons for the increased seed rates: poor or low germination rate of the seeds, dense plant population to compete with weeds, etc. However, these reasons have not been tested for their effects and importance.

Seed source
Farmers' own stocks are the principal seed source, followed by the Agricultural Bank as the second source of seed. However, there is a clear difference in seed source between zones and provinces.

Fertilizer application
Fertilizer use on barley has increased considerably, the percentage of applicants now being more than five times the number 10 years ago. A higher percentage of fertilizer users was reported by farmers cooperating with the project than by noncooperators. There is also a high percentage of new adopters of fertilizer on barley. This could be due to the impact of the project. A higher percentage of non-adopters are in Zone 3 than in Zone 2, and in Raqqa than in other provinces. This situation should be considered when locating next year's on-farm trials and demonstrations.

Land use and cropping pattern
About 63% of the total farm area (of the sample farmers) was allotted to barley, 19% for wheat, 6% for legumes and other crops, and 11% was fallowed. However, these cropping patterns did not differ between agroclimatic zones or between years (from year to year). However, there were some differences between provinces, such as higher allocations for barley in Raqqa and relatively higher importance for wheat in Hassakeh. Therefore, the medic trials should be concentrated in Hama and Raqqa provinces to replace the fallow. Rotation trials and the introduction of forage legumes should be concentrated over all the study areas to reduce the practice of continuous barley which has negative and damaging effects on soil characteristics, as is well demonstrated by research results.

Farmers' Acceptance of New Technologies

Emphasis was given in the 1990/91 farm survey to identifying farmers' reasons for participating in the project. About 75% of the 26 participants stated that acquiring scientific and practical knowledge and experience is the principal reason for their participation (Table 3). The benefits gained from the project were related to knowing about the positive response of barley to fertilizer application, about new and promising varieties, and about optimal seed rates.

Some questions concerning acceptance of the new technologies were addressed to non-participating neighboring farmers. Positive answers were given by 75% of these non-participants. This can be viewed as a good indicator of the positive impact of the project.

In the 1991/92 season, the demonstration program focused on barley production packages, with a total of eight individual components. Twenty-six farmers had demonstration trials. All of them included fertilizer as one component, 23 included promising lines (Arta, Zamabaka, Tadmor or WI 2991), 22 included released varieties (Furat 1 or 2), 16 included a medic rotation, and 2 included an annual forage legume rotation. The minimum package demonstrated was fertilizer, variety and/or promising lines. The maximum package was fertilizer, variety, promising lines, drill, seed rate, no tillage and forages. In order to estimate the acceptance of individual components, we had to de-aggregate the components within packages.

Unfortunately, this method precludes us from commenting upon the impact of component interactions. There are not enough cases to allow a statistically valid assessment of component interaction except for fertilizer with variety or promising lines.

As mentioned, the 1991/92 sample included the 26 collaborating farmers, 26 farmers who had no demonstrations but attended seminars or field days, and 23 farmers with no involvement in the project activities. Acceptance rates were determined by asking farmers if they would adopt individual components if these were available. A "Yes" answer means positive acceptance of a component. A "No" answer means a negative acceptance. Farmers without knowledge of a particular component were excluded from that component's acceptance rating. Table 4 presents acceptance ratings for some package components.

Table 3. Farmers' opinions (% of those surveyed) about the Mashreq Project in 1990/1991.

	Province			Zone		Total sample
	Raqqa	Hassakeh	Hama	1	2	
Reasons for collaboration						
Acquiring scientific knowledge	85.8	85.7	70.0	78.8	80.0	75.0
Acquiring practical experience	14.3				10.0	4.2
Economic considerations		14.3	10.0	7.1	10.0	8.4
Fertilizer importance	42.9	14.3		7.1	30.0	12.5
Knowing about varieties requested by MAAR			10.0	14.3		8.3
Benefits gained						
From fertilizer use	87.5	85.9	37.5	50.8	81.9	65.0
From new varieties	62.5	71.4	75.0	75.0	63.7	69.4
From optimal seed rate	62.5		25.0	33.3	36.4	34.6
Technology acceptance by neighbors	58.3	84.6	80.0	75.5	75.0	75.3

Table 4. Acceptance rating in 1991/92 season (% of farmers).

Component	Collaborators	Neighbors	
		Participants	Nonparticipants
Fertilizer	100	76	51
Released varieties	95	81†	0
Promising lines	87	81†	0
Seed drill	94	91	48

† Neighboring participants in project activities at field days did not differentiate between released varieties and promising lines.

Conclusions

In general, these figures present a pattern indicating that the demonstration program in Syria has been effective in improving the acceptance of the farm components. Unfortunately, we are unable to generate ratings for no-tillage, medic and forages because of the limited number of demonstrations and field days.

It should be recognized that the adoption process of any technology, idea or innovation does not occur instantly or suddenly. It takes time, and passes through several stages starting with knowledge or awareness to persuasion to decision-making, then implementation and, finally, confirmation. During these sequential stages, farmers need information related to the tested technology. The information needed differs according to each of the adoption stages. For the "knowledge stages" farmers would like to know about the components of the technology and how it works, whereas for the "persuasion and decision stage" the information required is related to the evaluation of technology in order to reduce farmers' fears of expected risk due to adoption. This helps them, thereby, to take a decision either to adopt the technology or parts of their fields as a certainty test of its performance, or to reject the technology and its adoption.

Applying these adoption concepts on the Mashreq Project in Syria, it can be stated that the technology tested is still in its early stages of adoption, i.e., knowledge and persuasion. However, the indications are positive and encouraging.

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٢- إن استجابة محصول الشعير للتسميد الفوسفاتي في أراضي تحتوي على أكثر من ٢٠ جزء بالمليون من الفوسفور ضئيلة جدا وغير إقتصادية ومبنية على تجارب بحثيه .

٣- إن إضافة الاسمدة الفوسفاتية مع البذار بالقرب من البذور على خطوط يخفف من تثبيت الفوسفور بالتربة الكلسية ويحسن من كفاءة الاسمدة الفوسفاتية ، وهذه النتائج مبنية على تجارب عديدة قامت بها إيكاردا والبرنامج الوطني في سوريا .

حسين صالح

متى تضاف الدفعة الثانية للسماد النيتروجيني وما هي مخاطر إضافتها ؟

محمد أديب صافي

- تضاف الدفعة الثانية من الاسمدة الازوتية في مرحلة الاشطاء وبكمية ٧٥كغم/هـ نترات الامونيوم (نسبة النيتروجين ٣٠٪) في كلتا منطقتي الاستقرار الثانية والثالثة عندما تسمح ظروف رطوبة التربة بذلك ، ومعرفة فيما إذا كانت الامطار التي هطلت والمتوقع هطولها تدل على أنها جيدة .
- أما عن مخاطر إضافتها فهي أولاً: عدم الاستفادة من إضافتها لعدم إنحلالها ووصولها الى منطقة الجذور . ثانيا : يؤدي إنحلالها بكمية قليلة من الرطوبة وبالقرب من الجذور إلى زيادة تركيزها مما يؤدي إلى الاضرار واحتراق جزئي للنبات .

أحمد الراوي

١- ما هو السبب في كون إنتاج الشعير في دورة شعير - شعير أقل من بور - شعير تحت نفس ظروف التسميد ؟ هل هذا يعود إلى انخفاض الرطوبة أو إلى تحسين خواص التربة الفيزيائية أم بسبب الادغال والامراض ؟

٢- هل تحديد الحدود للفسفور مبني على تجارب تحت ظروف مختلفة ؟

٣- هل قورنت طريقة إضافة الفسفور نثرا مع الاضافة بالبذارة حتى تأتي بهذه التوصية أم أنه مجرد معرفة نظرية ؟

محمد أديب صافي

١- سبب زيادة إنتاج الشعير في دورة شعير بعد بور على إنتاج الشعير في دورة شعير بعد شعير تحت نفس الظروف يرجع الى زيادة إحتفاظ التربة البور بالرطوبة أكثر من المزروعة وكذلك زيادة محتوى التربة من الأزوت المعدني وتحسين مواصفات التربة .

المناقشه

استجابة أصناف الشعير للتسميد وإقتصادية التسميد في منطقتي الاستقرار الثانية والثالثة

محمد أديب صافي و إلياس جبور
مديرية الاراضي - دوما - سوريا

حازم السمان

١- الدراسة تناولت مقادير الاسمدة ومدى تجاوبها مع معدل بذار واحد وهو ١٠٠ كغم / هكتار وأرى أنه من الافضل تناول عدة مقادير من البذار لكون هناك مناطق في سوريا تستعمل معدلات بذار تصل إلى ٢٥٠ كغم/هكتار .

٢- أعتقد أنه من المفروض تحديد الحد الادنى من السماد الواجب إضافته في تسميد الشعير حيث أن كميات الامطار غير مضمونة وهناك ارتباط ما بين معدل السماد ومعدل الامطار .

محمد أديب صافي

١- اختبرت الدراسة على معدل بذار ١٠٠ كغم / هـ لانه أفضل معدلات البذار بناء على دراسات سابقة ويسعى المشروع المشرقي إلى نشرها . كما أن هناك دراسات أخرى في المشروع تتعرض لمعدلات البذار المختلفة مع التسميد وبدونه سوف يتم عرضها لاحقا .

٢- حُدد الحد الادنى للأسمدة الازوتية بمقدار ٥٠ كغم/ هـ في منطقة الاستقرار الثانية و ٢٥ كغم/ هـ يوريا في منطقة الاستقرار الثالثة تضاف قبل الزراعة ويكتفى بها في حال كون الامطار شحيحة ، أما إذا كانت الامطار جيدة تضاف الدفعة الثانية .

٤- يجب أن يلعب الارشاد الزراعي دورا مهما في شرح أهمية التسميد حتى في المناطق والمواسم الجافة ، حيث يؤدي التسميد في السنين الجافة إلى زيادة الانتاج وإلى إغناء التربة بالفوسفور .

المراجع

١- تقرير مشروع التعاون المشترك حول تسميد الشعير في شمالي سوريا (الجزء الاول)
ملخص عن النتائج الزراعية والاقتصادية خلال أربع سنوات ١٩٨٤-١٩٨٨.

٢- تقرير مشروع التعاون المشترك حول تسميد الشعير في شمالي سوريا (الجزء الثاني)
ملخص أربع سنوات لنتائج تتعلق بامتصاص العناصر الغذائية واختبارات معايرة التربة ١٩٨٤-١٩٨٨ .

٣- التقارير السنوية لمشروع التعاون المشترك حول تسميد الشعير في شمالي سوريا بالتعاون بين مديرية الاراضي وإيكاردا اعتبارا من موسم ١٩٨٥ - ١٩٨٦ - ١٩٨٨ - ١٩٨٩.

٤- تقارير التعاون المشترك بين وزارة الزراعة والاصلاح الزراعي وإيكاردا اعتبارا من تقرير ١٩٨٥-١٩٨٩.

٥- التقرير الفني السنوي لمشروع المشرق للشعير والاعلاف والاغنام لموسم ١٩٨٩ - ٩٠ و موسم ١٩٩٠ - ٩١ .

٦- مسودة التقرير الاولى عن نتائج أبحاث المشروع المشرقي للشعير والاغنام والاعلاف لموسم ١٩٩١ - ٩٢ .

٧- توصيات ندوة تسميد الشعير في المناطق الجافة المنعقدة بالتعاون بين مديرية الاراضي ومديرية الارشاد الزراعي في حلب (إيكاردا) من ١١-١٢ حزيران ١٩٨٩.

٨- التقرير السنوي عن تسميد الشعير الارشادي بالتعاون بين مديرية الأراضي والارشاد الزراعي بالتعاون مع منظمة الشرق الادنى في مواسم ١٩٨٩-٩٠ ، ١٩٩٠-٩١ و ١٩٩١-٩٢ .

من عملية التسميد وكذلك في متوسط ربح محافظة الحسكة وحماه لمجموع السنوات الثلاث .

٤٠ الاستنتاجات والاقتراحات

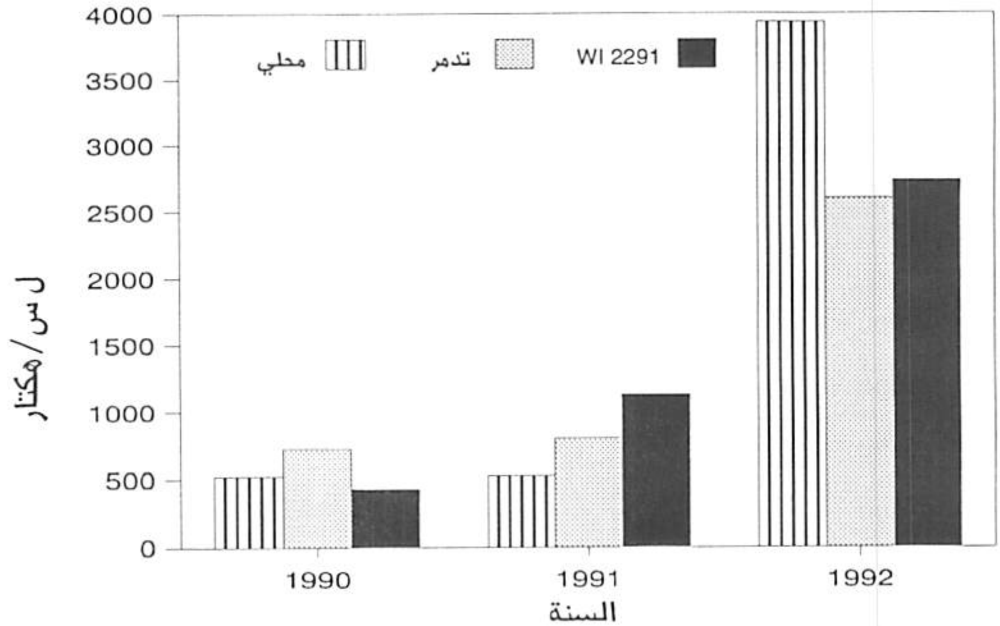
أكدت المشاهدات المتعددة والمنفذة في مناطق بيئية متباينة وبالزراعة التقليدية الموسعة والتي نفذت خلال المواسم الثلاثة (١٩٩٠-٩٢) من مشروع المشرق نتائج الابحاث والدراسات السابقة . حول أهمية وإقتصادية تسميد الشعير في المناطق الجافة . كما دلت هذه المشاهدات على أن للتسميد أهمية كبيرة في زيادة الانتاج . وأنه في مجمله يؤدي الى رفع دخل المزارع مهما كان الصنف المزروع . حيث سلكت كافة الاصناف الداخلة في المشاهدات نفس السلوك في استجابتها للتسميد ، وترجع الفروق الضئيلة التي ظهرت بين استجابة هذه الاصناف بالدرجة الاولى إلى ملاءمة الموقع والظروف البيئية وكمية الامطار لصنف ما أكثر من باقي الاصناف .

أمام هذه النتائج ونتائج الدراسات السابقة ونظرا لاستمرار المشروع لعامين آخرين نقترح ما يلي:

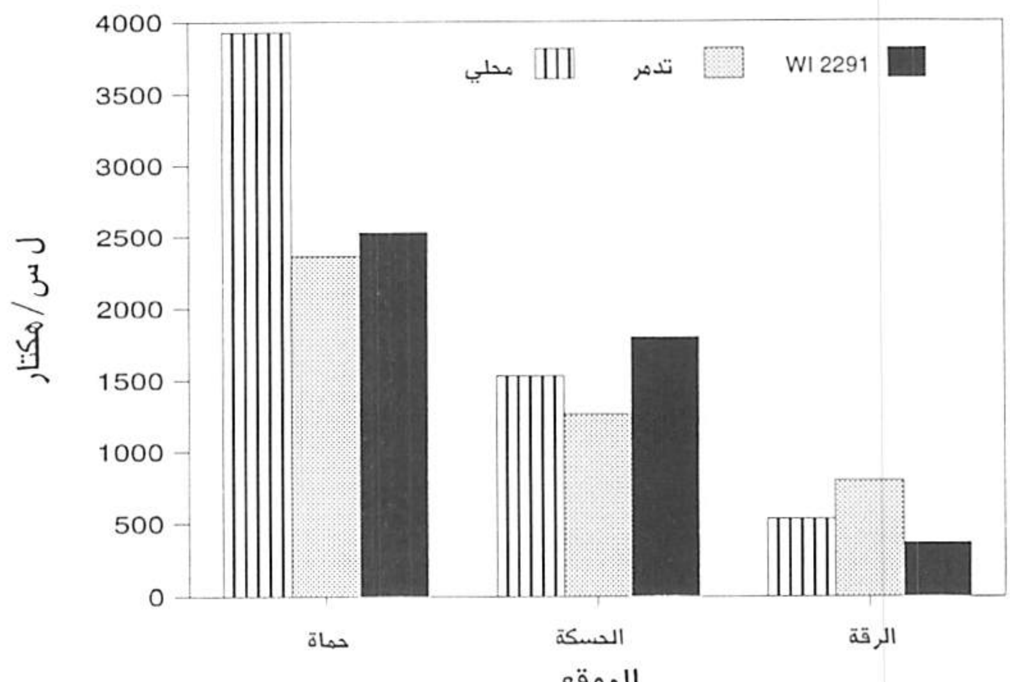
١- ضرورة نقل النتائج وشرح أهمية التسميد للأخوة الفلاحين خاصة في منطقة الاستقرار الزراعي الثالثة عن طريق الارشاد الزراعي .

٢- ضرورة العمل على إدخال طريقة إضافة الاسمدة الفوسفاتية على خطوط مع البذار باستخدام البذارة المسمدة ، لما لاضافة الاسمدة الفوسفاتية على خطوط قرب البذار من أهمية في رفع كفاءة استخدام هذه الاسمدة ، وبالتالي تخفيض الكمية المستخدمة في التسميد .

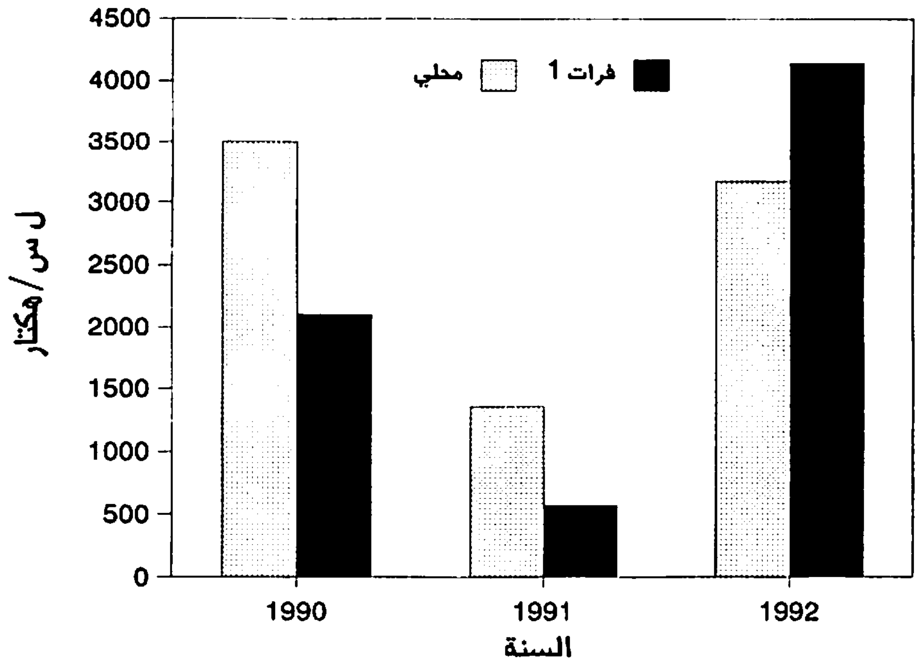
٣- كما ينبغي أن نقلل قدر الامكان من تكاليف التسميد ، وبالتالي الحد من مقدار المخاطرة عن طريق إعطاء توصيات سمادية فوسفاتية تعتمد على تحليل التربة . وكذلك التأكيد على أهمية إضافة السماد الازوتي على دفعتين . وإضافة الدفعة الثانية في حال كون الظروف المطرية مناسبة لذلك .



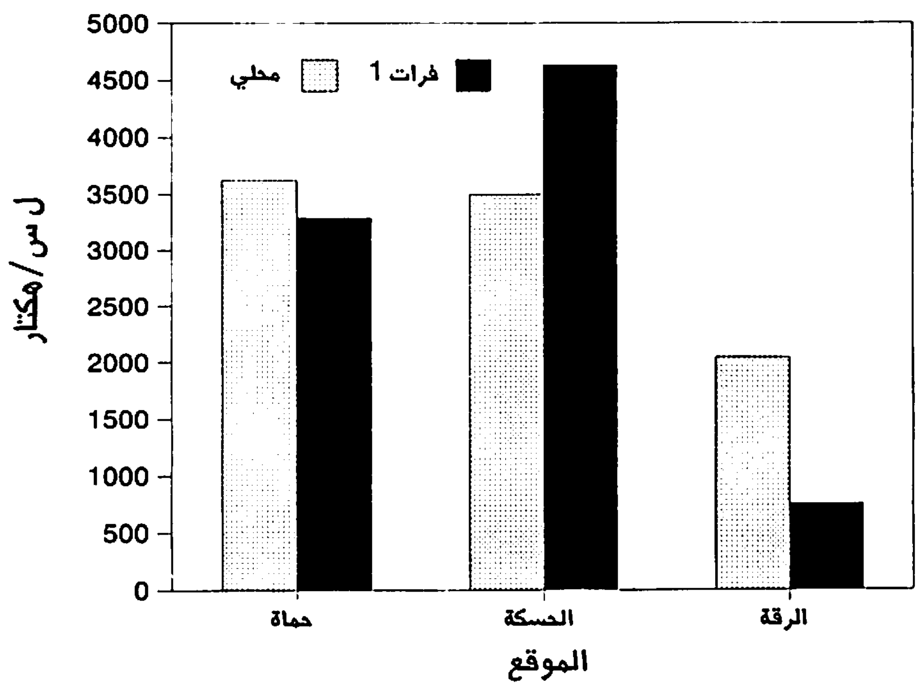
شكل رقم (٣) : صافي الربح نتيجة تسميد الصنف المحلي والأصناف المبشرة في منطقة الاستقرار الثالثة حسب السنوات .



شكل رقم (٤) : صافي الربح نتيجة تسميد الصنف المحلي والأصناف المبشرة في منطقة الاستقرار الثالثة حسب المواقع .



شكل رقم(١) : صافي الربح نتيجة تسميد الصنف المحلي والصنف المعتمد فرات (حسب السنوات) .



شكل رقم(٢) : صافي الربح نتيجة تسميد الصنف المحلي والصنف المعتمد فرات (حسب المواقع) .

في منطقة الاستقرار الثانية

الصنف المحلي : من أصل ٢٥ موقعاً كان تسميد هذا الصنف مربحا في ٢٣ موقعاً وكان هذا الربح يتجاوز حد المخاطرة المسموح به وهو ٤٠٪ من التكلفة في ١٩ موقعاً وكانت نسبة عائد توظيف رأس المال جيدة جدا في معظم المواقع إذ بلغت بالمتوسط لكافة المواقع بما فيها الخاسرة ٢٣٥٪ .

الصنف المعتمد فرات ١ : كان الربح الناجم عن عملية تسميد الصنف المعتمد فرات ١ مساوي تقريبا - بالمتوسط - الربح الناجم عن عملية تسميد الصنف المحلي (جدول ٣) حيث بلغ متوسط عائد توظيف رأس المال ٢٣٣٪ . إلا أن عدد المواقع التي كانت خاسرة بلغت ٨ مواقع. والشكل رقم (١) يبين مقارنة الربح الناتج عن تسميد الصنفين حسب السنوات . والشكل رقم (٢) يبين مقارنة الربح الناتج عن تسميد الصنفين حسب المحافظات فبينما تفوق الصنف المحلي في صافي الربح على فرات ١ في موسمي ١٩٩٠ و ١٩٩١ . تفوق فرات ١ على المحلي في موسم ١٩٩٢ . كذلك يلاحظ في الشكل رقم ٢ أنه وعلى أساس المعدل فإن الصنف فرات ١ قد تفوق في صافي الربح في الحسكة بينما كان الصنف المحلي متفوقا في كل من حماة والرقة .

في منطقة الاستقرار الثالثة

أعطى الصنف المحلي أعلى ربح نتيجة التسميد كمتوسط ل٢١ موقعا . حيث بلغ صافي الربح ١٨١١ ل.س /هـ مع العلم بأن تكلفة التسميد للأصناف الثلاثة هي متساوية (الجدول ٣) . ومن الاشكال ٣ و ٤ نلاحظ تفوق الربح الناتج عن تسميد الصنف تدمر على الربح الناتج عن باقي الاصناف . وذلك في السنة الاولى وكذلك بمتوسط محافظة الرقة . مما يدل على تفوق استجابة هذا الصنف للتسميد في المناطق والسنوات الجافة مقارنة بالصنفين الآخرين . بينما حقق الصنف WI2291 في السنة الثانية أكبر ربح . وفي السنة الثالثة حقق الصنف المحلي أكبر ربح

جدول رقم (٣) : إقتصادية التسميد للصنف المحلي للشعير والاصناف المعتمدة والمبشرة في منطقتي الاستقرار الزراعي الثانية والثالثة في محافظات الرقة والحسكة خلال المواسم ١٩٨٩/٩٠، ١٩٩٠/٩١ و ١٩٩١/٩٢ (القيمة بالليرة السورية) .

الكلفة وصافي الربح	منطقة الاستقرار	منطقة الاستقرار الثانية (٢٥ موقعاً)		منطقة الاستقرار الثالثة (٢١ موقعاً)		
(ليرة سوريه)	الصنف	محلي	فرات ١	محلي	تدمر	WI2291
قيمة الاسمدة		١٠٤١	١٠٤١	٩١٢	٩١٢	٩١٢
قيمة زيادة الحب		٢٦٠٤	٢٦٠٦	١٨٩٥	١٧٠٦	١٨٠١
قيمة زيادة التبن		٨٨٧	٨٦٢	٨٢٨	٦٥٥	٧٠٠
قيمة زيادة الانتاج		٣٤٩١	٣٤٦٨	٢٧٢٣	٢٣٦١	٢٥٠١
صافي الربح		٢٤٥٠	٢٤٢٧	١٨١١	١٤٤٩	١٥٨٩
توظيف رأس المال (٪)		٢٣٥	٢٣٣	١٩٩	١٥٩	١٧٤

وكما هو ملاحظ فإنه من مجمل الاختبارات التي تمت في ٢١ موقعا أعطى التسميد تأثيرا إيجابيا على زيادة إنتاج الحب في كل هذه المواقع .

٣- **إقتصادية التسميد**

استخدمت نتائج غلة الحب المدرجة في الجدولين ١ و ٢ وكذلك غلة القش بالنسبة لكل موقع في تقييم الجدوى الاقتصادية للتسميد وذلك للمواسم الثلاثة المدروسة حيث استخدمت طريقة الميزانية الجزئية واعتمدت الحسابات على الاسعار التالية :

٧٫٠٠ ل . س / كغم للشعير الحب
١٫٥٠ ل. س / كغم سعر تبن الشعير
٥٫٢٠ ل. س / كغم سعر سماد السوبرفوسفات الثلاثي ٤٦
٤٫٩٠ ل. س / كغم سعر سماد اليوريا
٣٫٤٠ ل. س / كغم سعر سماد نترات الامونيوم ٣٠
٤٠٫٠٠ ل. س / كغم تكلفة إضافة الكغم الواحد من السماد.

بينما أهملت باقي التكاليف (تكاليف الزراعة - الحصاد) لانها واحدة في الشاهد والمعاملة المسمدة وبذلك تكون التكلفة الاضافية الناتجة عن استخدام الاسمدة في منطقة الاستقرار الثانية ١١١٠ ل. س /هـ وذلك في حال إضافة الدفعة الاولى والثانية من الأزوت و ٨٢٥ ل. س في حال إضافة الدفعة الاولى فقط. وبلغت هذه التكلفة في منطقة الاستقرار الثالثة ٩٨٠ ل. س في حال إضافة الدفعتين و ٦٩٢ ل. س في حال إضافة الدفعة الاولى فقط .

وبتقدير قيمة الزيادة الناتجة عن عملية التسميد في إنتاج الحب والتبن وطرح هذه القيمة من تكلفة إضافة الاسمدة تم حساب صافي الربح الناتج عن التسميد لكل موقع ولمتوسط المواقع . وبقسمة صافي الربح على تكلفة إضافة الاسمدة نحصل على نسبة صافي الربح الى التكلفة (نسبة عائد توظيف رأس المال) لكل موقع ولمتوسط المواقع والاصناف (الجدول ٣ لمنطقتي الاستقرار الثانية والثالثة) التي يمكن أن نلخصها بالآتي :

جدول رقم (٢). إنتاجية واستجابة غلة الحب في الصنف المحلي (عربي أبيض وعربي أسود) وصنفين مبشرين للتسميد الآزوتي والفوسفاتي في منطقة الاستقرار الثالثة .

الصنف والمعاملة	الموسم / المحافظة	١٩٨٩/٩٠ الرقة (موقعين)	١٩٨٩/٩٠ الحسكة (موقعين)	١٩٩٠/ ٩١ حماة (٣ مواقع)	١٩٩٠/ ٩١ الرقة (٣ مواقع)	١٩٩٠/ ٩١ الحسكة (٣مواقع)	١٩٩١/٩٢ حماة (٣مواقع)	١٩٩١/٩٢ الرقة (موقع)	١٩٩١/٩٢ الحسكة (٤مواقع)
محلي غير مسمد		٢٣٧	١٥٢	١٠٥٣	٢٢٠	٤٠٠	٩٧٠	٦٤٠	١٢٢٨
محلي مسمد		٣١٧	٢١٥	١٢٧٧	٣٠٣	٤٥٧	١٥٦٠	٩٩٠	١٧١٠
نسبة الزيادة ٪		٣٤	٤١	٣١	٣٨	١٤	٦١	٥٥	٣٨
تدمر غير مسمد		٣٠٩	١٦٧	٦٤٧	١٩٠	٤١٢	٧٥٠	٩٤٠	١١٤٠
تدمر مسمد		٥٢٠	٢٣٧	١٠١٠	٣١٠	٤٧٨	١٠٨٠	١١٨٠	١٥٥٥
نسبة الزيادة ٪		٧١	٤٢	٥٦	٦٣	١٦	٤٤	٢٦	٣٦
WI2291 غير مسمد		١٤٦	٢٠١	٧٦٠	١٧٧	٣٦٦	٧٩٠	٦٦٠	٩٩٨
WI2291 مسمد		٢٢٧	٣٤٧	١١٩٣	٣٧٣	٣٨٠	١٠٨٠	٦٦٠	١٥٣٥
نسبة الزيادة ٪		٥٥	٧٣	٥٧	١١١	٤	٣٧	-	٥٤

جدول رقم (١). إنتاجية واستجابة غلة الحب في الصنف المحلي (عربي أبيض وعربي أسود والصنف المعتمد فرات١) للتسميد الآزوتي والفوسفاتي في منطقة الاستقرار الثانية.

الصنف والمعاملة	الموسم	١٩٨٩/٩٠		١٩٩٠/ ٩١			١٩٩١/٩٢		
	المحافظة	الرقة (موقعين)	الحسكة (موقع)	حماة (٤ مواقع)	الرقة (٤ مواقع)	الحسكة (موقعين)	حماة (٤ مواقع)	الرقة (٣مواقع)	الحسكة (٥مواقع)
محلي غير مسمد		١٤٤٠	٩٩٠	١٠٣٠	٢٧١	٥١٣	٢٤٧٨	٩٧٠	٢٠٨٢
محلي مسمد		١٨٤٧	١٤٣٠	١٢٩٠	٤٣٨	٧٥٠	٣١٣٨	١٠٨٠	٢٥٧٦
نسبة الزيادة ٪		٢٨	٤٤	٣٥	٦٢	٤٦	٢٧	١١	٢٤
فرات ١ غير مسمد		١١٧٧	١٠٦٨	١٠٧٧	٢٨٧	٤٣٥	١٥٢٠	٩٧٠	١٨٠٠
فرات ١ مسمد		١٥٤٧	١١٧٥	١٣٧٩	٤٤٤	٤٢٥	٢١٧٣	١٠٣٥	٢٥٦٨
نسبة الزيادة ٪		٣١	١٠	٢٨	٥٥	٢-	٤٣	٧	٤٣

إتسم الموسم الثالث (١٩٩١/٩٢) بهطول الامطار المبكر ، تبعه هطولات ثلجية غزيرة وفترات برودة وصقيع أثرت على الانبات . كما كان لقلة الامطار خلال شهري آذار ونيسان نفس الاثر ، إلا أن استمرار انخفاض درجات الحرارة وهطول الامطار خلال شهري نيسان وأيار كان له أثر إيجابي في تحسن النمو وارتفاع الانتاج وتحسن النوعية (نتائج أبحاث المشروع المشرقي لموسم ١٩٩١/٩٢).

٢- استجابة غلة الحب للتسميد الازوتي والفوسفاتي

يبين الجدول (١) نتائج كافة المواقع مأخوذة كمتوسطات لكل محافظة . كما ويبين استجابة كل من الصنف المحلي والصنف المعتمد فرات ١ للتسميد حيث تفوق إنتاج الصنف المحلي على إنتاج الصنف المعتمد في معاملة الشاهد والمعاملة المسمدة .

في معظم المواقع التي نفذت الدراسة فيها ، تراوحت الزيادة الناجمة عن إضافة السماد إلى الصنف المحلي ما بين ١١٪ في محافظة الرقة في موسم ١٩٩١/٩٢ و ٦٢٪ في نفس المحافظة في الموسم الذي سبقه . بينما كان معدل نسبة الزيادة في إنتاج الحب في الصنف المعتمد فرات ١ أقل مما كانت عليه في المحلي ، حيث تراوحت إلى ما دون الصفر في الحسكة في موسم ١٩٩٠/٩١ و٤٣٪ في حماة والحسكة في موسم ١٩٩١/٩٢ ، وهذا يشير الى استجابة أعلى للسماد من قبل الصنف المحلي مقارنة بالصنف المعتمد.

أما في منطقة الاستقرار الثالثة ، وهي المنطقة الاكثر جفافا ، كما تشير على ذلك إنتاجية الاصناف (جدول ٢)، فقد تفوق الصنف المحلي في معظم المواقع المدروسة على الصنفين المبشرين تدمر وWI2291 . وكان للتسميد تأثير فعال على زيادة الإنتاجية من الحب في كافة الاصناف . فتراوحت الزيادة في الإنتاجية بسبب إضافة السماد ما بين ٣١٪ الى ٦١٪ في الصنف المحلي ، بينما تراوحت ما بين ١٦٪ الى ٧١٪ في الصنف المبشر تدمر وما بين صفر - ١١١٪ للصنف المبشر WI2291.

النتائج والمناقشة

١- الظروف المناخية السائدة

الموسم الاول (١٩٨٩/٩٠) : هطلت في هذا الموسم ، وبعد الزراعة ، كميات غير كافية من الامطار إلا أنها موزعة توزيعا جيدا ضمنت تأمين رطوبة لا بأس بها لاستمرارية النمو حتى شهر شباط ١٩٩٠ . وخلال شهر آذار توقف هطول الامطار ، وكان لهذا الانحباس تأثيره السلبي على النمو والانتاج . وخلال شهر نيسان هطلت أمطار جيدة . وتميز هذا الموسم بحدوث صقيع شديد خلال شهر آذار (من ١٦-١٩) كان له الاثر الكبير في ضعف الانتاج في محافظة الرقة والحسكة وعدم الحصول على إنتاج في حماه .

(التقرير الفني السنوي لمشروع المشرق للشعير والاعلاف والاغنام لموسم ١٩٨٩/٩٠).

الموسم الثاني (١٩٩٠/٩١) : تميز بانحباس الامطار في بداية الموسم لنهاية شهر كانون الثاني في كل من الرقة والحسكة . حيث هطل في نهاية كانون الثاني وأوائل شهر شباط كمية كافية من الامطار للانبات ، إلا أن تكرار حدوث الصقيع لم يسمح بالنمو حتى خلال شهر شباط . وقد أتاح ارتفاع درجة الحرارة وهطول الامطار بكميات وتوزيع جيد خلال شهر شباط وآذار للبادرات الظهور في نهاية شهر شباط وأوائل شهر آذار واستمرارها في التحسن لغاية منتصف شهر نيسان . أدت الرياح المغبرة التي هبت على المنطقة مع قلة الامطار في هذا الشهر الى ضعف النمو وإبقاء النباتات صغيرة - لا تتجاوز ٢٥-٣٥ سم طولا - والسرعة في تكوين السنابل .

أما في محافظة حماه فكان توزيع الهطولات المطرية مناسب للأنبات مما أدى الى النمو الجيد والحصول على انتاج جيد . إلا أن الرياح الشديدة التي هبت خلال الفترة من ٢٠-٢٥ أيار ، أدت إلى إنفراط الحبوب (التقرير الفني السنوي لمشروع المشرق موسم ١٩٩٠ - ١٩٩١).

ج- **العمليات الزراعية :**

تم تحضير الارض للزراعة من قبل المزارع وبطريقته وآلياته . كما تمت الزراعة بإستخدام البذارة الآلية (كششيان) المستخدمة من قبل المزارعين وبمعدل بذار ١٠٠ كغم/هـ . كما تم حصاد كامل المعاملة باستخدام الحصادة المتوفرة بالمنطقة .

قدر إنتاج الحب والتبن عن طريق حصاد أمتار عشوائية من ثلاثة مواقع من كل معاملة .

د- **حساب الانتاج :**

إستجابة غلة الشعير من الحب والتبن للتسميد الأزوتي والفوسفاتي

نظرا لان الفلاح لم يستعمل معاملة مقاومة الاعشاب في معظم المواقع أصبحت هذه المعاملة مماثلة لمعاملة الفلاح وكلتاهما لا تشتملان على إضافة السماد . لذا تم اعتبار هاتين المعاملتين معاملة واحدة وهي معاملة بدون تسميد (معدل المعاملة الاولى والثالثة) . بينما أعتبرت معاملة التسميد معدل المعاملتين الثانية والرابعة .

تم حساب وتقدير إنتاج الحب عن طريق حصاد كامل القطعة . إلا في بعض المواقع التي تعذر حصادها لقصر طول النبات . حيث تم تقدير الحب فيها عن طريق أخذ عينات عشوائية . أما تقدير القش فقد تم عن طريق أخذ العينات العشوائية المتريه في بعض المواقع . أما الباقي فقد حسب على أساس أن وزن القش يعادل ١ر٥ مرة من وزن الحب في منطقة الاستقرار الثانية ، و١ر٨ مرة في منطقة الاستقرار الثالثة. وحسب هذا الرقم واعتمد كونه يمثل بشكل تقريبي أقل نسبة بين وزن القش والتبن لنفس المعاملة من خلال الدراسات السابقة المنفذة في مديرية الاراضي .

الثالث في محافظتي الرقة والحسكة . كما زرع الصنف عربي أبيض بدلا من الصنف عربي أسود في محافظة حماه مع الاصناف الاخرى .

ب- المساحة والمعاملات

في الموسم الاول والثاني زرع كل صنف في قطعة رئيسية بمساحة ٤ دونمات قسمت الى أربع قطع ثانوية متساوية بمساحة ١ دونم . تمثل كل قطعة ثانوية معاملة من المعاملات الاربع التالية :

المعاملة الاولى : شاهد تتم زراعتة بطريقة المزارع

المعاملة الثانية : الزراعة بطريقة المزارع مع إضافة الاسمدة

المعاملة الثالثة : الزراعة بطريقة المزارع مع استخدام مبيد الاعشاب

المعاملة الرابعة :الزراعة بطريقة المزارع مع استخدام مبيد الاعشاب والسماد

*** وكانت الاسمدة المضافة على أساس المعاملة السمادية الموصى بها والتي تم الاتفاق عليها خلال ندوة تسميد الشعير التي نفذت في إيكاردا في حلب من ١١-١٢/٦/١٩٨٩ وذلك على الشكل التالي :

١٠٠ كغم سماد سوبرفوسفات /هـ تضاف قبل الزراعة في كل من منطقة الاستقرار الثانية والثالثة .

٥٠ كغم سماديوريا/ هـ في منطقة الاستقرار الثانية و٢٥ كغم يوريا /هـ في منطقة الاستقرار الثالثة تضاف قبل الزراعة .

٧٥ كغم نترات أمونيوم (٣٠٪) تضاف عند الاشطاء في كل من منطقة الاستقرار الثانية والثالثة .

أما في موسم ١٩٩١/١٩٩٢ فكانت مساحة القطعة الرئيسية ١٠ دونمات ، وضمت معاملتين فقط شاهد ومعاملة مسمدة بالمعدلات السابقة .

٣-٥	٥٠	١٠٩
أقل من ٣	٦٠	١٢٠

أما بالنسبة للسماد الازوتي ، فإن تحديد احتياج محصول الشعير من السماد الازوتي على أساس اختبارات التربة يتطلب ما يلي :

أ- المستوى الحرج من ال NO_3N في التربة الذي يعطي الانتاج الامثل .

ب- تقدير كفاءة السماد الآزوتي المضاف وارتباطه بكمية الامطار .

(تقرير مشروع التعاون المشترك حول تسميد الشعير في شمالي سوريا (الجزء الاول).

المواد وطرق البحث

1. الموقع والاصناف

أولا: في منطقة الاستقرار الثانية

تم خلال السنوات الثلاث (١٩٩٠- ١٩٩٢) زراعة وحصاد ٢٥ مشاهدة إرشادية للأصناف المحلية والمبشرة في ٢٥ موقعا في محافظات حماه والحسكة والرقة .

زرع الصنف المحلي عربي أسود والصنف المعتمد فرات ١ والصنفان المبشران ريحان ٣ وفرات ٦٥٤ وذلك في الموسمين ٨٩-٩٠ و ٩٠-٩١ في كافة المواقع .

أما في الموسم ٩١-٩٢ فقد زرع الصنف المحلي عربي أسود في الحسكة والرقة والصنف المحلي عربي أبيض في محافظة حماه . كما زرع الصنف المعتمد فرات ١ والصنف المبشر عرطة في المحافظات الثلاث . والصنفان تدمر و WI2291 في محافظتي الرقة والحسكة .

ثانيا : في منطقة الاستقرار الثالثة

تم في منطقة الاستقرار الثالثة زراعة وحصاد ٢١ مشاهدة في ٢١ موقعا في محافظات حماه والحسكة والرقة .

زرع في الموسمين الاول و الثاني الصنف المحلي عربي أسود والصنفان المبشران تدمر و WI2291 وزرع الصنف زنبقة إضافة إلى الاصناف السابقة في الموسم

أهم الدراسات والنتائج والتوصيات السابقة

لقد تبيّن من خلال الابحاث التي نفذتها وزارة الزراعة والاصلاح الزراعي (مديرية الاراضي) على تسميد الشعير ومن خلال مشروع التعاون المشترك مع إيكاردا حول تسميد الشعير في شمالي سورية . والابحاث والدراسات المنفذة في إيكاردا في مجال تسميد الشعير . أن أقل من ١٥٪ من مزارعي الشعير في سوريا يستخدمون السماد على الرغم من نقص العناصر الغذائية الرئيسية (الفوسفور والآزوت الموجودة في التربة) . لقد وجد أن السماد يساعد على تحسين فعالية استخدام الشعير للمياه . كما أن كفاءة الاستفادة من الامطار تزدادعند استعمال الاسمدة الآزوتية والفوسفاتية معا.

لقد لوحظ عدم إستجابة الشعير للتسميد الآزوتي في المناطق التي يكون معدل أمطارها ١٥٠ ملم . كما لوحظ أن الاستجابة للتسميد الآزوتي تتزايد بتزايد الامطار . بينما تقل الاهمية النسبية للسماد الفوسفاتي بالمقارنة مع السماد الآزوتي تحت ظروف المعدلات العالية للأمطار. فلقد تبين أن محتوى التربة من الآزوت المعدني والفوسفور يؤثر على مستويات الغلة بشكل أخف بكثير من تأثيرات الامطار. كما كان هناك ارتباط معنوي بين محتوى التربة من الآزوت المعدني والفوسفور المتاح والاستجابة للتسميد .

تقرير مشروع التعاون المشترك حول تسميد الشعير في شمالي سوريا (الجزءان الاول والثاني).

بناء على الدراسة المشتركة التي تمت بين وزارة الزراعة والاصلاح الزراعي في الجمهورية العربية السورية وإيكاردا وعلى اجتماعات المساهمين في شبكة معايرة اختبارات التربة تم وضع التوصيات السمادية الاولية للفوسفور على الشكل التالي :

محتوى التربة من الفوسفور المتاح (جزء بالمليون)	كمية ال P_2O_5 الموصى بها (كغم/ هـ)	كمية سماد السوبرفوسفات (كغم/ هـ)
أكثر من ١٠	-	-
٧-١٠	٣٠	٦٥
٥-٧	٤٠	٨٧

مقدمة

يعتبر الشعير محصولا على قدر كبير من الاهمية في المناطق الجافة والتي تهطل فيها الامطار خلال الشتاء . ومن ميزاته أنه ينمو في مناطق متدنية الامطار . ويشكل السلعة الاساسية في النظم الزراعية السائدة . حيث يستخدم الحب والتبن في تغذية الاغنام . ونظرا لان غلة التبن يمكن أن تكون في معظم الاحيان ضعف غلة الحب . فإن لانتاج التبن وقيمته تأثيراً هاماً على دخل المزارعين، لذا يجب أخذ غلة التبن بعين الاعتبار عند أي تحليل للنتائج . وانطلاقا من أهمية محصول الشعير في زراعة القطر العربي السوري والمتجلية بزيادة المساحة المزروعة به . ونظرا للتذبذب الحاصل في غلته بين موسم وآخر والذي ينجم عن تباين معدلات الامطار وعدم انتظامها عبر المواسم . وانخفاض مستوى التقنية المستعملة في زراعته وخدمته في المناطق الاكثر جفافا (٢٠٠-٣٠٠) ملم . وبغية إدخال التقنيات التي يمكن أن تعمل على تحسين واستقرار الغلة .. والتي يعتبر استعمال الاسمدة الآزوتية والفوسفاتية عاملاً مهماً فيها لا سيما في المناطق الاكثر جفافا .. فقد قام العاملون في وزارة الزراعة والإصلاح الزراعي"مديرية الاراضي" وبرنامج تحسين استخدام الموارد الزراعية في المركز الدولي للبحوث الزراعية في المناطق الجافة "إيكاردا" بتنفيذ مشروع تعاون مشترك حول تسميد الشعير على مدى خمس سنوات (١٩٨٤-١٩٨٩) . وقد هدف المشروع إلى تقييم التأثيرات البيولوجية والاقتصادية الناجمة عن تسميد محصول الشعير بالسماد الآزوتي والفوسفاتي . وذلك بإقامة التجارب عند المزارعين في مواقع ومواسم متعددة . وشعوراً بأهمية نقل المعلومات التي تم الحصول عليها من تلك التجارب إلى المزارعين بواسطة جهاز الارشاد الزراعي . فقد تم الاتفاق على إدراج عدة مشاهدات حقلية في منطقتي الاستقرار الثانية والثالثة ضمن نشاطات مشروع المشرق من أجل إظهار أهمية تسميد الشعير في هاتين المنطقتين . وبهدف دراسة إقتصاديات تسميد أصناف الشعير المحلية والمبشرة في مواقع ومواسم متعددة .

استجابة أصناف الشعير للتسميد وإقتصادية التسميد في منطقتي الاستقرار الثانية والثالثة

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مديرية الاراضي - دوما - سوريا

الملخص

تم خلال السنوات الثلاث الاولى من مشروع المشرق تنفيذ وحصاد ٢٥ مشاهدة حقلية في منطقة الاستقرار الثانية و ٢١ مشاهدة في منطقة الاستقرار الثالثة في محافظات حماه والرقة والحسكة . وهدفت هذه المشاهدات إلى دراسة إستجابة أصناف الشعير المعتمدة والمبشرة للتسميد الأزوتي والفوسفاتي تحت ظروف المزارع ودراسة إقتصادية تسميد الشعير في هذه المناطق . أعطت المواقع الست وأربعون بيانات يعتد بها عن إقتصادية تسميد الشعير في ظروف مناخية خلال ثلاث سنوات . حيث استجاب إنتاج الحب والقش في الصنف المحلي للتسميد بشكل جيد في ٢٣ موقعاً من أصل ٢٥ موقعاً وبتفوق المعاملة المسمدة على الشاهد بمقدار ٢٧١ كغم/هـ من الحب و٥٩٣ كغم/هـ من القش في منطقة الاستقرار الثانية . وبلغ متوسط الربح الناتج عن عملية تسميد الصنف المحلي ٢٤٥٠ ل.س/هـ ، وبنسبة عائد توظيف رأس المال (٢٣٥٪) وبزيادة بسيطة عن الربح الناتج عن عملية تسميد الصنف المعتمد فرات ١.

كما استجاب إنتاج الصنف المحلي من الحب والقش للتسميد في ٢٠ موقعاً من أصل ٢١ موقعاً في منطقة الاستقرار الثالثة وبزيادة إنتاج المعاملة المسمدة على إنتاج الشاهد بمقدار ٢٧١ كغم/هـ من الحب و٥٢٢ كغم/هـ من القش وبتفوق بسيط على باقي الأصناف (تدمر و WI2291) . وحقق تسميد أصناف الشعير في منطقة الاستقرار الثالثة ربحا صافيا بلغ بالمتوسط ١٨١١ و ١٤٤٩ و ١٥٨٩ ل.س /هـ للأصناف : المحلي و تدمر وWI2291 ، على التوالي .

Response of Barley Cultivars to Fertilization and Economic Feasibility of Fertilization in Zones 2 and 3 in Syria

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Abstract

During three growing seasons (1990-1992), 25 demonstrations in Zone 2 and 21 in Zone 3 were conducted on farmers' fields to determine the response of barley cultivars to fertilization, and also to study the economic feasibility of fertilization in these agricultural zones in northern Syria. The local cultivar responded positively to fertilization in 23 out of 25 demonstrations in Zone 2. Fertilization resulted in a grain yield increase of 371 kg/ha and a straw yield increase of 593 kg/ha. The net return was 2450 SL/ha with an investment revenue of 235%. Furat 1, the improved cultivar, was profitable in 17 locations out of 25, with a net profit of 2427 SL/ha and investment revenue of 233%. In Zone 3, the local cultivar responded positively to fertilization in 20 out of 21 locations. The fertilized treatment gave an increase of 271 kg/ha in grain yield and 522 kg/ha in straw yield. Fertilization resulted in a net profit of 1811, 1449, 1589 SL/ha for the three cultivars local, Tadmor and WI2291, respectively.

Panel Discussions

Crop-Livestock Integration

Panel

Dr T. Treacher (Chairman)
Mr H. Nabulsi
Dr M. Jones
Dr R. Tutwiler
Dr E. Bailey (Rapporteur)

Comments from Panel

T. Treacher
It is recognized that there is a problem with integration of crop and livestock components of the Mashreq Project. The panel was asked to define the problem, and then to consider the implications for technology transfer.

M. Jones
Defining the problem: how much integration is there already? Do we want to increase it? If so, why? Do we all agree on what crop-livestock integration is? Within the Mashreq Project are three basic forms of crop-livestock integration:

1. Smallholder farmers with dual enterprises with different degrees of interdependence of crops and livestock
2. Interaction between crop farmers and independent livestock producers who utilize crop residues (different operators in two different enterprises)
3. More commercial crop farmers growing feed crops for the market.

The materials involved are fodder crops, crop residues and animal manure back to crops. The issues are: declining grazing resources but increasing crop residues (particularly with increase in irrigated areas); much greater mobility of livestock; development of market economy, and a trend among producers to greater specialization, further separating crop and livestock producers.

T. Treacher
A balance between feed resources and small ruminant numbers exists. If we include the < 200 mm zone (outside Mashreq Project) then in the past there was a balance between the grazed feed resources and the number of small ruminants, with animal numbers fluctuating in relation to drought years (balancing). A number of factors have resulted in the transfer of inputs from crop-growing areas to the steppe-based animals. Animal numbers have not stabilized, but have increased. There is

increasing dependence (integration) of livestock on barley. Now, more than 60% of feed for the year comes from the cropped areas.

The issues include: at what level do we consider crop-livestock integration — farm level (production unit level), regional level, national level? At the national level the factor of imports of inputs is important.

At one level, one could say there is no problem. Economically the system functions. But underlying this is a feeling that it is not sustainable in the biological sense, and in the long term it is not economically sustainable.

R. Tutwiler
[Asked by Treacher to comment on a critical factor: if there is an imbalance between animal numbers and feed supply, is this inevitable? Will technology that increases feed supplies or farm incomes merely lead to increased animal numbers, i.e., will it simply exacerbate the problem?]

Is it inevitable that there is an imbalance between animal numbers and feed supply? Normally, historically, imbalances are corrected. People leave the system, animal numbers are reduced, etc. If farmers adopt technologies that increase feed supply on the farm, will this lead to expansion in animal numbers? If farmers are finding livestock profitable and can continue to make a profit by increasing the number, then they will. There is a distinction between quantity (number of animals) and quality of the animals and their products.

What about alternative investment opportunities? We can see investment trends, in machinery for example. But to anticipate how farmers will invest is difficult. Livestock will continue to be an important agricultural activity and producers will continue to invest in livestock.

Re the Mashreq Project and the question of crop-livestock integration and technology transfer: in practical activities, we have to address ourselves to the farm level and also to specialized producers. This implies different technologies for different types of farmers.

H. Nabulsi
Integration implies the combination of two or more things. We have to take into consideration the resources available: land, animals, plants, humans. We cannot have animals without land on which to produce feed. There is also an animal-animal interrelation related to the choice of activity. Different animals utilize plants in different ways: sheep vs. goats vs. camels.

We have to consider the type of farmer: those who are both farmers and herders vs. specialists (as mentioned by Jones). Human resources also include the researchers, policy makers/decision makers etc.

Re the balance between animal numbers and feed supply: in the past the balance was there. There was no problem of overgrazing; animals moved in relation to water supplies and grazing availability. New developments (mechanization, transportation) have led to the imbalance and deterioration of rangelands.

Re level of integration: for the moment we should tackle the individual level (production unit) and assess specialization vs. diversification (risk reduction).

Re technology: identify positive aspects of technology for transfer. Introduction of forages into the cropping system is one of the most important components, in addition to grazing management.

Re research: focus on feed requirements of local animals in their local environments; mechanical harvesting of legumes and development of suitable cultivars for mechanical harvesting.

General Discussion

N. Haddad
From my experience with the Mashreq Project we face difficulties with introducing some technology components (e.g., legumes) because of the lack of integration **at the farm level**. I propose that farmers who have both crops and livestock (diversified, reducing risk) are more likely to adopt innovations. There should be a focus on encouraging such integration at the farm level and this should be explicit in the project.

R. Booth
The panel has discussed the level of interactions and imbalances, but has failed to address **the lack of integration within the research community**. Are there any comments on how, in the Mashreq Project, we can integrate crop and livestock scientists and crop and livestock research?

A. Qrunfuleh
Dependence of animals on agricultural resources is increasing because of the deterioration of the pasture land. In the Mashreq Project we have not yet developed a strategy for addressing this problem.

F. Bahhady
We have to address the point: who is responsible for raising the animals? Many livestock owners are absentee farmers/herders. We have to work with farmers in villages as a group; these are the target farmers.

T. Treacher
I am unconvinced that getting together in workshops is sufficient to bring about integrated research in crops/livestock.

K. Shideed
There remains the problem of agricultural policy. Policies tend to be biased toward crops at the expense of livestock. Policies do not support integration of crops and livestock.

M. Ababneh
Re forage production: we must start with

1. Agricultural policy to support introduction of forage legumes into wheat as well as barley zone (i.e., replacing wheat/fallow);
2. Incentives to make farmers accept the system, including making services and inputs available and cheap;
3. Introduction of appropriate, adapted species of forage legumes.

M. Harb
Do we need integration? And in which system? There are three systems of sheep production:

1. Farmers with sheep on arable land
2. Intensive producers (feedlots, fatteners)
3. Independent sheep herders, who often have a hostile relationship with crop farmers. This is where the problem is.

T. Treacher
If we accept that integration is needed, how do we achieve it?

M. Harb
Of the feed available to sheep, 60% comes from cereals and cereal residues, 30% from rangeland. Thus we have to look at these two components of feed (cereals and range) with the participation of those producers involved. We must also look at incentives/subsidies.

T. Goodchild
One problem has not yet been touched on: the variability in climate and therefore variability in feed production from year to year. We have to use integration to

stabilize feed supply (e.g., storage of feed from one year to the next). This relates to defining feed requirements, etc. We also have to look at the whole continuum from production to utilization, storage, marketing, etc.

T. Treacher
Why is this not going on already? We are not starting at the right place. Re Ababneh's and other's comments: we have to "convince" the farmer. This is a top-down approach. Is there room for a participatory, bottom-up approach in the Mashreq Project? Is this a feasible research approach for integrating crops and livestock?

Q. Mamdouh
In the Mashreq Project our target has been farmers who have both crops and sheep. But if we go to crop farmers or to sheepherders, will they accept the same system that is targeted to mixed farmers? Also, farmers are responding to agricultural policy, subsidies, etc. So a program to integrate crops and livestock has to be within a well-defined policy.

A. Adary
Sheep herders can buy their fodder from any part of the country. Without developing fodder resources within an area it is not possible to talk about integration. All components of the system must be present.

S. Hamadeh
You have to define the problems. Are they technical, socioeconomic, political, etc.? How will the Mashreq Project deal with often conflicting aims of sustainability and productivity?

Closing Comments

M. Jones
In response to Booth's remarks on integrating crop and livestock scientists: we cannot change systems abruptly, but must follow the direction in which systems are evolving and try to influence the evolution. This may need more diagnosis or more "action research." My concern with the Mashreq Project is that the livestock research has been mainly on breeding, and not on management and feed which is where livestock interact with crops.

In response to Tutwiler's remarks in the morning session suggesting there is not enough diagnosis of animal production, livestock diagnosis involves farmer participation. Where do we start? In the workshop, livestock scientists have talked about different livestock production systems, which are not the same as the systems we have discussed in this panel (e.g., references to extensive and semi-intensive systems in other papers). A starting point would be a diagnosis of current different systems of livestock production and possibilities for crop-livestock integration.

In response to Dr Treacher's comments on a top-down vs. a bottom-up research approach: does anyone have any suggestions for technologies that could be called **integrative technologies**? Mr Nabulsi has mentioned grazing management. Dr Tutwiler suggests feed processing, particularly of legumes, i.e., hay-making vs. harvesting at maturity.

N. Nabulsi
Re integration within the farm, from my own experience. In 1990/91, a bad season with late rains, I had planned to plant 250 du (25 ha) to vetch, planning to harvest it for grain and straw. Because I have sheep and goats I went ahead and planted despite the late rain. If I could not harvest I would graze it. The production was very low. I harvested 60 du (6 ha) manually (expensive in labour) and the remainder was grazed by my sheep. If I had not had animals on my farm I could not have handled, and benefitted from, the crop in this way.

Re Nasri Haddad's question as to whether sheepherders are quitting the system: in the feedlot/intensive system, most people have quit, yet lamb fattening in the intensive systems is successful. The majority of people in animal production are there to stay.

Two important points for integration (and development): research and policy. We don't need to "convince" farmers. If you have a feasible, practical solution, farmers will adopt. If it is not feasible, then farmers will never be "convinced."

Re policy: dry farming and livestock are neglected within agricultural policy in general.

T. Treacher
1. **We need to define target farmers** and these are the farmers who have both crops and livestock. We should work toward integrating these farmers within the production unit. Nomadic or range-based sheepherders are more difficult to help within the Mashreq Project. In the next phase of the Mashreq Project it should be made very clear and specific which farmers our technology is directed at.

2. **A participatory, bottom-up approach** has to be attempted, and this is the role of the national programs. ICARDA can help, but national programs have to undertake this problem, particularly how to integrate scientists into a team to undertake this approach.

An example of such research at ICARDA is on straw processing. Forty-five farmers were interviewed and asked an open-ended question: "What is your biggest problem?" Invariably they defined the spring period (lactation) as their major problem, and that the lack of rainfall during this period contributes to the problem. Scientists can now work **with** farmers (participatory) on solving the problem **identified by the farmer** (bottom up).

In summary, I recommend a participatory, farmer-led approach, in place of the top-down, "convincing the farmer" approach to research in crop-livestock integration.

Mashreq Project's Future Directions

Panel

Dr R. Booth (Chairman)
Dr N. Haddad (Rapporteur)

Comments from Chairman

Dr Booth asked the group to focus the discussion on two major issues:

1. The future directions within the existing Mashreq project
2. The direction of a second phase of the project and the justification for a second phase.

General Discussion

Future Directions

W. Al-Tawil
Raised several points which he suggested be included in the future project activities:

- to priorize project technologies and implement them according to their importance and their possible adoption by farmers.
- mechanical harvesting of forage legume crops should be given more attention by the project.
- crop-livestock integration is being successfully implemented in irrigated areas; however, in the dry areas not much information is available and more research is needed.
- constraints for adoption of project technology should be identified and carefully studied.
- project evaluation is needed for better implementation of future activities.
- field days and publication should be intensified and the project should invest in them in the future.

A. Khneifis
The demonstration in Syria should be distributed after obtaining good knowledge of the farmer and his capabilities in dealing with the technology.

A. Qrunfuleh
As 52% of farmer's income in Syria comes from animal production, future project activities should have more focus on animal production activities.

B. Al-Rawi
We should focus at this stage on successes, and not overload farmers with the technology. More emphasis should be given to training and education.

K. Shideed
More emphasis should be given to economical evaluation, effectiveness studies, development of strategies for risk avoidance and socioeconomic factors affecting adoption. He encourages the project to take a close look at the full-package system introduced by the project.

A. Al-Shamma
Some project efforts should be devoted to seed production.

A. Adary
Large areas should be planted and more advanced technology should be introduced.

S. Ceccarelli
The area project trials should be increased with efficient evaluation. The project should produce its own seeds.

Second Phase

R. Booth
Dr Booth indicated to the group that from the last two days' presentations we find that the project was successful. Therefore, he questioned why the countries do not carry the project on their own. Is there a need for phase 2? He asked for the participant's reaction.

N. Mona
I do not agree with Dr Booth's assumption and feel that there are structural changes the project will not be able to solve, one of which is the problem of marketing efficiency.

R. Booth
If I were a donor, I would not be convinced by this argument.

B. Al-Rawi
Phase 2 is needed and should have a shifting in directions, not objectives. Focus on technology to suit local conditions.

M. Mechil
The project should focus on farmer training and education. Many of the results are not available to farmers. Extension should have a stronger role.

Y. Sweidan
The project was successful in developing and strengthening the relationship between research and extension.

A. Hajichristodoulou
The government should be more involved to ensure 100% project success.

R. Booth
I would remind the participants about the next phase of the project and ask what you think about a next phase. The development of a next phase should be a bottom-up approach and not a top-down. For a new document to be developed there should be feedback.

N. Haddad
The present phase of the project was able to achieve the objectives but there are many areas which are not fully implemented. For example, in animal production most of the activities are still under validation by testing them on sheepowner flocks. If successful, they will be demonstrated and adopted by farmers. Moreover, the technology when applied might need refinement to suit local farmers' conditions, and here rises the importance of a feedback mechanism from extension and farmers to researchers. Future project focus will be on extension and extension-related activities. Monitoring and adaptation and impact studies will be a major component of the second phase of the project.

Q. Mamdouh
Animal production activities started late in the project and the time left will not be enough for achieving the full objective in this area.

S. Ceccarelli
The economic situation in the donor community will not be in favor of supporting a second phase. The key word should be the integration between crop and livestock at the farm level.

K. Tadrous
I would like the second phase to include some activities on the range.

R. Booth
Please give your views on project activities, the balance between commodities, and between crops and small ruminants, and the countries to be included in the second phase. I suggest that in the second phase the countries should take over the in-country activities and the donor should support the inter-country (among countries) activities.

B. Jamal
The project has the mobility and the flexibility to introduce the technologies to farmers and it is important that such mobility shall continue.

M. Jones
The focus in the second phase should be on farmers and extension with support from researchers. More focus on integration also is needed.

A. Qrunfuleh
Some animal production technology such as the improved rams needs a second phase to be well evaluated and make an impact.

M. Safi
In the second phase a soil analysis approach might be followed to determine fertilizer requirement at the farm level.

A. Mavrogenis
Integration is also needed within the same discipline, i.e., integration between animal breeders and animal nutritionists.

A. Al Rawi
Much has been achieved with barley, but more focus is needed on forage production through an integrated system (plant/animal). Also, some emphasis on unconventional sources of feed is required.

H. Nabulsi
I agree with Dr Al-Rawi that the concentration should be on forage and legume feed production. Mechanical harvesting and grazing management need to be addressed. Farmers need advice about utilization of green fodders and techniques for lamb fattening.

M. Hadjipanayiotou
The second phase should be oriented to help farmers apply what has been found

by researchers within and outside the region, especially in the area of feed production and utilization.

O. Gursoy
The activities in animal production started relatively late owing to the nature of these activities and to the progress that was made in the national programs. In the second phase, there will be a better chance to achieve progress. The second phase should consider the integration of the improvement, nutrient and management technologies. It should also consider the increase in product with the marketing aspects. Farmer training should be intensified.

S. Al-Haj Hassan
Lebanon is ready and willing to participate in the second phase. Results are available at the national program but need to be transferred to farmers.

A. Hadjichristodolou
Cyprus is ready to participate, although from the donor point of view this might not be possible. However, scientists and institutions in Cyprus are ready to continue the interaction with the project and with the scientists in the national programs.

M. Jones
The second phase should consider the participatory approach of farmers, more focus on socioeconomics and livestock aspects.

Closing Comments

R. Booth
Dr Booth indicated to the group that there is an urgent need for the national programs to give these issues some thoughts, provide their views on the project's future, and send them back to the regional coordinator. Their response should include their opinion, interest, comments and justification for a new phase. After this is received we will be able to start working on a new document for a second phase of the project which will be done in close cooperation with national programs.

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