Crop Production Practices in the Farming Systems of Maragheh and Hashtrod provinces of Iran

1. Introduction

To initiate a "farming system" dimension to the research approach of the Dryland Agricultural Research Institute (DARI), a training course on "Farm Survey Methodology" was conducted at DARI, Maragheh in May 1994. The objective of the training was to familiarize researchers of DARI with the theory and practice of farm survey methodologies. The practical components of the training were focused on how to use farm surveys for system diagnosis and problem identification. However, it has been realized by DARI/FRMP that further 'practical' training on conduct of 'real' diagnostic farm survey was needed to complement and strengthen the capacity of DARI researchers on this field of farming systems research. The specific objectives of this exercise were to: (i) enhance the skill of DARI researchers on conducting practical diagnostic farm surveys, with particular emphasis on questionnaire design, analysis and interpretation of the data collected, (ii) provide a preliminary description and problem identification of major rainfed farming systems in Maragheh region; and (iii) use the findings to guide the planning and design of on-station and on-farm trials.

For this purpose, following the design of a questionnaire, a farm survey was conducted in the important agricultural areas of Maragheh (1300 m altitude) and Hashtrod (1600 m altitude) provinces (Figure 1) with 61,645 ha and 87,414 ha cultivated area, respectively. A sample of 49 farmers of the two provinces was chosen randomly, using multi-stage sampling method, and interviewed by the trainees during the course. Data collected and analyzed allowed to give an overview of the current farming system in the two provinces, identify major constraints to crop improvement, and build-up an adaptive research program accordingly.

2. Climatic characteristics

Mean climatic data of Maragheh (1983-1993) is given in Figure 2a which shows that dry period starts in mid June and lasts until the end of October. This is similar to Central Anatolian Plateau of Turkey where many research trials have been conducted on soil and crop management practices aiming at improving water conservation and water use efficiency by improved management of the fallow and cropping season.

Relative humidity goes down from 65% in December-January to 35% in July- September which makes it relatively dry. Mean Temperature goes below zero only in January (-1.2 ^{o}C) and in February (-0.8 ^{o}C), but frost occurs between November and April (Figure 2a). Total frozen days range from 69 in 1985 to 167 in 1993 (Figure 2b). Long-term mean annual rainfall is about 350 mm, analogous to Haymana (1150 m altitude) representing Central Anatolian Plateau (Guler *et al.*

1991) (Figure 2c). Both regions have rainfall in winter as snow. Spring rainfall which is most effective, is higher in Maragheh than in Haymana, 170 mm and 125 mm, respectively. However, summer rain, mostly falls in the first two weeks of June, is higher in Haymana, 50 mm compared to 20 mm in Maragheh. The seasonal distribution of total rainfall is shown in Figure 2d. These similarities between the two regions might allow the use of some research results from Haymana to rapidly develop appropriate technologies for Maragheh. There have been already successful examples of this approach in production fields of the old research station in Maragheh.

2. Soils of the region

Landscape of the region is undulated with the slope ranging mostly from 2 to 8%, higher in Hashtrod compared to Maragheh, causing water erosion problems in some agricultural areas of the region. Soils are mostly clay loam changing from moderately deep to deep, over a lime layer or a hard bed rock, with different levels of stoniness. Soil maps of the region are available in Soils and Water Directorates for planning of any relevant research. These maps, with long-term weather data which is available in the country will also be useful for agro-ecological characterization purposes. This will eventually help in utilizing crop models to be tested for their validations and extrapolation of the research findings from their site-specific nature to wider agro-ecological zones in the future.

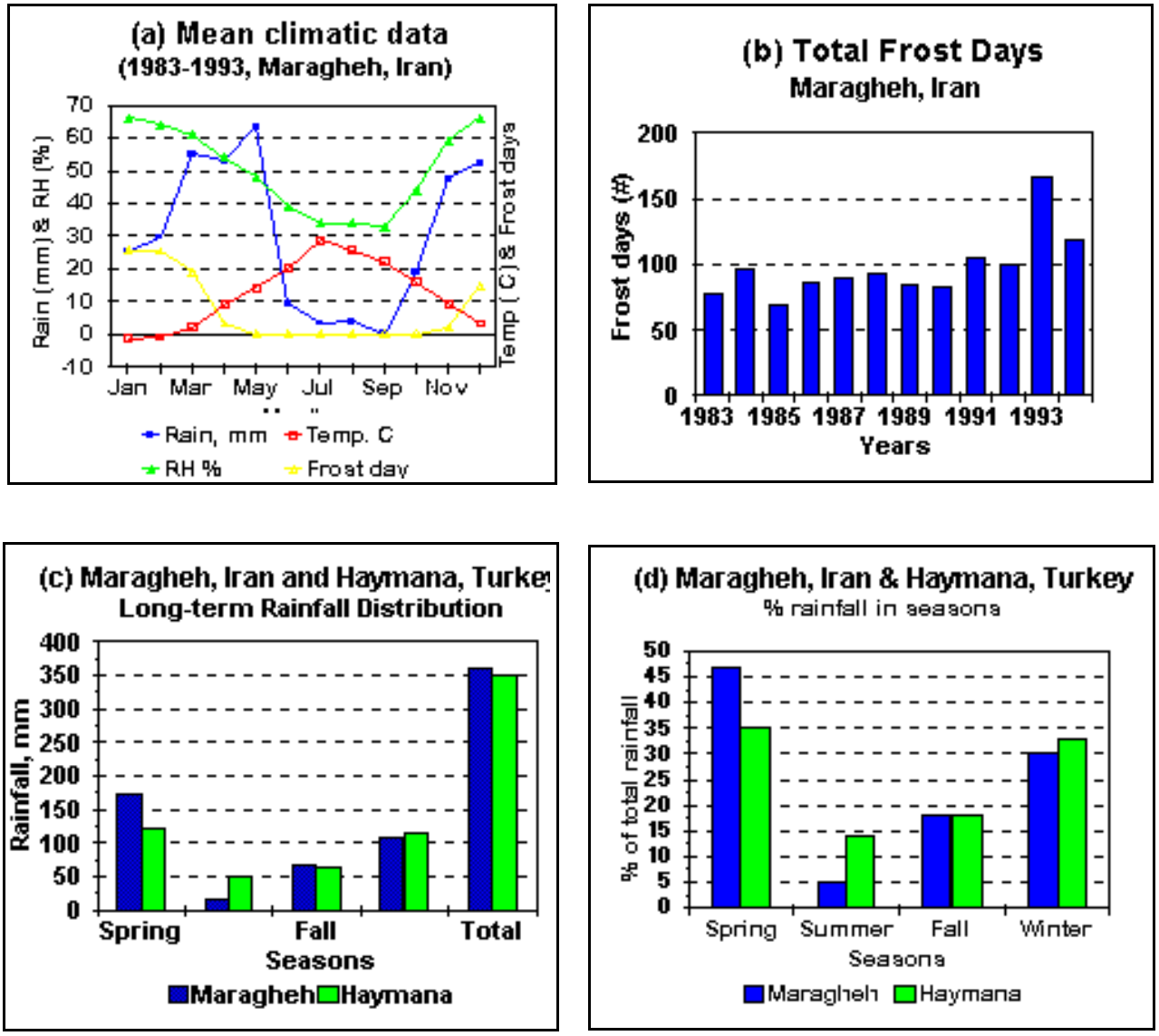


Figure 2. Summary of long-term climatic data in Maragheh, Iran compared with data from Haymana of Central Anatolian Plateau of Turkey.

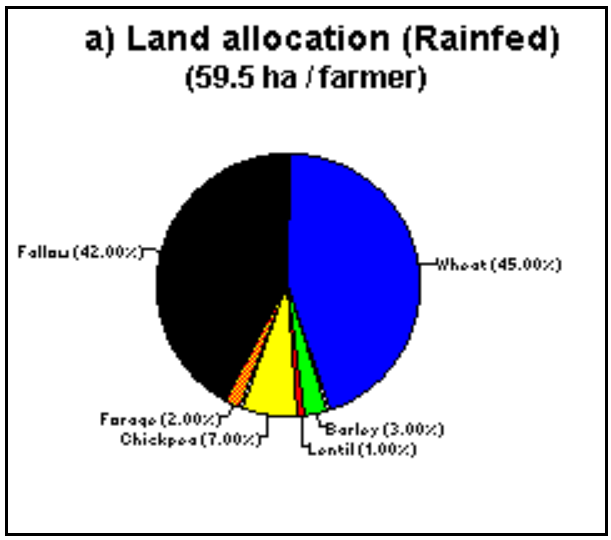
3. Land use and farming system

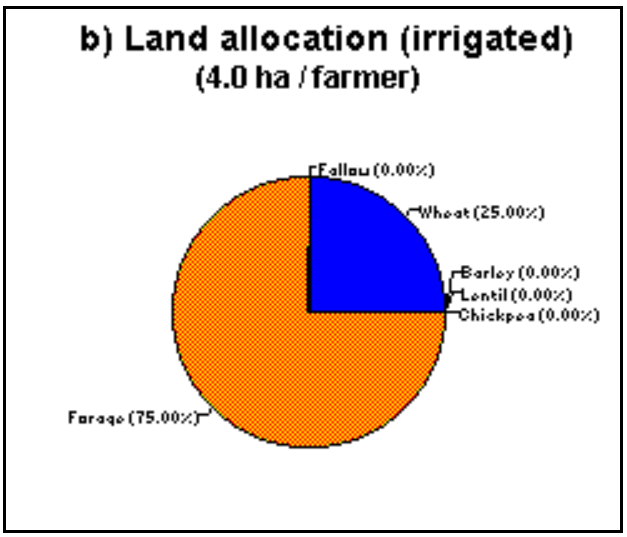
The major system in the target region is cereal/livestock farming system, with wheat-fallow rotation applied by 90% of farmers on **rainfed** plots. The main crop rotation on **irrigated** plots, however, is forage-wheat or forage-forage. Average landholding is 63.5 ha of which 94% rainfed and 6% irrigated (Figure 3a, 3b, 3c). Wheat, assigned 44% of total farm area and grown mostly in winter (96%), is the principal crop in the farming system of the region. Chickpea is also an important rainfed crop grown every year by almost every farmer (92%). Barley is grown every year by 49% of farmers interviewed, and it is planted in spring using local varieties exclusively, with very low seed rate and very low yields. Lentil has the smallest land allocations (1% only) and is grown every year by 27% of farmers. Forages are important crops under irrigation condition occupying 75% of the land irrigated. Some farmers grow forages rainfed, but on small land allotments. The considerable proportion (40%) of the land left for fallow every year (Figure 3a, 3b, 3c) indicates a good potential for improvement in crop production by fallow replacement. Oilseeds, lentil, cumin, and forages would be alternative crops suitable for replacing the fallow, and this has been applied successfully in Central Anatolia. Livestock is an integral part of the farming system, providing the second income source for farmers following crop production. Therefore, the need of animals for feed opens an horizon for introduction of forage crops in fallow areas of the region which are potentially good for legumes. However, the feasibility of growing forages rainfed, and why these crops are not widely grown under rainfed conditions should be investigated, with other aspects not covered by this survey work, by another farm survey with a forage/livestock focus.

4. Farmers' production practices

4.1. Tillage

Tillage practices applied during fallow year to conserve moisture and to prepare the land for wheat planting, are most likely not appropriate in terms of frequency, timing, and implements used. Most farmers (57%) practice a single tillage before planting their wheat, some give two, and few farmers apply three cultivations (Table 1). The first tillage is applied late, mostly during the second half of May and the first half of June, the second tillage is also delayed by 62% of





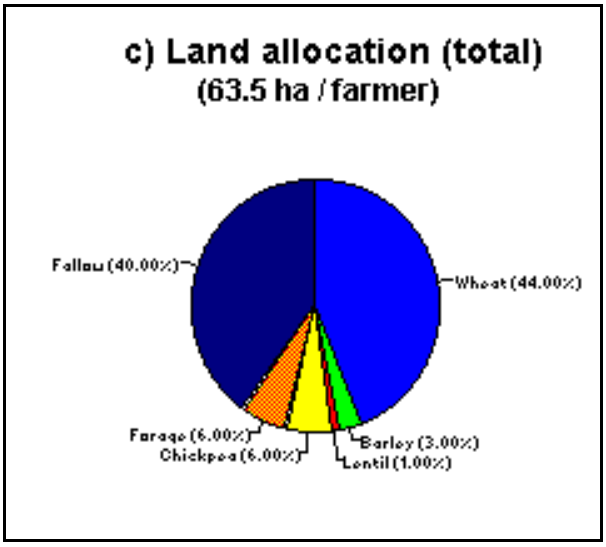


Figure 3. Land allocation in the surveyed area.

farmers to mostly planting time (Table 2). This delayed tillage is also improper and inefficient, because it causes less penetration of rain water into the soil and allows more moisture loss from the soil by evaporation and by transpiration of weeds. The first two tillages are mostly done using moldboard by 90% and 47% of farmers for the first and second, respectively, and the third, if done at all, is 100% by the sweep plow (Table 3). The second tillage done by moldboard (47%) should be replaced by the sweep which is already in use by farmers. Research findings in Central Anatolia clearly indicates an increased fallow efficiency in water conservation by using moldboard for the initial tillage in early spring, and the sweep for secondary cultivation, immediately after rainfall cease (Yesilsoy, 1974; Guler *et al.* 1979, 1991; Pala, 1982). In the areas where initial spring tillage by moldboard is difficult to apply because of snow melt and rainfall, it can be applied in fall making no difference in water storage. Barley is given less cultivations than wheat, about 26% of crop growers do not cultivate barley fields before planting. They just broadcast the seeds and cover it. This practice is also done by around 48% of lentil and 44% of chickpea producers (Table 1).

Table 1. Distribution of farmers by the number of pre-planting tillage practices.

Samples	**n= 49**	**n=39**	**n=21**	**n=48**
Tillage Number	**Wheat**	**Barley**	**Lentil**	**Chickpea**
	% of farmers			
0	-	26	48	44
1	57	64	52	50
2	35	8	-	6
3	8	3		

Table 2. Distribution of farmers by the time of initial and secondary tillage practices.

	% of farmers		
Time	**1st Till**	**2nd Till**	**3rd Till**
Fall	14	-	-
Before May 15	6	-	-
May 15-June 15	62	16	11
After June 15	18	22	33
After Sep. 15		62	56

Table 3. Distribution of farmers by tillage implements used

	% of farmers		
Implement	**1st Till**	**2nd Till**	**3rd Till**
Moldboard	90	47	-
Chisel	6	-	-
Discharrow	-	11	-
Sweep	4	42	100

4.2. Planting

Most farmers (88%) plant wheat during mid-September to mid-October, 8% in late October, and 4% in spring. This reflects a proper timing for wheat planting. However, barley, lentil and chickpea are planted in spring by 85%, 100% and 100% of crop growers, respectively. Spring planting is necessitated by the lack of cold tolerance of these crop varieties which are mostly local. Barley varieties planted in fall by 15% of crop producers are cold-tolerant improved ones (Table 4). This shows the importance of introducing cold tolerant barley, lentil and chickpea varieties to the region for increasing crop production without any additional cost.

Planting is mostly done by hand broadcasting then covering by moldboard in 48% of the cases for wheat. Using moldboard implement for seed covering, which is an improper practice, is even more applied on barley, lentil and chickpea (Table 5). Seed drills are not available in the region and need to be demonstrated for their advantage compared to hand sowing. This might encourage farmers to have their own machines or enhance custom operation in machine planting which is commonly applied in many highland parts of Turkey.

Farmers of the sample, generally, tend to use low seed rate for spring-sown crops. Most farmers use less than 100 kg/ha for barley, lentil, and chickpea. In case of wheat, most farmers apply 100-150 kg/ha of seed, which is quite an appropriate rate, however, about 20% of farmers still tend to use more than 200 kg/ha seed (Table 5). There may be an opportunity to study reasons of farmers behind using higher seed rates for autumn-sown crops (mainly wheat and some of the barley) and lower seed rates for spring-sown crops in combination with drill use in the region.

Table 4. Distribution of farmers by sowing date of different crops.

Sowing date	% of farmers			
	Wheat	Barley	Lentil	Chickpea
Spring	4	85	100	100
Sep. 15-Oct. 15	88	15	0	0
After October 15	8	0	0	0

Table 5. Distribution of farmers by sowing method, seed covering implement and seed rate.

	% of farmers			
Sowing Method	**Wheat**	**Barley**	**Lentil**	**Chickpea**
Hand	84	92	95	92
Drill	16	8	5	8
Seed cover				
Moldboard	48	68	75	89
Disch arrow	48	32	25	11
Sweep	4	--	--	--
Seed rate, kg/ha				
< 100	12	64	73	46
100-150	49	23	18	30
151-200	21	3	9	13
> 200	18	10	--	11

Local crop varieties are dominating in the survey area. Sardari, a local wheat variety, is planted by 90% of wheat farmers, other varieties reported were Sabalan, Azer, Spring and Sebtser. Akarpa, a local barley variety is grown by 56% of barley producers. Small local lentil variety is used by 95% of lentil producers, and 58% of chickpea farmers use Desi types. Other varieties of chickpea grown are Pirooz, local cultivars named Yellow, and White. Improved varieties have to be obtained and disseminated through on-farm verification and demonstration trials in combination with improved management practices which also are lacking.

4.3. Fertilizer Use

Average applications of fertilizer on wheat were 32 kg/ha of P_2O_5 and 46 kg/ha of nitrogen. All farmers apply nitrogen and 80% of farmers use P_2O_5 on wheat. Fertilizer is less used on barley compared to wheat, as only 23% of barley farmers apply P_2O_5 and 60% use nitrogen. Lentil and chickpea receive less than 25 kg/ha fertilizer as P_2O_5 from 5-10% of producers, and as nitrogen from 19-23% of producers (Table 6). The variability in fertilizer use is extremely high, the coefficient of variation (C.V) is 78% for P_2O_5 and 56% for N applications on wheat, and it is well over 100% for other crops. The importance of fertilizer is well known by farmers in the two provinces, but it is not available at the amount they want to apply due to fertilizer allocation policy. The extreme majority (88%) of farmers considered the amount of fertilizer currently used on wheat is not sufficient. It seems to be an institutional problem more than a technical one in fertilizer use.

Table 6. Distribution of farmers by fertilizer application rates.

	% Of farmers			
P2O5, kg/ha	**Wheat**	**Barley**	**Lentil**	**Chick**
0	**20**	**77**	**95**	**90**
< 25	**30**	**8**	**5**	**10**
26-50	**29**	**7**	**-**	**-**
51-75	**10**	**5**	**-**	**-**
>75	**6**	**3**	**-**	**-**
N, kg/ha				
0	0	41	81	67
< 25	20	31	19	23
26-50	41	8	-	6
51-75	27	10	-	4
> 75	12	8	-	-

5. Crop yields

Farmers were asked to state the yields of wheat, barley, lentil and chickpea that they would expect under different (good, normal, and bad) agro-climatic conditions. Yields are generally low, and highly variable in the two provinces (Figure 4).

Yields of cereal crops estimated by Maragheh farmers were higher than Hashtrod's, but the differences were not significant except for bad years. The average of yield estimates for wheat and barley, even in years of good harvest, were 1.5 t/ha, and 1.2 t/ha, respectively, with about 60% of wheat farmers and 80% of barley farmers obtaining yields less than these averages (Table 7). Yield average for wheat and barley in normal years is less than 1.0 t/ha, and yields of less than 0.5 t/ha were reported by 22% and 50% of farmers for wheat and barley respectively. In years of poor harvest, wheat yields are only one third of good years, and barley is a little bit less affected (Figure 4).

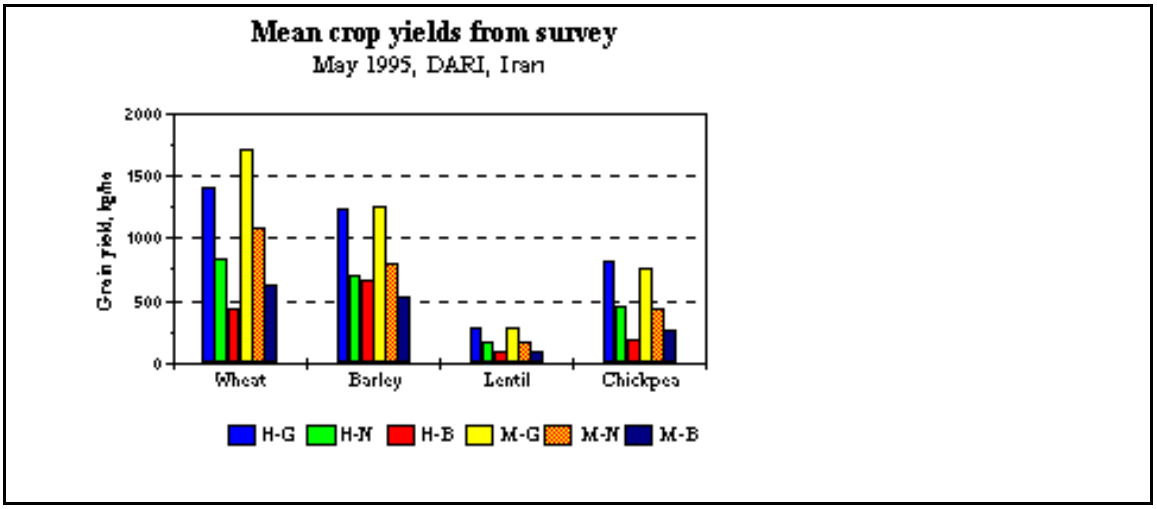


Figure 4. Mean grain yields of main crops under different conditions; (H=Hashtrod, M=Maragheh; G=godd, N=normal, B=bad seasons)

Lentil yield is dramatically low in the two provinces, less than 0.3 t/ha even in years of good climatic conditions. The main reason for this could be the spring sowing of the crop (to avoid cold damage), using very low seed rate, local cultivars, and other improper management practices. Average chickpea yield is about 0.8 t/ha in good years, but about 65% of producers obtain more than 1.0 t/ha. In normal years the average yield was estimated at less than 0.5 t/ha (Table 7 and Figure 4).

Table 7. Distribution of farmers by crop yield levels.

	% of farmers					
Yield	**Wheat**			**Barley**		
(kg/ha)	Good	Norm	Bad	Good	Norm	Bad
<500	2	22	56	16	50	70
501-1000	41	44	40	40	30	24
1001-1500	18	19	4	25	10	3
1501-2000	10	13	-	7	7	3
>2000	29	2	-	12	3	-
	Lentil			**Chickpea**		
<500	37	90	100	5	15	54
501-1000	58	10	-	30	58	39
1001-1500	5	-	-	23	20	5
1501-2000	-	-	-		5	2
>1000	-	-	-	14	2	-

Farmers rated fertilizer application (88%) and lack of machinery (69%) as the most important factors affecting crop production, followed by time of tillage (30%). Other factors of minor importance reported were credit, tillage implements, sowing method, labor shortage, harvesting method, weeds and seed rate. Although time of tillage came out to be the third most

important factor affecting crop production, yet 70% of farmers rated it not important. Unless constrained by environmental and, or, institutional factors of which farmers have no control, this may imply farmers' unawareness of some factors which may affect crop production significanly.

Crop yields, sowing date and seed rate relationship

As it was indicated in earlier section (4.2. Planting), seed rate was rather low, and wheat was sown mainly in autumn but barley and legumes were sown in spring. It was interesting to analyse crop yield data in relation to sowing date and seed rate used by farmers. The results in this respect are given in Table 8.

Common trend in wheat is increasing yields with increasing seed rate in all seasons and similar results are obtained also for barley production. This is actually related mainly to sowing date. If wheat or barley is sown in autumn seed rate correlates positively with crop yield (not given in Table 8). When cereals (mostly barley) are sown in spring, most of the farmers are using low seed rate and yield is not increased with increased seed rate over 150 kg/ha. Mean wheat and barley yields are much higher in autumn planting compared to spring planting in all seasons. However, this is pronounced better under unfavorable conditions.

Legumes are sown in spring with low seed rates in general. Most of the farmers are using seed rate less than 50 kg/ha resulting in lower yields. When seed rates are increased upto 100 kg/ha legume yields also increase.

Lower seed rates used in spring sown crops such as barley, chickpea and lentil may be attributed to favorable soil and air temperatures for crop growth that it would allow most of the seeds to emerge. In autumn sowing, some of the seeds placed in soil may not emerge or emerged plants might be killed by frost, or plant emergence can totally be delayed to early spring in which case some of the seeds may die during winter.

6. Conclusion: problems and proposed solutions

Problems limiting crop productivity identified by this diagnostic farm survey are:

1. Improper fallow management in terms of timing, implements, and frequency of tillage.
2. Extensive use of local, or old improved varieties with sometimes quite low and sometimes quite high seed rates.
3. Hand broadcasting of seeds and using the moldboard for covering.
4. Spring sowing of barley, chickpea and lentil.
5. Fertilizer allocation and pricing policies.
6. Farmers unawareness of the importance of weed control (applied by about 25% of farmers).

7. Absence of research-extension-farmers interaction resulted in ineffective and inefficient transfer of improved technologies.

Table 8. Crop yields estimated by farmers with respect to sowing date and seed rate in different seasonal conditions.

Crop yields (kg/ha)						
Seed rate	**Wheat**			**Barley**		
(kg/ha)	Good	Norm	Bad	Good	Norm	Bad
< 75	725	425	275 (4)	1200	674	305 (19)
75-100	1157	731	414 (14)	978	631	389 (8)
100-150	1513	873	546 (12)	1070	690	480 (2)
> 150	2092	1239	661 (18)	2188	1270	890 (5)
Winter sow.	1618	1015	568 (42)	2375	1575	1175 (4)
Spring sow.	975	550	250 (2)	1106	643	322 (30)
Seed rate (kg/ha)	**Lentil**			**Chickpea**		
< 50	244	138	77 (15)	733	436	222 (26)
50-100	450	300	227 (4)	950	484	253 (15)
> 100	-	-	-	727	455	257 (4)

Figures indicated in parenthesis are the number of observations.

According to the problems listed above, some trials were designed together with the trainees to be discussed in the annual Iran/ICARDA coordination meeting. More emphasis was given to on-farm research and demonstrations, because several research activities are on-going at research stations and some of them have been completed already. Therefore, some results obtained on the stations can be simplified and conducted on farmers' fields as on-farm trials. Suggested research and demonstration activities are summarized below:

a) On- farm demonstration of wheat varieties and seed rates. There are already yield trials carried out on-station,

b) Fertilizer on-farm trials to be used for convincing the decision makers to allocate more fertilizers to farmers, and also for identifying the wheat response to a range of nitrogen applications in different locations combined with the soil analysis.

c) Time and frequency of tillage, and sowing method on-farm trials to compare recommended and farmers practice. Detailed tillage work has been conducted on the station which might be solving relevant problems identified by the survey.

d) Weed control, by herbicide will be superimposed on farmers' wheat fields to compare with the weedy check. There are on-going on- station research in this area for legumes.

e) Barley variety, sowing date, and seed rate on-farm trials.

f) Chickpea variety and seed covering methods at spring planting as on-farm trials.

g)Chickpea variety, sowing date and seed rate on-farm trials.

After starting on-farm trials on the ground, farmers will be monitored for their perception and acceptance of the new technologies. The on-farm work (trials and monitoring) would help in understanding the factors behind accepting or rejecting specific technologies tested under specific farmers' conditions.

Active participation of the extension authorities, together with researchers and farmers, in conducting and monitoring on-farm activities is strongly recommended for the success of this new exercise. This participation would improve the technical capacity of extension agents; and consequently enhance the process of technology transfer. Supporting Dryland Agricultural Research team, at Maragheh, by appointment of socio-economist(s) is also recommended.

(M. Pala, A. Mazid, and A. B. Salkini from ICARDA and H. Maksood and A. Hagigati from DARI, Maragheh)

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