FARMING SYSTEMS

RESEARCH AND TRAINING PLANS

1985/86 SEASON

International Center for Agricultural Research in the Dry Areas

(ICARDA)

P.O. Box 5466

Aleppo, Syria

FARMING SYSTEMS RESEARCH AND TRAINING PLANS
1985/86 SEASON

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INTRODUCTION

Our program planning session (28th and 29th September) were scheduled after other ICARDA programs had completed their own. This allowed FSP staff to attend those sessions, and also allowed other ICARDA staff to attend ours. By definition, FSP's cooperation with other programs is essential if we, and ICARDA, are to succeed in conducting our research within a "systems" context. The planning schedule adapted this year was successful in achieving this objective.

Our plans, formulated in cooperation with PFLP, FLIP and CP are presented in this document under four major project headings

(1) Barley Livestock Farming Systems
(2) Wheat Based Systems
(3) Intersystems Research
(4) Training

We believe that these plans reflect an increasingly applied and farmer orientated program of research and training designed to produce successful and acceptable solutions to the current constraints facing increased productivity and rural welfare in the region ICARDA serves.

Dr. Peter J.M. Cooper
Leader
Farming Systems Program

FSP PLANNING SESSIONS

1985

Office 1

Saturday, 28 Sept. **WHEAT BASED FARMING SYSTEMS**

WHEAT

0800 - 0830	(1)	Wheat Production Survey in N.W. Syria	Tully
0830 - 0845	(2)	On-Farm Wheat Trials	Dakermanji
0845 - 0900	(3)	Soil Test Calibration for Wheat Fertilization in Farmers' Fields	Matar
0900 - 0915	(4)	Weed Control in Wheat (on Station Trials) at Tel Hadya	Dakermanji
0915 - 0925	(5)	Regional Wheat/Vertisol Trial	Cooper
0925 - 1030	(6)	Integration of Wheat On-Farm Trials and Soil Test Calibrations with Survey Follow Up and Cooperation with Cereal Program and National Program	Cooper/ Srivastava
1030 - 1100	C O F F E E		

LEGUMES

1100 - 1130	(7)	On-Farm Legume Trials with FLIP	Cooper/Saxena
1130 - 1145	(8)	Weed Control Research at Tel Hadya	Haddad
1145 - 1215	(9)	Food Legume Microbiology	Afendi
1215 - 1230	(10)	Soil Test Calibration for Food Legumes	Matar
1230 - 1300	L U N C H		

CROP ROTATIONS

1300 - 1400	(11)	Crop Rotation Trials at Tel Hadya and Discussion	Harris

LIVESTOCK STUDIES

1400 - 1410	(12)	Sheep Feeding Strategies (PhD Study - University of Hohenheim)	Nordblom
1410 - 1420	(13)	Closing Comments of Wheat Based Systems Research	Somel

INTERSYSTEMS RESEARCH

1420 - 1500	(14)	Supplementary Irrigation	Perrier/Salkini
1500 - 1540	(15)	Agroclimatic Zonation	Goebel
1540 - 1600	(16)	Phosphate Fixation in Rainfed Soils	Matar

Sunday, 29 Sept.		**BARLEY LIVESTOCK FARMING SYSTEMS**	
		BARLEY	
0800 - 0815	(1)	Collaboration with Syrian Soils Bureau	Somel
0815 - 0845	(2)	On-Station Barley Agronomy	Harris/Cooper
0845 - 0900	(3)	Long Term Application of Phosphate on Barley	Matar
0900 - 0915	(4)	FSP/CP/Reading Root Studies	Harris/Acevedo
		ANNUAL SOWN FORAGE LEGUMES	
0915 - 0930	(5)	Forage Agronomy	Harris
0930 - 0945	(6)	Forage Microbiology	Afendi
0945 - 1000	(7)	Forage BNF and BNR	Harris
1000 - 1030	(8)	Constraints to Adoption of Legumes in Dry Areas and On-Farm Evaluation	Tully
		CROP ROTATION TRIALS	
1030 - 1040	(9)	2-Course Rotations at Breda and Tel Hadya	Somel/Harris
1040 - 1100	C O F F E E		
		CROP/LIVESTOCK RESEARCH	
1100 - 1120	(10)	Economics Analysis of Grazing Forage Legumes On-Farm Trials (PFLP/FSP)	Jaubert/Thomson
1120 - 1135	(11)	Livestock Feeding Strategy	Jaubert
1135 - 1145	(12)	Economic Analysis of Tel Hadya Unit Farm (PFLP/FSP)	Nordblom
1145 - 1200	(13)	Tah Medic Survey (PFLP/FSP)	Nordblom
1200 - 1300	(14)	General Discussion on Barley Livestock Systems Research Plans and Cooperation with PFLP/CP	Cooper
1300 - 1400	L U N C H		
1400 - 1445		TRAINING	Bakheit
1445	(15)	Open Discussion on FSP Research Plans for 1985/86	

BARLEY LIVESTOCK SYSTEMS (BL)

RESEARCH PLANS 1985/86

RESEARCH WITHIN CURRENTLY PRACTICED CROP ROTATIONS

Following our very successful first year's cooperative research with the Soils Directorate, this work will continue on an expanded basis to include a comparison of economics of phosphate and nitrogen fertilizer responses in contrasting rotations (barley/barley, fallow/barley) and deep and shallow soils (BL-1). This work will be conducted entirely in farmers' fields in the four main barley growing provinces of Hassakeh, Raqqa, Aleppo and Hama, and will remain one of our highest priority research topics.

This on farm work will continue to be supported by on station research at Breda (278 mm), Khanasser (220 mm) and Ghrerife (250 mm), where we have now taken a long term lease on 2 ha of land. In trial BL-2 we will measure residual effects of N and P fertilizer applied in contrasting rotations in the previous season. Since rotation x fertilizer responses are now being evaluated in farmers' fields in BL-1, on station experimentation will be phased out on this issue. In addition we will use the long term rotation trial at Khanasser to measure the effects of previous phosphate fertilizer application on soil P-levels and phosphate response for a second year (BL-3). Pre-soaking of barley seed to ensure rapid germination and winter growth is a feasible option for farmers. We will investigate these effects for a second year (BL-4).

ANNUAL SOWN FORAGE LEGUMES

We will continue to evaluate, in farmers' fields, the potential of vetch and lathyrus both for grazing and harvesting as a mature crop. In trial BL-5, the residual effects of 6 rotations, phosphate and carbofuran

will be measured using a uniform barley crop, and in cooperation with PFLP and the Directorate of Steppe, Range and Sheep we will continue to measure the productivity of ewes and lambs grazing both vetch and lathyrus (BL-6). This work is now being expanded to a "whole farm" basis.

In addition to this on farm work, back up work will continue on station. Farmers have indicated problems with insects in legume production in dry areas, and this will be evaluted for a second year (BL-7). Results have also shown that high seed rates are required under farmer management to produce satisfactory stands, but that harvest time (hay .v. mature crop) interacts. Trial BL-8 will investigate this for a second year in succession.

We will also continue our research on improving BNF of forage legumes through improved crop management (BL-9) and to assess the residual effect of these treatments on nitrogen availability to a uniformly sown barley crop (BL-10).

Lastly, a new field of research is being initiated in response to survey findings which indicate that farmers forsee high seeding rates and high seed costs as a severe constraint to growing annual sown forages. In this research (BL-11) we will investigate the possibility of establishing productive vetch pastures by undersowing barley with vetch in the preceding year. In year two, a naturally regenerated vetch pasture will be evaluated. Observations in the N.W. Coastal area of Egypt, and a simple trial at Breda indicate that this is a very promising possibility.

CROP ROTATION TRIALS

The two large crop rotation trials with 20 combinations of rotation x fertilizer management will continue next season (BL-12). Forage peas have come under question due to unpalatability at the grazing stage and susceptibility to frost, disease and insects. 8 of the twenty rotations

include peas and during this year we will decide how we should replace them. The inclusion of lathyrus or vicia disycarpa are two strong possibilities.

COLLABORATIVE RESEARCH WITH PFLP

Both FSP and PFLP share common objectives in evaluating the potential for both self regenerating and annual sown legumes in dry areas, either to replace fallow land or to break continuous barley cultivation. Substantial cooperation takes place between the two programs and duplication of effort is avoided. Three major cooperative projects are briefly described in this document under the PFLP prescheduling numbers L1, M6 and L13, and can be found in more detail in PFLP documents.

In these three research topics, FSP's contribution lies in economic evaluation of results.

BARLEY LIVESTOCK SYSTEMS

Title (BL-1) Fertilizer Responses of Barley in Dryland Areas.

Objective To assess biological and economic responses of barley to phosphate and nitrogen fertilizer within the fallow/barley and barley/barley rotations on deep and shallow soils, and to relate crop performance to soil fertility, rainfall and fertilizer application.

Location 24 locations around Hassakeh, Raqqa, Aleppo, and Hama.

Treatments 16 combinations of 2 factors (N and P) at 4 levels each N_0, N_{20}, N_{40}, N_{60} -- P_0, P_{30}, P_{60}, P_{90}

Design 4 x 4 factorial, 2 replicates/location

ANOVA Each Location

Source of var.	df.
Total	31
Rep.	1
N	3
P	3
N x P	9
Error	15

Related Measurements Soils analysis (N x P), rainfall, soil moisture dynamics, crop phenology, economic survey.

Principal Scientists Involved Soils Directorate (MAAR) - Dr. J. Abdel Karim, Mr. K. El Haj

ICARDA - Dr. P. Cooper, Dr. K. Somel, Dr.A. Matar, Dr. H. Harris

BARLEY LIVESTOCK SYSTEMS

Title (BL-2)

2nd Year Residual Effects of Nitrogen and Phosphorus Fertilizer Response Surfaces in Contrasting Barley Rotations

Objectives

1) To provide a second year's data on residual effects of nitrogen and phosphate fertilizer applied in 1984/85 season.
2) To assess the economic implications of crop rotation effects on fertilizer use on a two year basis.

Location

Breda

Treatments

Uniform barley will be sown at 100 kg/ha over 25 combinations of 2 factors (N & P) at 5 levels each

N	0,	30,	60,	90,	120	
P	0,	60,	120,	180,	240	established in 1984/85 season

Design

5 x 5 factorial, 2 replicates/rotation

ANOVA

For each rotation:

Source of Var.	df
Total	49
Rep.	1
N	4
P	4
N x P	16
Error	24

Principal Scientist Involved

Dr. Harris, Dr. Cooper, Dr. Somel

BARLEY LIVESTOCK SYSTEMS

Title (BL-3)

Long Term Phosphate Application and its Effect on P-Response.

Objective

To utilize crop rotation trial at Khanasser to assess the effect of differential levels of P_2O_5 application (0-240 kg/ha) over the first five years on P-response of barley in the sixth year.

Note: The trial has failed as a rotation trial due to bird damage on forage legumes. B/F, B/Vetch and B/Peas rotations are thus identical except for history of P application.

Treatments

Utilizing these three rotations, the following plots can be identified which are due to be planted with barley this year.

9 plots - zero P_2O_5 over 5 years
9 plots - 120 kg/ha P_2O_5 over 5 years
9 plots - 240 kg/ha P_2O_5 over 5 years

These plots are sufficiently large to be split three ways and three levels (0, 60, 120 kg/ha) P_2O_5 will be applied.

Design

Original design of trial was phased entry randomized block, 3 replicates, 12 rotations. This year treatments will be completely randomized amongst 27 identified plots.

ANOVA

Source of var.	df.
Total	80
Current P application	2
Previous P application	2
Pc x Pp	4
Error	72

Related Measurements

Initial soil analyses, P uptake by plants

Principal Scientists Involved

Drs. A. Matar and P. Cooper

BARLEY/LIVESTOCK SYSTEMS

Title (BL-4)

Effect of Pre-Wetting Barley Seed on Growth, Vigour and Yield.

Objective

Previous research has shown the importance of rapid crop establishment and early ground cover in setting yield potential through improved water use efficiency. This trial aims to investigate the possibility of increasing the rate of crop emergence and early crop growth through pre-wetting of barley seed, and its effect on subsequent growth and yield.

Location

Breda

Treatments

4 combinations of two factors (wet/dry seed, ± fertilizer) at two levels each.

Design

2 x 2 factorial with four replicates

ANOVA

Source of var.	df
Total	15
Rep.	3
Seed Trt.	1
Fert.	1
S x F	1
Error	9

Related Measurement

Crop phenology, dry matter and GAI

Principal Scientist Involved

Mr. Z. Arous

BARLEY LIVESTOCK SYSTEMS

Title (BL-5) On-Farm Rotation No. 2 (Second Year)

Objectives

1) Compare vetch, lathyrus, lentils, barley, barley + N, and fallow for effect on a subsequent barley crop.
2) Measure residual effects of phosphate applied in first year on subsequent crops, with and without an additional application.
3) Measure residual effects of sitona larva: control (carbofuran).

Location Six farmers' fields, (two each in Abu Rouel, Deir Qaaq, and Soussiane) plus Tel Hadya (2 reps).

Treatments First year had 24 combinations of six rotations, two levels of phosphate, and two levels of carbofuran.

Second year will re-split the phosphate blocks with 2 levels of phosphate.

Design Split-strip

ANOVA

Source of var.	df.
Total	383
Field	7
Rotation	5
Error (a)	35
Carbofuran	1
Rot x carbofuran	5
Error (b)	42
Phosphate	3
Error (c)	21
Rotation x Phosphate	15
Error (d)	105
Phosphate x Carbofuran	3
Rotation x P x Carbofuran	15
Error (e)	126

Related Measurements Rainfall

Principal Scientists Involved Drs Tully and Cooper

BARLEY LIVESTOCK SYSTEMS

Title (BL-6)

On-Farm Forage Trials Involving Ewes and Lambs.

Collaborative project with the PFLP and the Syrian Ministry of Agriculture (Directorate of Steppe, Range and Sheep).

Location

Breda/Bueda area; 35 km south of Aleppo

Goal

Test the feasibility of vetch and lathyrus for grazing by ewes and/or lambs.

Objectives

1) To measure the effect of replacing the entire fallow land with vetch and lathyrus on whole farm productivity and subsequent barley grain and straw yields.
2) To measure the growth rate of lambs and live-weight changes and milk production of ewes grazing spring pastures of vetch and lathyrus.
3) To measure the seed and straw yields of these species when harvested at the mature stage.

Experimental Outline

A comprehensive on-farm program involving annually sown forage crops was undertaken in 1984/85. The sheep production data is reported by Thomson, Jaubert and Oglah (1985).

Milk production of ewes was similar on the marginal land and on the vetch and lathyrus pastures. In villages where flocks have access to non-arable areas, forages are a valuable fed resource to complement the marginal grazing in particular regarding lambs. As shown by the demand of farmers, in these villages, grazing lambs seems the most promising option to develop forage/barley rotations.

In villages with little, or heavily degraded marginal grazing, forage can be grazed by ewes and lambs.

As compared to 1984/85 the design of the trials will be simplified and the numbers of farms increased.

Methods

1. Site and farmer selection

   As many as possible of the eight farmers from the 1984/85 Breda/Bueda sample will be involved in the 1985/86 study. Two or three farmers located to the east of Kafr Abiad-Breda road will be added to the sample so that four or five farms in the sample are located on shallow, stony soils. Farmers will be responsible for cultivating and planting the land.

2. Species

   Vetch (Vicia sativa) and Lathyrus (Lathyrus sativus) will be used.

3. Field layout

   Half of the fallow area will be planted to each species, but one or more fallow strips should be left depending on the field shape.

4. Fertilizer level

   50 kg per hectare of P_2O_5 (110 kg TSP containing 48 percent P_2O_5) to all forage area but none to the fallow strip.

5. Seed rate

   160 kg per hectare of clean seeds will be used.

6. Land preparation

   The land will be prepared using traditional farmer practices: Duckfoot cultivator (Ayar).

7. Planting method

   Hand broadcasting by farmer or local broadcaster.

8. Seed incorporation

   Duckfoot cultivator (Rdad)

9. Crop utilization

   The farmers will be responsible for deciding how to utilize his crop. By keeping in close touch with him it should be possible to know in advance how he is going to utilize his crop whether for grazing or for seed and straw production or both.

10. Measuring forage productivity

If the trial will be used for grazing, 10 samples (2.0 x 2.0) will be taken from each species before grazing starts. Fresh weight of each of the 10 samples will be determined. The 10 samples will be subsampled and bulked to determine the dry matter content.

Five wire cages (1.8 x 1.8 m) will be ungrazed up to end of grazing. The crop inside the cages will be harvested to determine the total biological yield (seed and straw separately).

If the crop is going to be kept for seed and straw, only 10 samples (2.0 x 2.0 m) will be taken from each species before harvesting begins to determine total biological yield (seed and straw separately).

11. Measuring sheep productivity

If a farmer decides to use the forage crops for grazing, sub-sample of his flock will be weighed at the start of grazing. Up to a maximum of 10 ewes in each flock will be monitored and compared with another 10 ewes which may go to the steppe or graze on marginal land. If possible ewes and lambs will be weighed every 14 days during the grazing period.

The milk yield of the ewes which are no longer being suckled by lambs will be measured every 14 days during the grazing and on at least two occasions separately by seven days once grazing has ended.

12. Whole-farm productivity

Cropping practices of all crops on each farm will be recorded: planting date, seed rate and cost, land operations (date, cost), harvesting date, crop yield, cost of harvesting, etc.

Sheep enterprise will be monthly recorded: all inputs and outputs, quantities and prices, changes in flock composition, births, deaths, sales, purchases, gifts, opening and closing inventories of feedstuffs and sheep by category; supplementary feeding practices.

Supervisors	E. Thomson	(PFLP)
	M. Oglah	(FSP)
	F. Bahhady	(PFLP)
	T. Nordblom	(FSP)
Research Assistants	A. K. Sumaqieh	
	A. K. Ferdawi	
	M. Touma	

BARLEY LIVESTOCK SYSTEMS

Title (BL-7) Insect Control in Forage Crops

Objective To assess the importance of insect damage to seed production in forage legume crops, and to relate the findings to farmer opinion as determined from survey.

Location Breda and Tel Hadya

Treatments 6 combinations of three legume species (vetch, lentils and lathyrus), with two spraying treatments (unsprayed or sprayed at flowering)

Design Randomized block in three replicates

ANOVA

Source of var.	df.
Total	17
Block	2
Species	2
Insect Control	1
Species x Insect Control	2
Error	10

Principal Scientists Involved Dr. H. Harris, Dr. D. Tully, Entomologist

BARLEY LIVESTOCK SYSTEMS

Title (BL-8) Forage Crop Agronomy

Objective To evalute the main effects and interactions of seeding rate, planting method and harvest time on the yield and yield components of several forage legumes grown either for hay or grain plus residue; to relate the findings to farmers' opinion and current practices as determined by survey methods.

Location Breda

Treatments 48 combinations of three species (lentil, vetch and lathyrus) with two planting methods (drilled and broadcast), four seeding rates (to span farmer practice) and two harvest time (for hay or grain).

Design 3 x 2 factorial with crop species and sowing methods as main plots, and seeding rate and harvest time as sub-plots respectively with 3 replications.

ANOVA Within Harvest Time

Source of var.	df.
Total	71
Block	2
Sowing method (SM)	1
Species (S)	2
SM x S	2
Error (a)	10
Rate (R)	3
R x SM	3
R x S	6
R x SM x S	6
Error (b)	36

Principal Scientists Involved Dr. H. Harris, Dr. D. Tully

BARLEY LIVESTOCK SYSTEMS

Title (BL-9)	Biological Nitrogen Fixation by Forage Legumes (BNF)
Objectives	To quantify the effects of individual components and interactions of improved agronomic practices on BNF by forage legume crops.
Location	Tel Hadya and Breda
Treatments	96 combinations of five management practices (weed control, insect control, phosphate, inoculation and row spacing) at two level (traditional and improved) with three species, lentils, vetch and lathyrus.
Design	2^5 factorial for each crop species.
ANOVA	See Over
Principal Scientists	Dr. H. Harris, Mr. F. Afendi

ANOVA

1. Within Species:

Source of var.	df.
Total	31
Blocks	3
W.C.	1
Inoc.	1
P	1
In.	1
Rsp.	1
1st Order Interactions	10
Error	16

2. Same Species Across Site:

Source of var.	df
Total	63
Site	1
W	1
Inoc.	1
P	1
Insect C.	1
Rsp.	1
1st Order Interactions	15
Error	42

3. Combine Over 3 Species - same site:

Source of var.	df.
Total	95
Species	2
W	1
Inoc.	1
P	1
Insect	1
Rsp.	1
1st Order Interactions	20
Error	68

4. Combine Over 3 species - two sites:

Source of var.	df.
Total	191
Species	2
Site	1
W	1
Inoc.	1
P	1
Insect	1
Rsp.	1
1st Order Interactions	27
Error	156

BARLEY LIVESTOCK SYSTEMS

Title (BL-10)	Residual Effects of BNF
Objective	To quantify the residual effects of biological nitrogen fixation effects of forage legumes in year one by examining the nitrogen uptake by a well phosphate fertilized barley crop in year two.
Location	Tel Hadya and Breda
Treatments	Residual effects of 48 combinations of five management practices (weed control, phosphate, insect control, inoculation and row spacing) at two levels (local and improved) for three crop species, lentil, vetch and pisum.
Design	2^5 factorial for each crop species
ANOVA	See Over
Principal Scientist Involved	Dr. H. Harris

ANOVA

1. Within Species:

Source of var.	df.
Total	31
Blocks	3
W.C.	1
Inoc.	1
P	1
In.	1
Rsp.	1
1st Order Interactions	10
Error	16

2. Same Species Across Site:

Source of var.	df.
Total	63
Site	1
W	1
Inoc.	1
P	1
Insect C.	1
Rsp.	1
1st Order Interactions	15
Error	42

3. Combine Over 3 species - same site:

Source of var.	df.
Total	95
Species	2
W	1
Inoc.	1
P	1
Insect	1
Rsp.	1
1st Order Interactions	20
Error	68

4. Combine Over 3 Species - two Sites:

Source of var.	df.
Total	191
Species	2
Site	1
W	1
Inoc.	1
P	1
Insect	1
Rsp.	1
1st Order Interactions	27
Error	156

BARLEY LIVESTOCK SYSTEMS

Title (BL-11) Under Sowing of Barley with Vetch (2 Year Trial)

Objectives

1) To determine the potential for establishing productive and economic vetch pastures (year 2) through the undersowing of barley in year one.
2) To assess the effect of undersowing barley with vetch on barley productivity in year one.

Locations Breda, Tel Hadya (following fallow (Breda) and lentils (Tel Hadya)).

Treatments

1) 10 treatment combinations of two factors, barley seeding rate, 60 & 120 kg/ha and vetch seeding rate, 0, 20, 40, 60, 80 kg/ha.
2) Uniform phosphate will be applied (60 kg/ha P_2O_5) at planting with the option of top dressing 20 kg/ha N in February if the season warrents it.
3) Treatments will be imposed by the farmers' practice of broadcasting over ridges and covering with a tabban. Plot size 5 x 12.5 m.
4) Hand weeded if necessary.

Design 2 x 5 factorial, three replicates/location. Three additional plots of pure vetch (80 kg/ha seeding) will be planted at random within the layout.

ANOVA Over 2 locations:

Source of Var.	df
Total	59
Rep. in Loc.	4
Location	1
Bs	1
Vs	4
Bs x Vs	4
Bs x Loc	1
Vs x Loc	4
Bs x Vs x Loc	4
Error	36

Related Measurements

Year 1

At harvest of barley, full yield components of both barley and vetch plus assessment of vetch seed production and nutritive value of barley + vetch.

Year 2

a) Regular monitoring of the productivity of the naturally regenerated vetch pasture to assess its potential for both grazing and hay production.

b) Economic analyses of the two years data set.

Principal Scientist Involved

Dr. Harris, Dr. Cooper, B/L Agronomist.

BARLEY/LIVESTOCK SYSTEMS

Title (BL-12) Forage Crop Rotation Trial

Objective To determine the long term suitability and economic viability of current and alternative two course rotations in dry barley growing areas

Location Tel Hadya, Breda

Treatments 20 combinations of 5 rotations (B/B, B/V, B/P, B/VB, B/PB) and 4 fertilizer management strategies and 2 combinations of B/F at two fertilizer management levels.

Design 2-course phased entry with 3 replicates in randomized block

ANOVA

Source of var.	df
Total	131
Blocks	2
Treatments	43
Error	86

Related Measurement

1) Seasonal monitoring of microbial activity of forage legumes
2) Development of methodology for economic evaluation

Principal Scientists Involved Dr. H. Harris, Dr. K. Somel, Microbiologist

BARLEY LIVESTOCK SYSTEMS

1. Title — Productivity of Unit Farms and Flocks (L1)

   Objective — To use six year's data on Unit Farm crop rotations and ewe nutrition/response in a comprehensive economic framework.

   Methods — Linear Programming techniques, first for single-year analysis using averaged data, then for a six year sequence to allow solutions for year to year changes in crop sales and feed purchases. This study will also depend upon rangeland yield and response data being measured by Dr. A. Osman in LM2 at Tel Hadya.

   Research Supervisors — E.F. Thomson, F. Bahhady and T. Nordblom

2. Title — Development of a Productive Integrated Livestock/ Cereal Producing Farming System at Village Level (M6)

   Objectives

   1) Determine the constraints operating at village level when farmers use pastures to replace fallows in the traditional cereal/fallow farming system.
   2) Provide the technical support that farmers will need when they adopt the pasture/cereal system.
   3) Establish an implementation procedure for the widespread introduction of the pasture/cereal system in Syria and eventually through North Africa and other parts of West Asia.

   Methods — 12 on-farm trial sites around Tah village, one site in Horan and one near Al Bab, will be used for establishing new stands of annual medic species which will be grazed by farmers' flocks of sheep and managed to allow sufficient seed drop for spontaneous regeneration in the year following the subsequent cereal crop. Production costs and economic constraints will be surveyed in and around the study villages.

   Research Supervisors — H. Sawmy, E. Thomson, P. Cocks and T. Nordblom

   This is a collaborative project with the Syrian National Program (Directorate of Steppe, Range and Sheep)

3. Title — Productivity of a Wheat/Medic Rotation Compared with Three Alternative Forms of Land Use: Wheat/Lentils, Wheat/Water Melons and Wheat/Vetch (L13).

Objectives — To assess maximum productivity of a wheat/medic rotation ("the medic system") by monitoring the effect of stocking rate, and comparing its economic and biological stability to lentil, melon and vetch rotations with wheat.

Research Supervisors — A. Smith, F. Bahhady, P. Cocks, N. Nersoyan, T. Nordblom, E. Thomson and M. Touma

WHEAT BASED FARMING SYSTEMS (WB)

RESEARCH PLANS 1985/86

ON FARM TRIALS AND SURVEYS

An intensive survey on wheat production practices was conducted in 1984/85 in Homs, Hama, Idlib, and Aleppo accompanied by on farm trials investigating fertilizer and weed control effects. Much of this data has been already analysed, but a follow up survey and further analyses will be done in 1985/86 (see WB-1). In addition, further analyses will be performed on survey data collected on labour issues involved in agricultural production in these wetter areas and a subsequent follow up survey will be conducted (see WB-2).

One striking factor emerging from the recent survey on wheat production was the extent to which nitrogen and phosphate fertilizers are being used by wheat growers, and the enormous variations in amounts applied. Initial analyses showed that wheat farmers apparently consider "previous crop" to be an important factor determing rates of fertilizer use. However, in contrast to experimental results, farmers do not use herbicides to the same extent. In 1985/86, a series of on farm trials will be run to investigate these survey results in more detail (see WB-3).

FLIP has demonstrated that large improvements in chickpea production can be obtained through early planting with inoculated seed and phosphate fertilizer in the presence of herbicide. A trial (WB-4) will be run on 10 chickpea farmers'fields under their management conditions to assess and demonstrate this potential. Similar increases in yield are possible when lentils are sown early with phosphate and sitona weevil control in the presence of herbicide and these factors will be tested in farmers' fields (WB-5). Economic analyses will form an important component of all our on farm trials this year.

RESEARCH ON WHEAT

In addition to these general on farm trials, we will continue our more specific investigations on fertilizer and herbicide use in wheat and food legumes. This year we will assess the effect of herbicides on increased frost susceptibility of wheat (WB-6), and in cooperation with CP will assess variety-herbicide interactions (WB-7) and monitor new herbicides for wheat (WB-8) at Tel Hadya. Concerning fertilizer use on wheat, we will continue to assess the effect of level and method of application of phosphate on wheat production in three contrasting soil types (vertisols, luvisols, aridosols, WB-9), and assess the residual effects from a similar trial last year using lentil as a test crop (WB-10).

An important new activity this year involves the development of strategies for wheat yield forcasting and improved efficiency of nitrogen fertilizer application in variable rainfall environments (WB-11). This activity brings together the disciplines of agronomy, economics, climatology and soil science and we attach high priority to it. We believe the objectives are achievable and will be of great practical value to both farmers and policy makers.

Lastly, on wheat production, FSP/ICARDA is serving as the co-ordinator of a regional trial (Syria, Tunisia, Cyprus, Morocco) on rainfed wheat production on vertisols in the mediterranean region (WB-12).

RESEARCH ON FOOD LEGUMES

We will continue to evaluate, in cooperation with FLIP, promising herbicides for chickpea, lentil and faba bean at four contrasting locations, Lattakia, Jindiress, Tel Hadya and Breda (WB-13). In addition, we will assist in the screening of food legume cultivars for nodule nitrogen fixing efficiency (WB-14), in screening ICARDA's rhizobium culture collection for food legumes in the laboratory (WB-15), and evaluating promising rhizobium strains in the field (WB-16).

CROP ROTATION TRIALS

Three crop rotation trials involving wheat, food legumes and summer crops, have been running at Tel Hadya for the last 6 years. In all three of them, modifications will be made this year in the light of previous experience and the need to produce more clearly defined objectives which focus on tillage and crop residue management issues.

Trial WB-17, the large three course rotation trial (established 1978) will be modified to compare the effect of contrasting tillage techniques in two rotations. The emphasis in this research will be, not so much on increasing yields through improved or sophisticated tillage techniques, but more on reducing the number and cost of tillage operationswhilst still retaining high yields.

Trial WB-18 contains six contrasting two course rotations involving wheat in rotation with fallow, summer crop, wheat, vetch, chickpea and medics. This year the wheat phase will be split with four nitrogen nitrogen fertilizer levels and three stubble managements practices. As well as the principal objective of evaluating the effect of crop rotation and wheat stubble management on nitrogen responses of wheat, detailed monitoring of inputs and outputs will be recorded to allow economic evaluation.

In the previous years, trial WB-19 (established 1978) compared the effect of five tillage techniques, five weed control methods and two fertilizer levels on the yields of wheat and lentil in a two course rotation. Unfortunately, a phased entry design was not used. Starting this year, this trial is being modified to remove both residual weed control and fertilizer effects and concentrate entirely on the tillage effects. This allows the introduction of a phased entry design with increased replication.

LIVESTOCK SRUVEYS

Our previous research has very largely focused on the integration of livestock in barley growing areas where they form the basis of the farming system. However, livestock also are an integral part of the system in the wetter areas of our region, and much of our current research on forage (both at Tel Hadya and Tah) looks at the potential for improved forage production in these areas. More detailed information is required on the current feeding strategies employed by farmers and the constraints they face. Trial WB-20 will investigate (through survey and data analyses) these problems.

WHEAT BASED SYSTEMS

Title (WB-1)	Wheat Production Practices in Syria
Objectives	Determination of wheat production practices in main wheat growing areas; explanation of variance among producers; evaluation of economic constraints and returns in wheat production.
Location	Northwestern Syria: areas over 325 mm annual rainfall in Homs, Hama, Idlib, and Aleppo provinces.
Sample	63 farmers; three randomly selected in each of three villages selected with probability proportional to size in each of seven sub-districts each chosen randomly within seven areas of equal rainfed wheat area (3 visits completed).
Method	Analysis with SPSS of data from wheat production survey conducted in 1984/85; additional data to be collected in one followup questionnaire with the same sample, asking questions raised in the primary analysis.
Principal Scientists Involved	Ms A. Rassam, Dr D. Tully

WHEAT BASED SYSTEMS

Title (WB-2)	Labor Issues in Crop Production in Syria
Objectives	Development of information on labor inputs to agriculture in wetter areas of Syria, including the items required by various tasks, the division of labor by task according to technique employed, the effect on crop profitability of using family labor, hired labor, or mechanized techniques, the effect of off-farm employment, and the nature of the rural labor force.
Location	Northwestern Syria, especially Azaz mantika of Aleppo province.
Sample	Initial survey: 48 farmers, 12 randomly selected in each of four villages, two in zone 1 and 2 in zone 2 (completed). Followup survey: sample to be designed after further data analysis.
Method	Analysis with SPSS of data from labor allocation survey conducted in 1982; followup questionnaire to address questions raised in analysis of the previous survey.
Principal Scientists Involved	Ms A. Rassam, Dr D. Tully

WHEAT BASED SYSTEMS

Title (WB-3)	Nitrogen, Phosphate and Herbicide Effects on Farmers' Wheat production
Objective	To assess the affect of crop rotation and rainfall on nitrogen and phosphate responses surfaces of wheat in farmers' fields and their interaction with herbicide use.
Location	14 farmers' fields throughout wheat growing area. (6 following chickpeas, 4 following irrigated summer crops, 4 following rainfed summer crops).
Treatments	32 combinations of 4 nitrogen levels (0, 60, 120, 180 kg/ha N), 4 phosphate levels (0, 50, 100, 150 kg/ha P_2O_5) and two weed control levels (± herbicide).
ANOVA	(See over page)
Related Measurements	Soil analyses, rainfall, crop phenology, weed infestation levels and economic survey
Principal Scientists Involved	Mr Dakermanji, Drs Harris, Tully, Matar

ANOVA

Single Location

Source of var.	df	
N	3	
N Linear		1
N Quad		1
Deviation		1*
P	3	
P Linear		1
P Quad		1
Deviation		1*
N x P	9	
N Linear x P Linear		1
N Linear x P Quad		1
N Quad x P Linear		1
Deviation		6*
Herbicide	1	
Herbicide x N	3	
H x N Linear		1
Deviation		2*
Herbicide x P	3	
H x P Linear		1
Deviation		2*
Herbicide x N x P	9*	
* Pool for Error		21 df

14 Locations

Source of var.	df.
Total	447
Location	13
Nitrogen	3
N x Location	39
Phosphorus	3
P x Location	39
N x P	9
N x P x Loc	117
Herbicide	1
Herb x Loc	13
N x Herb	3
N x Herb x Loc	39
P x Herb	3
P x Herb x Loc	39
N x P x Herb	9
N x P x Herb x Loc	117 ← Error

WHEAT BASED SYSTEMS

Title (WB-4)	Improved Production Practices for Chickpea.
Objective	To assess the main effects and interaction of inoculation, phosphate fertilizer, time of sowing and weed control on the yield and economics of production of chickpea in farmers' fields.
Location	10 farmers' fields in N.W. Syria, following wheat.
Treatments	16 treatment combinations of inoculation (±), phosphate fertilizer (0, 50 kg/ha P_2O_5), time of sowing (winter .v. spring) and weed control (± pre-emergence herbicide). In all treatments farmers tillage and sowing methods will be used.
Design	2^4 factorial split for time of sowing. 2 reps/ location.
ANOVA	(See over page)
Related Measurements	Soil analyses, rainfall, crop phenology, weed infestation level and economic survey. In four selected treatments (inoc+, P+, WC+, S_W) (inoc-, P+, WC+ S_W) (inoc+, P+, SC+ S_S) (inoc-, P+, WC+ S_S) the main effect and interaction of inoculation and date of sowing on BNF will be assessed through seasonal monitoring of ARA and nodule formation.
Principal Scientists Involved	Mr Haddad, Mr Afendi, Drs Harris, Tully, Matar. In cooperation with FLIP

ANOVA

Single Location

Source of var.	df.
Total	31
Rep	1
Date	1
Error (a)	1
Inoc	1
Herb	1
Inoc x Herb	1
Phos	1
Inoc x Phos	1
Herb x Phos	1
Inoc x Herb x Phos	1

Source of var.	df.
Date x Inoc	1
Date x Herb	1
Date x Inoc x Herb	1
Date x Phos	1
Date x Inoc x Phos	1
Date x Herb x Phos	1
Date x Inoc x Herb x Phos	1
Error	14

20 Locations

Source of var.	df.
Date	1
Location	19
Error (a) [pooled]	20
Inoc	1
Herb	1
In x He	1
P_4 OS	1
P x H	1
p x In x H	1
D x In	1
D x H	1
D x In x H	1
D x P	1
D x P x In	1
D x P x H	1
D x P x In x H	1

Source of var.	df.
Loc x In	19
Loc x He	19
Loc x In x He	19
Loc x Phos	19
Loc x P x In	19
Loc x P x H	19
Loc x D x In	19
Loc x D x H	19
Loc x D x In x H	19
Loc x D x P	19
Loc x D x P x In	19
Loc x P x H x D	19
Loc x D x P x In x H	19
Error [pooled]	280

WHEAT BASED SYSTEMS

Title (WB-5)	Improved Production Practices for Lentils.
Objectives	To assess the main effects and interactions of date of sowing, weed control, sitona weevil and phosphate fertilizer on the yield and economics of production of lentil in farmers' fields.
Location	10 farmers' fields in N.W. Syria, following wheat
Treatments	16 treatment combinations of date of sowing (early .v. late), weed control (± pre-emergence herbicide), sitona weevil control (± carbofuran) and phosphate fertilizer (± 50 kg/ha P_2O_5). In all treatments farmers tillage practices and sowing methods will be used.
Design	2^4 factorial split for date of sowing. 2 reps/ location.
ANOVA	(See over page)
Related Measurements	Soil analyses, rainfall, weed infestation level and economic survey. In four selected treatments (Sit cont.+, P+, WC+, S_E) (Sit cont.-, P+, WC+, S_E) (Sit cont.+, P+, WC+, S_L) (Sit cont.-, P+, WC+, S_L) the main effect of sitona weevil control and date of sowing on BNF will be assessed through seasonal monitoring of ARA and nodule formation and damage.
Principal Scientists Involved	Mr. Haddad, Mr. Afendi, Drs. Harris, Tully, Matar. In cooperation with FLIP.

ANOVA

Single Location

Source of var.	df.
Total	31
Rep	1
Date	1
Error (a)	1
Sitona	1
Herb	1
Sit x Herb	1
Phosphorus	1
Sit x Phos	1
Herb x Phos	1
Sit x Herb x Phos	1

Source of var.	df.
Date x Sit	1
Date x Herb	1
D x S x H	1
D x P	1
D x S x P	1
D x H x P	1
D x S x H x P	1
Error (b)	14

20 Locations

Source of var.	df.
Date	1
Location	19
Error (a) [pooled]	20
Sitona	1
Herb	1
S x H	1
Phos	1
P x S	1
H x S	1
P x H x S	1
D x S	1
D x H	1
D x S x H	1
D x P	1
D x S x P	1
D x H x P	1
D x S x H X P	1

Source of var.	df.
Loc x S	19
Loc x H	19
Loc x S x H	19
Loc x P	19
Loc x S x P	19
Loc x H x P	19
Loc x S x H x P	19
Loc x D x S	19
Loc x D x H	19
Loc x D x S x H	19
Loc x D x P	19
Loc x D x P x S	19
Loc x P x H x D	19
Loc x P x D x P x S x H	19
Error [pooled]	280

WHEAT BASED SYSTEMS

Title (WB-6) The Effect of Herbicides on Increased Frost Susceptibility of Wheat.

Objective To determine an overlaping effect of herbicides and low temperature on wheat injury and yield losses.

Location 3 locations (2 with probability of low temperature occurrence during growing season).

Treatments 6 combinations of herbicides application time: weedy control, hand weeding, early post emergence (3 leaf stage) herbicide application, late post (6 leaf stage) herbicide application, late post (beginning tillering) herbicide application, late post (end tillering) herbicide application.

Design RCB with 3 replications

ANOVA

Source of var.	df
Total	17
Rep.	2
W	5
Error	10

Related Measurements Met. data collection, crop phenology, crop injury, weed infestation.

Principal Scientists Involved Mr Dakermaji, Dr Harris

WHEAT BASED SYSTEMS

Title (WB-7) Wheat Cultivar, Weed Competition and Herbicide Tolerance.

Objective To assess the ability of promising new bread wheats and durum wheats to compete with weeds and identify their level of tolerance to different herbicides.

Location Tel Hadya

Treatments For both bread and durum wheat, 20 combinations of 5 wheat varieties with 4 weed control methods (none, pre-emergence Preforan, post-emergence Printazol, post-emergence Bromonil + Illoxan)

Design RCB, 2 reps.

ANOVA (per wheat type)

Source of var.	df.
Total	59
Blocks	2
Weed Control	3
Cultivar	4
W.C. x Cult.	12
Error	38

Related Measurements Crop phenology, weed infestation, crop injury, cultivar tillering ability

Principal Scientists Involved Mr Dakermaji and Mr El Mahdi, in cooperation with CP

WHEAT BASED SYSTEMS

Title (WB-8) Chemical Weed Control in Wheat.

Objective To identify and evaluate the best new herbicides or their combination and compare with currently used products.

Location Tel Hadya

Treatments 10 herbicides and their combinations

Design RCB, 4 replicates

ANOVA

Source of var.	df.
Total	39
Rep.	3
Treatment	9
Error	27

Related Measurements Crop phenology, crop phytotoxicity, weed infestation levels

Principal Scientists Involved Mr Dakermanji, Mr. El-Mahdi, in cooperation with CP

WHEAT BASED SYSTEMS

Title (WB-9)

Effect of Amount and Placement of Phosphate on Wheat in Rainfed Soils.

Objectives

a) To determine the effect of rate of phosphate added and its method of application (banding vs broadcasting) on yields of wheat

b) To assess the relation between response to rate of method of P added to other environmental variables.

Location

Jindiress, Tel Hadya and Breda

Treatments

8 combinations of four levels of phosphates (0, 40, 80 nad 120 kg/ha)

2 method of application (banding vs broadcasting)

Design

Factorial experiment with 3 replicates

ANOVA

Source of var.	df.
Total	23
Rep.	2
Method	1
Level of P	3
Method x level	3
Error	14

Related Measurements

Soil analyses, rainfall, crop dry matter production and P-uptake

Principal Scientist Involved

Dr. Matar

WHEAT BASED SYSTEMS

Title (WB-10)

Residual and Direct Effect of Phosphate on Yield of Lentil Following Wheat.

Objectives

1) To study the residual effect of P applied in the first year in 4 different rates and 2 methods of application on the P-responses of wheat to direct application in four different levels, in the second year

2) To relate P-responses to soil and climatic factors.

Location

Tel Hadya, Jindiress and Breda

Treatments

32 combinations of residual and direct application of P result from 8 residual treatments (4 levels of P x 2 method of application), and 4 levels of direct application of P to each residual treatment; (0, 40, 80 and 120 kg P_2O_5/ha)

Design

Split plot design with three replicates

ANOVA

Single Location

Source of var.	df.
Total	95
Rep	2
Residual P	3
Error (a)	6
Method (previous)	1
Residual x Previous method	3
Error (b)	8
Applied P (direct)	3
Applied P x Residual P	9
Error (c)	24
Direct x Method (previous)	3
Direct x Resid. x Method	9
Error (d)	24

ANOVA

Combined Across Sites

Source of var.	df.
Total	275
Site (S)	2
Residual P (R)	3
S x R	6
Pooled Error (a)	18
Method (M)	1
S x M	2
R x M	3
S x R x M	6
Pooled Error (b)	24
Applied P (P)	3
S x P	9
S x R x P	18
Pooled Error (c)	72
P x M	3
S x P x M	6
R x P x M	9
S x R x P x M	18
Pooled Error (d)	72

Related Measurements

Soil analyses, rainfall, crop dry matter production and P-uptake

Principal Scientist Involved

A. Matar

WHEAT BASED SYSTEMS

Title (WB-11)	Development of Concept for Yield Forecasting and Evaluation of Nitrogen Fertilization Strategies for Rainfed Wheat
Objectives	To enable ICARDA to use available agro-ecological data on stochastic generation of weather factors and simulation of plant growth response in a rational framework for wheat yield forecasting and for evaluation of N fertilizer strategies (a) at selected farm sites and (b) ultimately, in collaboration with national programs in the region, for nation-wide harvest forecasting and fertilizer policy evaluations. Tangible progress only on part (a) is envisaged in the 1985/86 season
Methods	1) Combination of a wheat growth model (CERES-WHEAT-N, or SIMTAG) with a weather generator in a program package which facilitates computation of frequency distributions of yield from multiple simulation runs given site-specific parameters for weather and soil. 2. Incorporation of an economic model (after Nordblom, et al., 1985)* which uses modeled crop responses "observed" up to a decision date, followed by modeled "expectations" of response up to harvest time. This will allow evaluation of the economics of N-fertilization strategies by E-V analysis of outcomes. 3. Validation of concept through comparison of simulated yields with measured yields at both on-farm trial and experiment station sites.
Principal Scientists Involved	T. Nordblom, W. Goebel, and H. Harris

* Nordblom, T.L., A.H. Ahmed, S.F. Miller and D.M. Glenn, 1985. "Long Run Evaluation of Fertilization Strategies for Dryland Wheat In North-Central Oregon: Simulation Analysis," Agricultural Systems, Volume 18, September 1985. Elsevier Applied Science Publishers Ltd., England

WHEAT BASED SYSTEMS

Title (WB-12) Regional Wheat Production on Vertisols

Objectives

1) To quantify the main effects and interactions of improved production practices on wheat grown on vertisol soil types and to evaluate economic returns.

2) To utilize selected treatments for detailed soil moisture and crop monitoring to provide a regional data base for the verification of a recently developed wheat growth model SIMTAG (Simulation of Triticum Aestivum Gentotypes). This model was developed by ICARDA/University of New England, Australia, specifically for West Asia and North Africa.

Locations Syria (1), Tunisia (1), Morocco (1) and Cyprus (1)

Treatments 32 combinations of five principal management factors (weed control, nitrogen, phosphate, time of sowing, wheat genotype (early .v. late variety) at two levels of management.

Weed Control (WC)	none	+ Herbicide
Nitrogen (N)	none	+ 60 kg/ha N
Phosphate (P)	none	+ 90 kg/ha P_2O_5
Sowing (S)	Late	Early
Genotype (G)	Early Maturity	Late Maturity

Design 2^5 factorial trial, single replicate/location

ANOVA (See over page)

ANOVA

Single Location

Source of var.	df.	
Total	31	
Date	1	
	No Error for Date	
N	1	
P	1	
N x P	1	
Cv	1	
N x Cv	1	
P x Cv	1	
WC	1	
WC x N	1	
WC x P	1	
WC x Cv	1	
D x N	1	
D x P	1	
D x Cv	1	
D x WC	1	
Error	16	(High Order Interactions)

4 Locations

Source of var.	df.	
Location	3	
Date	1	
Error (a)	3	(Loc x Date)
N	1	
P	1	
N x P	1	
So	1	
N x So	1	
P x So	1	
WC	1	
N x WC	1	
P x WC	1	
So x WC	1	
D x N	1	
D x P	1	
D x So	1	
D x WC	1	
Loc x N	3	
Loc x P	3	
Loc x So	3	
Loc x WC	3	
Error	94	

Related Measurements

a) Site characterization:

(1) Soil analyses for available N and P (plus other important properties)

(2) Daily rainfall at location

(3) Temperature and radiation (nearest met. station)

b) System characterization: (localized small survey)

(1) Predominant cropping systems

(2) Current farming practice

(3) Production costs and harvest values

c) Selected plots for SIMTAG verification:

Four treatments combinations

WC+,	N+,	P+	S(early)	G(early)
WC+,	N+,	P+	S(early)	G(late)
WC+,	N+,	P+	S(late)	G(early)
WC+,	N+,	P+	S(late)	G(late)

would be selected. One additional plot of each of these four treatment combinations would need to be planted at random within the experimental design to provide a second replicate. In each replicate, two moisture access tubes would be installed to 2 m depth (4/treatment, 16/trial) and would be regularly monitored at 10 day intervals using the neutron probe methodology.

In addition, detailed crop phenology and dry matter production would be monitored in each treatment.

Principal Scientists Involved

Dr. Harris, and Dr. Cooper	(Syria)
Dr. Croy	(Morocco)
Dr. Stilwell	(Tunisia)
Dr. Papastylianou	(Cyprus)

WHEAT BASED SYSTEMS

Title (WB-13)

Chemical Weed Control in Legumes (Lentils, Chickpea and Faba Bean).

Objectives

To evaluate the best herbicides which were identified in the preliminary study for weed control in lentils, chickpea and faba bean. These treatments will also be used in the International Weed Control Trial.

Location

Tel Hadya (chickpea, lentil and faba bean), Lattakia (faba bean), Jindiress (chickpea) and Breda (lentil).

Treatments

15 herbicides

Design

RCB, 4 replications

ANOVA

For Each Crop at Each Location

Source of var.	df.
Total	59
Rep.	3
Treatment	14
Error	42

Related Measurements

Crop phenology, crop injury and weed infestation levels.

Principal Scientists Involved

Mr Haddad and Mr El Mahdi, joint project with FLIP

WHEAT BASED SYSTEMS

Title (WB-14) Food Legume Cultivar Response to Inoculation

Objective To screen some promising faba bean, chickpea and lentil cultivars for their nodule efficiency, biological and grain yield production.

Location Tel Hadya

Treatments 30 treatment combinations of 15 cultivars with and without inoculation.

Design Split plot with 3 replicates

ANOVA For Each Crop

Source of var.	df.
Total	89
Rep.	2
Main plot (A)	1
Error (a)	2
Sub-plot (B)	14
A x B	14
Error (a x b)	56

Related Measurements N_2-ase activity

Principal Scientists Involved Drs W. Erskine, L. Robertson, J.B. Singh, R.S. Malhotra -- (FLIP)

B. Abu Dan, F. Afendi and M. Tahhan -- (FSP)

WHEAT BASED SYSTEMS

Title (WB-15)	Screening ICARDA Culture Collection for Food Legumes.
Objective	To identify specific superior strains for each food legume crop to be later tested under field conditions.
Location	Growth chamber
Treatments	212 strains for different food legume crops, 4 replicates
Related Measurements	Nodulation and N_2-ase activity
Principal Scientists Involved	Dr M.C. Saxena -- FLIP Ms F. Khanji, Ms S. Kabalan, and Ms S. Sabouni -- FSP

WHEAT BASED SYSTEMS

Title (WB-16) — *Rhizobium* Strain Selection.

Objective — To test superior strains of *Rhizobium* for all legume crops (faba bean, chickpea and lentil), under field conditions.

Location — Tel Hadya

Treatments — Six promising strains plus control
Total treatments are 7 for each crop

Design — RCB, 4 replicates

ANOVA — For Each Crop

Source of var.	df.
Total	27
Treatment	6
Rep.	3
Error	18

Related Measurements — N_2-ase activity, plant dry weight, nodule dry weight, grain and total biological yield.

Principal Scientists Involved — Dr. M.C. Saxena -- FLIP

M. Tahhan, F. Afendi, and B. Abu Dan -- FSP

WHEAT BASED SYSTEMS

Title (WB-17) Tillage Methods Comparison

Objectives

To compare current farmer tillage practives with alternative tillage practices with respect to:

1) The biological productivity of wheat/winter chickpea/summer crop (melon) and wheat/lentil/summer crop (melon) rotations
2) Soil physical parameters: aggregate stability, infiltration rate, porosity, bulk density
3) Efficiency of water use
4) Cost and fuel efficiency

Location

Tel Hadya, Block B

Treatments

1) (i) Farmer tillage practices: deep disking prior to rain (early October), seed bed preparation following rain.
   (ii) Duck-foot cultivation following rain.

2) (i) Alternative practices: deep chisel ploughing prior to rain, seed bed preparation following rain.
   (ii) Zero tillage. [This treatment to be commenced in the 1986/87 season subject to acquisition of appropriate seeding equipment.]

3) General cultural practices: fertilizer application, weed control, seeding methods and cultivars will be optimized according to the best known practices each season.

Design

Three course phased entry rotations with 4 replicates in 2 blocks, split plot with complete randomization with blocks.

WHEAT BASED SYSTEMS

Title (WB-18) The Productivity of Farming Systems

Objectives

1) A comparison of the productivity of farming systems involving six cropping sequences and utilization of forages and stubble by sheep, using economic returns as the integrative factor for comparison. [The crop sequences already established, are wheat/chickpea, wheat/lentil, wheat/medic, wheat/vetch, wheat/fallow and continuous wheat.]
2) Evaluation of the effects of nitrogen application and stubble management on the productivity of the systems.

Cultural Practices

Common cultivation and seeding practices will be used for all but medic plots: Phosphate (60 kg P_2O_5 ha^{-1}) will be applied to all plots in 1985/86, and to the wheat phase thereafter.

Crops and forages will be managed according to the best available advice from specialists.

All inputs and outputs will be monitored.

Treatments

1) The plots will be split into four sub-plots and nitrogen at 0, 30, 60, 90 kg N ha^{-1} will be applied to the wheat phase in 1985/86.
2) Stubble management treatments (details still subject to debate) will be imposed following the 1986 harvest.

Design A split-plot randomized block, with three replicates.

ANOVA

Wheat Phase 1985/86

Source of var.	df.
Total	71
Replicate (R)	2
Rotation (C)	5
Error (a)	10
Nitrogen (N)	3
C x N	15
Error (b)	36

WHEAT BASED SYSTEMS

Title (WB-19)

The Effect of Long Term Tillage Systems on the Stability of Wheat/Lentil Rotations.

Objectives

1) To study the effect of long term tillage practices on crop yield and water balances in a time course wheat/lentil rotation.
2) To study the effect of long term tillage practices on soil structural stability and water relations.
3) Opportunistically, to study weed control (herbicide) regimes necessary to control heavy infestations of graminareous and broad leafed weeds.
4) Opportunistically, to study the effect of liberal (180 kg P_2O_5 ha^{-1}) dressings of P on restoring the productivity of a soil with depleted P levels.

Locations

Tel Hadya

Treatments

60 combinations of five tillage practices, two soil fertility levels and five weed infestation levels.

Design

A split-split plot with 3 replications

ANOVA

Source of var.	df.
Total	149
Replicate (R)	2
Tillage (T)	4
Error (a)	8
Weed Infestation (W)	4
W x T	16
Error (b)	40
Fertility (F)	1
T x F	4
W x F	4
T x F x W	16
Error (c)	50

Related Measurements	Soil analysis (P) Soil physical parameters: aggregate stability, porosity, infiltration rate, bulk density
Principal Scientists Involved	Dr. H. Harris and Mr. S. Dozom

WHEAT BASED SYSTEMS

Title (WB-20)

Economic Feasibility and Impacts of Increased Integration of Small Ruminants with Intensified Management of Rainfed Cropping and Pasture Systems of Northern Syria.

Problem

For Northern Syria, and regions with similar physical environments, several techniques are being examined by ICARDA. Among these are intensification of forage crop production with traditional (lathyrus, vetch) and new (peas, annual medic) species, improved use of inputs, improved nutritional regimes for sheep flocks producing lambs and milk, and improved management of non-arable grazing lands. The relevance and feasibility of new techniques into actual farming systems is heavily influenced by long-term socio-economic impacts.

Objectives

1) To analyse past development of the farms and households as well as farm structure in small regions to define constraints of the traditional system and to understand farmers' behaviour.
2) To define optimal development paths for farming systems under different rainfall conditions and resource combinations given the new techniques being examined by ICARDA.

Methods

Data collection and analysis will be biased toward smallholders and toward emphasis on livestock integration in the higher rainfall cropping systems where wheat is the dominant cereal crop (approx. 3 locations). For comparative analysis one location may be chosen in the lower rainfall areas where barley is the dominant cereal crop.

Data are presently available from the Syrian Ministry of Agriculture and from the past seven years of survey efforts and field experiments by ICARDA. A key source of information, however, will be the student's data collection on both farm and household levels. Tabulation and analysis of survey data will require use of ICARDA's SPSS software. Analysis and testing of strategies will be done by quantitative methods, in particular, models using linear programming techniques.

Principal Scientists Involved	1. Mr. Ulrich Marz, PhD candidate, University of Hohenheim, Stuttgart 2. Dr. Werner Doppler, Professor, Institute of Agricultural Economics and Social Sciences (490), University of Hohenheim, Postfach 700-562, 7000 Stuttgart 70, West Germany 3. Tom Nordblom, FSP, Research Supervisor 4. Euan Thomson, PFLP
Date of Commencement	January 1986
Date of Completion	(Field Work and Analysis at ICARDA) December 1987 (PhD Dissertation) June 1988

INTERSYSTEMS RESEARCH PLANS (IS)
1985/86

We have four major areas of research described in this project, namely Agroecological Characterization, Classification and Mapping, Supplementary Irrigation Research, Soil Test Calibration and Mechanization. These are briefly described below:

AGROECOLOGICAL CHARACTERIZATION, CLASSIFICATION AND MAPPING

The objectives of this work are outlined, and seven areas of research described under the following headings:

- IS-1 Determination of Wheat Genetic Parameters
- IS-2 Development of an Improved Weather Generator
- IS-3 Development of "Event Evaluator" Concept
- IS-4 Development of a Concept for Spatial Interpolation of Weather Generator and Event Evaluator Parameters
- IS-5 Construction of Rainfall Maps for Pilot Areas in N. Syria and N. Tunisia
- IS-6 Evaluation and Improvement of Wheat Models
- IS-7 Characterization of Key Sites.

IMPACT AND POTENTIAL OF SUPPLEMENTAL IRRIGATION

The rationale, objectives and research approach of this work are outlined, and fourfield activities are described:

IS-8 Technical and Socio Economic Farm Surveys of Supplemental Irrigation Farming Systems

IS-9 Farm Survey of Irrigation Equipment and Aquifers

IS-10 Supplemental Irrigation of Spring Wheat and Vetch (Tel Hadya)

IS-11 Supplemental Irrigation of Spring Wheat and Barley (Farmers' fields)

SOIL TEST CALIBRATION

The subject is introduced and the value and need for regional calibration of a soil test for the major nutrients N and P is discussed. Trial IS-12 describes a joint FSP/FLIP soil test calibration of available phosphorus for wheat, lentil and chickpea.

MECHANIZATION

Currently, major crops in Syria (i.e., wheat, lentils, barley) are sown by hand broadcasting seed (often plus phosphate fertilizer) over ridges and then covering the seed either by ridge splitting or through the use of a tabban. This involves four passes over the land:

(i) Tractor plus ducksfoot cultivator to ridge land

(ii) Hand broadcast seed

(iii) Hand Broadcast fertilizer

(iv) Tractor (plus cultivator or tabban) to cover seed and fertilizer

We have recently developed a simple Single Pass Planter incorporating the commonly used ducksfoot cultivator, locally made depth controlled driving wheels, two boxes (one for seed, one for phosphate fertilizer with rate control) and a fixed tabban. This planter can work directly into moist or dry uncultivated soil and in one pass opens the ridges, places the phosphate fertilizer, drops the seed and covers both seed and fertilizer.

Initital trials in 1984/85 showed this planter gave superior yields of barley (plus and minus phosphate) to those achieved by the traditional method with far lower planting costs. These yields were not different from those achieved by using the Oyjord Plot Planter to simulate combine drilling.

This planter will be further evaluated this year in two contrasting soil types at Tel Hadya and Breda for wheat, lentil and barley (IS-13).

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification, and Mapping.

Objectives:

(1) To assist the definition of research priorities and resource allocation in the IARC's and national research programs.

(2) To indicate how technologies, specific cultivars, or new cropping systems might be developed to make the most profitable use of land resources within specifically imposed ecological and human constraints.

(3) To describe climatic variability and environmental risk. This also includes both the assessment of long-term or cyclical environmental change and early warning applications.

(4) To establish a commonly (CG-centers) accessible data base.

Subsidiary objectives related to (1) and (2):

(a) To assist in the efficient design and interpretation of regional yield trials.

(b) To determine recommendation domains for new technologies and to improve the efficiency of research in similar local environments or in major environmental groupings by taking advantage of spillover effects.

(c) To determine land carrying capacity for animals or people to increase the efficiency of land use planning, particularly in large areas where information sources are limited.

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification and Mapping.

Title: (IS-1) Determination of Wheat Genetic Parameters.

Objective: To determine the genetic input parameters for simulation models for promising new lines and for standard Tunisian varieties.

Location:
- Tel Hadya, Block B, for internal material
- Tel Hadya, GRU isolation area, for Tunisian material.

Treatment: Phased entry (15/11,15/12, 15/1, 1/3)

Design: 3 replicates for first and third entry, second and fourth entry not replicated.

Observations: Phenological observations (Zadok's scale) twice per week during critical periods.

Sampling:
- Biomass samples at three-leave stage, anthesis, milk-ripe, harvest from replicated entries.
- Head samples at two occasions during grain filling.

Analysis:
- Implementation of computer program to estimate genetic parameters from observed data.
- Validation of estimated parameters through simulation runs.

Principal Scientists: W. Goebel
H. Harris
G. Ortiz-Ferrara

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification and Mapping.

Title: (IS-2) Development of an Improved Weather Generator.

Objective: To create a weather generator which in mediterranean climates does not significantly overestimate rainfall in the dry tail and of the frequency distribution and which can also be used for estimating missing data.

Methods:

1. Identification of suitable criteria to distinguish between typical seasonal weather situations in available weather records.
2. Selection of appropriate algorithms to model the change-over between weather situations.
3. Implementation of computer programs
   - i. Richardson weather generator
   - ii. Stern/Dennett rainfall generator
   - iii. Stern/Dennett rainfall generator with subroutine to model seasonal change-over between weather situations
   - iv. to scan meteorological data for events
4. Test for significant differences between frequencies of events in actual data and data generated with the two versions of the Stern/Dennett rainfall generator.
5. Exchange of unsatisfactory algorithms and retest.
6. Complementation of improved rainfall generator with temperature and radiation subroutines from the Richardson weather generator.
7. Evaluation of result through crop models.
8. Selection of appropriate algorithms which ensure that means, medians, and variances of data generated in lieu of missing data fit into the data gap without detectable discontinuity or disruption of seasonal change.

9. Implementation as subroutine in weather generator program.
10. Test for significant differences between measured data and data generated to fill artificial data gaps.
11. Exchange of unsatisfactory algorithms and retest.

Principal Scientist: W.Goebel

INTERSYSTEMS RESEARCH

Subproject: Agro- Ecological Characterization, Classification and Mapping.

Title: (IS-3) Development of "Event Evaluator" Concept.

Objective: To reduce daily meteorological series into a manageable set of parameters from which probabilities for the occurence of climatic events of 1 to 365 days duration can be estimated.

Methods:

1. Selection of appropriate algorithms.
2. Implementation of computer programs to:
   - i. compute the parameter set from meteorological data
   - ii. generate the probabilities of events from parameter sets
   - iii. scan meteorological data for events.
3. Test for significant differences between counted and estimated frequencies of events.
4. Exchange of unsatisfactory algorithms for alternative options and retest.

Principal Scientist: W.Goebel.

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification and Mapping.

Title: (IS-4) Development of a Concept for the Spatial Interpolation of Weather Generator and "Event Evaluator" Parameters.

Objective: To generate daily weather data and to estimate the probabilities for the occurence of climatic events for locations at a distance from meteorological stations.

Methods:

1. Implementation of computer programs
   - i. weather generator
   - ii. "event evaluator"
   - iii. to scan weather data for the occurence of events.
2. Collection of all daily weather data in pilot areas with a sufficiently dense network of meteorological stations and computation of the parameter sets.
3. Identification of suitable environmental descriptors which can be mapped manually to serve as a basis for regression.
4. Selection of appropriate regression techniques to regress the parameters against environmental descriptors.
5. Test for significant differences between weather series/event probabilities generated for a station through spatial interpolation and measured data from that station.
6. Exchange of unsuitable environmental descriptors and unsatisfactory regression techniques and retest.
7. Validation through simulated crop response to measured and interpolated weather data.
8. Evaluation of density of station network on quality of interpolation results.

Progress on points 1-7 only is expected during the 1985/86 season.

Principal Scientist: W. Goebel

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification and Mapping.

Title: (IS-5) Construction of Rainfall Maps for Pilot Areas in Northern Syria and Northern Tunisia.

Objectives:
-To provide scientists with more accurate spatial information on rainfall than is obtained from small scale atlases
-To provide a basis for spatial interpolation of weather generator and "event evaluator" parameters.

Methods:
1. Manual plotting of mean rainfall and number of rainy days by month and cropping season
2. For Tunisia only, manual plotting of mean rainfall and number of rainy days during seasons of the year characterized by typical weather situations.

This research proposal is for an activity expected to continue over several seasons. At least maps for seasonal rainfall will be produced during the 1985/86 season.

Principal Scientst: W. Goebel.

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization. Classification and Mapping.

Title: (IS-6) Evaluation and Improvement of Wheat Models.

Objective: To identify the wheat model with best performance in mediterranean climates and , if feasible, to improve it by the inclustion of superior subroutines.

Methods:

1. Implementation of computer programs
   - i. CERESW wheat model
   - ii. TAMW wheat model
2. Evaluation of performance of SIMTAG, CERESW, and TAMW wheat models through comparison of simulated data with data sets for model validation
3. Implementation of SWRRB program
4. Improvement of SPAW model
5. Evaluation of water balance subroutines in SIMTAG, CERESW, TAMW, SWRRB, and improved SPAW with soil moisture data sets from the region.
6. If indicated, recombination of superior crop model with new water balance subroutine and evaluation of performance of the improved model.

Tangible progress for the 1985/86 season is expected only for points 1 and 2.

Principal Scientists: W.Goebel
H.Harris

INTERSYSTEMS RESEARCH

Subproject: Agro-Ecological Characterization, Classification and Mapping

Title: (IS-7) Characterization of Key Sites

Objectives:

- To provide scientists with information about environmental conditions ans risk, and about suitable genetic make-up for wheat cultivars.
- To serve as abasis for clustering.

Methods:

1. Collection of climate, soils and disease data for the sites.
2. Implementation of computer programs
   i. weather generator
   ii. "event evaluator".
3. Definition of climatic conditions and risk by means of the "event evaluator"
4. Determination of optimal genetic make-up for frost and drought avoidance, maturity and kernel type through repeated simulation runs with optimization of of genetic parameters.
5. Definition of yield potential for grain and straw through simulation runs with optimized genetic parameters.

This is a proposal for an activity expected to continue over several seasons. It is expected that 10-20 key sites can be characterized during the 1985/86 season, depending on the speed with which the required meteorological data can be procurred.

Principal Scientists: W.Goebel
D.Mulitze

INTERSYSTEMS RESEARCH

Title

Impact and Potential of Supplemental Irrigation Within Rainfed Areas.

Personnel

Dr. Eugene R. Perrier, Soil-Water Agronomist, and Mr. Abdul Bari Salkini, Agricultural Economist

Location

Potential study areas throughout Syria:

1) Aleppo province: Shahba Reservoir and Breda
2) El Hassakeh province: Qamishly and Hassakeh

Goal

The economically improve productivity of basic food crops in the rainfed areas using supplemental irrigation technology with emphasis on wheat, barley, faba beans, chickpeas and lentils as well as forages.

Objectives

A. Delineate technical and agronomic practices, as well as the socio-economic profile;

B. Identify major technical, agronomic and soio-economic constraints and predict future problems;

C. Estimate supplemental irrigation requirements for ICARDA mandate crops;

D. Evaluate the supplemental irrigation method most feasible technically and economically; and,

E. Define the optimal water-management system at each small farm within the study sample.

Justification

ICARDA scientists have shown that a linear relation exists between yield of cereal crops and seasonal rainfall under rainfed conditions. Research results indicate that supplemental irrigation on cereals, particularly wheat, would support a minimum yield of 3.5 t/ha with a possibility of up to 6.0 t/ha and more in the wheat growing areas of the region (350mm rainfall and above). Currently, the average yield in the region for rainfed agriculture is below 1.5 t/ha. Supplemental irrigation would permit higher and more stable yields by increasing the total volume of water applied as well as timing of irrigations at critical stages of growth and periods of drouth.

Supplemental irrigation is associated with more sophisticated farming methods and usually represents an improvement in technique on existing farm practices. Whether to irrigate or not is decided purely on the estimated profitability of doing so. It is estimated that the cost of supplemental irrigation for one cubic meter of water is between 2.5 and 10.0 cents ($US). This amount of water can produce 1.5 kg of wheat which is equivalent to 30 cents or about 20 cents net profit. The economic appraisal study of the Upper Yarmouk Project in Syria reported that net revenue per hectare could be increased from SL 131 under rainfed agriculture to SL 1025 with supplemental irrigation; and increase of nearly tenfold.

Wheat, the number one crop produced in Syria, is also the major rainfed crop receiving supplemental irrigation. Barley, which responds well to irrigation, is the second major crop to receive supplemental irrigation followed by faba beans and chickpeas. The remainder of the ICARDA mandate crops, lentils and forages, receive supplemental irrigation to a lesser extent.

The purpose of this project is to improve supplemental irrigation farming where farmers actively participate with any improvements made. Small scale supplemental irrigation systems will be examined in detail from agronomic, socio-economic, and technical perspectives to identify potential areas for improvement and development.

Research Approach

The Farming Systems Research approach will be used which is farmers based with an iterative and dynamic research methodology; identification of problems with practical constraints emphasized and solutions prioritized; and, interdisciplinary team coordination which is complementary to ICARDA research, national programs, and other scientific institutions. This is an evaluational approach of implementable improvements to existing farming systems which includes four major stages:

I. Diagnosis of Present Farming Systems

The effect of supplemental irrigation on rainfed agriculture will be assessed and evaluated with extensive data collection using both primary and secondary sources. Analysis will characterize and describe the farming system which is predominate at each site and delineate the technical, agronomic, and socio-economic components.

II. Design of Feasible Technological Solutions

Alternative solutions based upon ICARDA research results will be designed for problems previously identified. These solutions will be defined technically and economically and will be prioritized for implementation through assessment of farmer acceptance.

III. Tests of Optimal Solutions

On-farm trials will be implemented to test optimal solutions previously identified to determine the appropriateness of each and to evaluate the feasibility of these solutions both technically and economically. Any necessary modification to the optimal solutions can be done at this stage.

IV. Field Demonstration and Farmer Extension

Technically and economically feasible solutions can then be generalized and extended to a larger sample of farmers.

Experimental Procedure

Four small farm areas located within the two provinces of Aleppo and Hassakeh have been designated for the supplemental irrigation study.

I. Sample Selection at Each Site

A. Within a 15 km radius of each of four specified small farm areas with supplemental irrigation, a preliminary list of villages will be made and categorized.

B. Within each specified farm area a sample of 10 to 15 farms with supplemental irrigation will be selected for agronomic and socio-economic analysis.

C. From these sample farms a subsample of 6 farms with supplemental irrigation will be selected for technical data collection and on-farm trials.

II. Data Collection

Primary and secondary data will be collected and analyzed for each small farm area.

A. Technical data to be collected includes:

1. Climatic data will include daily rainfall, temperature, humidity, and evaporation.

2. After the climatic data has been collected, it will be necessary to estimate the climatic risk parameters by using probability analysis.
3. Soil survey information will be obtained from secondary sources but, if necessary, will be verified at each farm.
4. At each farm soil physical properties will be estimated and measured where necessary.
5. In addition, some soil/water chemical properties will be estimated and measured where necessary.

B. Agronomic and socio-economic data to be collected on each farm will include:

1. The number of farms of different size, shape and arrangement to define recommendation domains;
2. The total land area under cultivation and with supplemental irrigation;
3. The cropping patterns of crop types and sequences;
4. The farming methods used including practices and input levels;
5. The economics of crop production: levels, costs, and returns;
6. The economics of livestock production:
7. The marketing of crop and livestock production;
8. The number and types of farm machines in use and owned;
9. The types of machines rented;
10. The family size and contribution to the labor requirement;
11. Other sources of on-farm labor;
12. Off-farm employment of family labor;
13. The total family income and its source;
14. The level of training necessary to introduce supplemental irrigation;

15. The availability of equipment and supplies for new technology; and,
16. The availability of governmental aid.

III. Design Criteria for Small Farm Survey and Field Plot Projects

A. Features of the power plant will be evaluated;
B. Cost of irrigation water;
C. Evaluation of the supplemental irrigation method; and,
D. Design of plot work for irrigation scheduling.

IV. Preliminary Assessment Profile Describing the Technological Potential for Supplemental Irrigation

Based on project findings, a supplemental irrigation program for each farm in the study will be designed including the most practical improvements which specify irrigation facilities and scheduling. An optimal design for farm management will be planned stressing supplemental irrigation, crop selection, management alternatives, and potential economic benefits feasible under existing technology and economic outlook, i.e. a futuristic design to fit conditions existing at each farm.

INTERSYSTEMS RESEARCH

Subproject Supplemental Irrigation

Title (IS-8) Technical and socio-economic farm surveys of supplemental irrigation farming systems.

Objectives

1. To identify current irrigation management practices,
2. To identify areas of potential improvement in management, and
3. To assess the economic impact of supplemental irrigation on rainfed farming systems.

Location

1. Aleppo Province
   a. Tel Dhaman subdistrict (Breda), and
   b. Mare'a subdistrict (Shahba reservoir area).
2. Hasakeh Province
   a. Qamishly, and
   b. Tel Hameis.

Methodology

1. A stratified sample of villages, farms, and farmers will be randomly selected to represent physical, economic, and social variations in the population.
2. Two questionnaires will be used to gather information at the village level and at the farm level. Analysis will emphasize the impact of supplemental irrigation on rainfed systems together with the constraints, problem definition, and prioritization of solutions.

Principal Scientists Involved Mr. Abdul Bari Salkini and Dr. Eugene R. Perrier

INTERSYSTEMS RESEARCH

Subproject	Supplemental Irrigation
Title (IS-9)	Farm survey of irrigation equipment and aquifers
Objectives	1. Inventory of farmers' irrigation equipment, and 2. Compilation of information on wells and watertables.
Location	1. Tel Dhaman subdistrict (Breda) 2. Mare'a subdistrict (Shahba reservoir area), 3. Qamishly, and 4. Tel Hameis.
Methodology	1. A stratified sample of villages, farms, and farmers will be randomly selected to represent physical, economic, and social variations in the population. 2. A structured questionnaire will be used to gather descriptive data.
Analysis	SPSS will be used.
Principal Scientists Involved	Dr. E. Perrier and Mr. Abdul Bari Salkini

INTERSYSTEMS RESEARCH

Subproject (IS-10) Supplemental Irrigation

Study Supplemental irrigation on spring wheat and vetch

Objective To improve supplemental irrigation practices, estimate the consumptive use of water, and determine irrigation scheduling requirements under local conditions to insure the effective and efficient use of water to improve crop yields and crop quality.

Location Tel Hadya (one-hectare in the eastern-half of field A18)

Treatments

I. Supplemental Irrigation
   - A. Rainfed (no irrigation).
   - B. Irrigate to replenish one-third of water balance requirement.
   - C. Irrigate to replenish two-thirds of water balance requirement.
   - D. Irrigate to replenish total water balance requirement.

II. Crop Types
   - A. Spring wheat
   - B. Vetch

Design Split block, main plots are supplemental irrigation and subplots are crop type.

ANOVA

Source of Var.	df
Subplots	31
Main plots	15
Reps	3
Sup. irr.	3
Main error	9
Crops	1
Error b	3
Sup. irr. x crops	3
Error c	9

Principal Scientists Involved Dr. E. Perrier, Dr. P. Cocks and Mr. A.B. Salkini

INTERSYSTEMS RESEARCH

Subproject Supplemental Irrigation

Study (IS-11) Supplemental irrigation of spring wheat and barley.

Objective To monitor supplemental irrigation practices, estimate the consumptive use of water, and determine irrigation scheduling requirements under local conditions to improve crop yields and crop quality.

Location

1. Tel Dhaman subdistrict (Breda)
2. Mare's subdistrict (Shahba reservoir area)
3. Qamishly
4. Tel Hameis

Treatments

I. Supplemental Irrigation
   - A. Rainfed (no irrigation)
   - B. Irrigate to replenish one-third of water balance requirement.
   - C. Irrigate to replenish two-thirds of water balance requirement.
   - D. Irrigate to replenish total water balance requirement.

II. Crops (Local Varieties)
   - A. Wheat
   - B. Barley

Design Split block

ANOVA

Source of Var.	df
Subplots	31
Main plots	15
Reps	3
Sup. irr.	3
Main error	9
Crops	1
Error b	3
Sup. irr. x xrops	3
Error c	9

Principal Scientists Involved Dr. E. Perrier and Mr. A.B. Salkini

INTERSYSTEMS RESEARCH

SOIL TEST CALIBRATION

INTRODUCTION

Soil test has been used in many developed countries as a mean to determine the level of available nutrients in soils and make the recommendations needed to farmers on the best and most economical amount and types of fertilizers for optimum yields of crops.

In irrigated agriculture or under high rainfall areas, where soil moisture is not limiting, or kept at optimum levels, the most limiting factors for plant growth become the available nutrients in soils. This assumes that drainage conditions are satisfactory, weed control, plant diseases and insects are all under control. The relationships between growth of plants or yields and soil test have been found to be very often satisfactory and its use for crop prediction and fertilizer recommendations were quite successful.

Under dry farming agriculture, where soil water is usually a limiting factor to growth of plants, soil moisture stress can interfere with relationships between yield of crops and soil tests, and make it more complicated. Consequently, because of the interaction between rainfall and efficiency of applied fertilizers on yields, the soil test/yield relationships will need to include rainfall in its computation.

In addition, fertilizers applied in dry years, if unused by plants will remain in soils at least partly available to following crops. Consequently, the economy of fertilization requires an estimation of residual fertilizer remaining in soils to be also considered in the determination of adequate fertilizers need for following crops. From literature, many examples have been cited on residual effect of phosphates and sometimes nitrates in soils. Appropriate soil test would be the easiest methods to determine the residual fertilizers in soils.

Another factor of interest, is that the relationship between crop response to fertilization and soil test, may well be influenced by the previous crops. Many field crops are used in rotation with wheat or barley. For instance, lentil, vetches, peas, broadbean, chickpeas, or fallow are all found depending upon the climatic conditions and the prevalent farming system.

Many other factors, could also affect the yield/soil test relationships. These factors could be classified into three groups:

- Climatic factors: available moisture, soil and air temperatures.
- Soil factors: in addition to the level of the available nutrients; many other soil properties could affect, to various degrees, the soil test/yields relationships, e.g., the soil pH, salinity, cation exchange capacity, the free calcium carbonate, texture, structure and organic matter content of soil and subsoils, the type of clay mineral, etc.
- Farm management variables: e.g., tillage operations, seed bed preparation and time of seeding, varieties used, weed control method, etc.

It is therefore not surprising that soil test calibrations worked out in one area are not usually valid for another different set of agricultural conditions. Therefore, the soil test calibrations which are applied in industrialized countries cannot be transferred to developing countries. In the latter case new calibrations must be made under local conditions if soil tests are to be used for fertilizer recommendations (1).

Chemical soil testing is still the quickest, and in the long run, the cheapest means to determine fertilizer needs and predict yields for individual fields, once it is calibrated by field experiments.

As a result, the development of a program for the calibration of soil test by field experiment covering the principal rainfed crops of the ICARDA region and cultivated on the dominant soils, will be very useful in relating fertilizer recommendations to rainfall, soil type, nutrient level in soils and previous crops.

In the proposed program two questions need to be answered for each crop:

- First, the critical level of nutrient in soils below, which the response to application of that nutrient to soil as fertilizer is expected. A classification of soil tests into low, medium or high, very high should follow.

- Second, given a certain soil test, the expected increase in yield from addition of each increment of fertilizer, and consequently the optimum or most economical fertilizer recommendation should be determined.

These kinds of calibration experiments need to be conducted for the two main limiting nutrients in rainfed soils of the region; phosphorus and nitrogen on the dominant soils in the region.

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   FAO Soils Bulletin No. 12, Rome 1971

3. FAO, The Calibration of Soil Tests for Fertilizer Recommendations
   FAO Soils Bulletin No. 18, Rome 1973

4. ASA, Soil Testing: Correlating and Interpreting the Analytical Results
   ASA Special Publication No. 29, American Soc. of Agron. 1977.

INTERSYSTEMS RESEARCH

Title (IS-12) Phosphate Soil Test Calibration in the Dry Areas

Objectives

1) To determine relationships between soil tests of available P in soils to P-responses, by wheat, lentils and chickpeas.
2) To determine the critical level of soil P test beyond which no response to P is expected and the relationship of critical level to other environmental variables.

Location 20 locations in the Aleppo, Idlib, and Hama areas, with four classes of available P in soils; (low, medium, high and very high).

Treatment At each site 3 plant species to be grown: wheat, lentil and chickpeas.

4 levels of P to be used (0, 50, 100 and 150 kg P_2O_5/ha). 3 replicates.

ANOVA

For Each Species, at Each Site

Source of Var.	df.
Total	11
Rep.	2
P level	3
Error	6

Related Measurements Soil analyses, plant P uptake and rainfall, economic survey

Principal Scientists Involved Drs. A. Matar, M. Saxena (FLIP)
Dr. K. Somel (FSP)

INTERSYSTEMS RESEARCH

Title (IS-13) Evaluation of Single Pass Planter for Barley and Lentil and Wheat

Objective

1) To compare the biological and economical efficiency of the newly developed planter with traditional planting methods and combine drilling.
2) To assess planting method x phosphate response interactions

Location Breda, Tel Hadya

Treatment

1) 8 treatment combinations of two levels of phosphate (0, 60 kg/ha P_2O_5) with four sowing methods:
   i) Combine drilling
   ii) single pass planter
   iii) broadcast over ridges + tabban
   iv) broadcast on uncultivated soil and cover with cultivator
2) N to be topdressed in February if necessary (barley and wheat only)

Design 2 x 4 factorial, three replicates/location

ANOVA For Single Crop. 2 locations:

Source of var.	df.
Total	47
Rep. in Loc.	4
Location	1
S_M	3
P	1
S_M x P	3
S_M x Loc	3
P x Loc	1
S_M x P x Loc	3
Error	28

Related Measurements

1) Full yield analyses of barley, lentil and wheat
2) Economic evaluation of data

Principal Scientists Dr. P. Cooper, Dr. H. Harris, Dr. K. Somel,

PLANS FOR TRAINING AND AGROTECHNOLOGY TRANSFER
FARMING SYSTEMS PROGRAM
1985 - 1986

...ACTIVITY	NO. OF PARTI-CIPANTS	DURATIONS	COUNTRIES	SOURCES OF BUDGET
1. RESIDENTIAL COURSE	20	1½ month	competitive from all countries of the region	ICARDA
2. SHORT COURSES				
2.1 Soil and plant analysis	8	2 weeks	Syria, Jordan Tunisia, Morocco Egypt, Sudan, N. and S.Yemen, Pakistan	ICARDA
2.2 Farming Systems' survey techniques (in-country)	15	1 week	Tunisia	IDRC/ICARDA
2.3 Three-stage, farming systems field plot techniques (in-country)	10	1 week each stage	Tunisia	IDRC/ICARDA
2.4 Economics Training? (in-country)		1 week	Turkey	Ford Foundation
3. INDIVIDUAL				
3.1 Training Associate				
3.1.1 On-farm research	1	7 weeks	Pakistan	BARD, PARC
3.1.2 Soil fertility	1	12 months	Syria	ICARDA
3.1.3 Field experimentation*	1	long-term	N.Yemen	Boun Project (GTZ)
3.2 Research Scholar (MSc)				
3.2.1	1	2-2½ years (Aleppo University)	N.Yemen	FAO

ACTIVITY	NO. OF PARTI-CIPANTS	DURATION	COUNTRIES	SOURCES OF BUDGET
3.3 Research Fellow (PhD)**				
3.3.1	1	3 years		
3.4 Senior Research Fellow**				
3.4.1	1	3-4 months		
3.4.2	1	3-4 months	Syria	
4. WORKSHOPS				
4.1 Farming Systems***	27 approx.	4-6 days	Pakistan	BARD/AZRI/ FORD FOUNDATION
4.2 Farming Systems****	?	2-3 days	Tunisia	IDRC/ICARDA
5. TRAINEE TRAINING**				
Officer	1	2 years		

* Details will be worked out during my tentatively planned visit to N.Yemen.

** Participants for the research fellowship , senior research fellowship and trainee training officer to be identified from countries of the region. Source of budget is ICARDA or any other available source.

*** This is a three way BARD/AZRI/ICARDA workshop under the sponsorship of PARC.

**** Participants are senior researchers from all Farming Systems Projects in Tunisia.

Note: Added to the above is FSP contribution to other programs' residential training courses and also expected visits.