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FIRST EXPERIENCES WITH JOINT MANAGED FORAGE AND GRAZING TRIALS

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INTRODUCTION

In the agricultural zones receiving 200 to 350 mm annual rainfall in Syria, barley/fallow and continuous barley rotations predominate (ICARDA, 1982). Such rotations are also common in the countries of North Africa and West Asia which are included in the ICARDA region. Considerable emphasis at ICARDA is being placed on research which aims to identify crops that replace the fallow or break the continuous barley rotations. In this respect leguminous crops such as vetch (Vicia sativa), peas (Pisum sativum) and annual self-regenerating Medicago species are being examined to determine their dry matter yield potential for pasture and hay production, soil water utilization, soil nitrogen enrichment and effect on subsequent barley grain yield (ICARDA, 1982).

The research on pasture and forage leguminous crops is undertaken by the Farming Systems (FSP) and Pasture and Forage Improvement (PFIP) Programs of ICARDA. The research in the FSP is currently being conducted within the framework of the now familiar four stage farming systems process (Gilbert, Norman and Winch, 1980). During the initial phase of the FSP, emphasis was placed on stage one -- describing systems and diagnosing problems. At the present time the major research effort is being devoted to stage two -- problem oriented experimentation and system design. Since 1981 there has been a continued evolution of the FSP's research into on-farm joint (scientist-farmer) managed trials, although on-farm scientist managed trials have been conducted by ICARDA's commodity programs and the FSP since the establishment of the Center in 1977. This shift of focus is appropriate since stage three -- tests on farmers' fields -- together with stage one, are the essence of the Farming Systems Research (FSR) approach.

The FSR and ICARDA started in 1977 with a three year descriptive study in six rainfed villages distributed across a 200 to 600 mm rainfall transect in Aleppo Province, and in two irrigated villages in Hama Province of NW Syria (ICARDA, 1980). A parallel three year study of nomadic families began in 1976 in the driest steppe areas of Aleppo and Raqqa Provinces receiving about 200 mm annual rainfall where sheep production dominates the farming system (Thomson and Bahhady, 1983). This research on the first stage of the FSR process included a smaller shorter study which focused on the temperal changes in the liveweight of about 175 Awassi ewes in 13 flocks across different rainfall zones and on the growth performance of their lambs (ICARDA, 1983b).

In early 1980 livestock systems research was initiated on the second stage of the FSR process using information from the surveys. This on-station research concentrates on designing and testing improved husbandry practices which increase sheep productivity by exploiting the genetic potential of the indigenous Awassi breed and by making the best use of the existing resource base (ICARDA, 1983b).

First attempts at joint managed on-farm trials involving barley (Nygaard, 1983) and forage crops were made in 1981/82. Many lessons were learned from those initial attempts, and, acknowledging the essential inclusion of on-farm trials in the FSR process, such trials were considerably expanded in 1982/83 to include first attempts at on-farm livestock trials.

The livestock systems research at ICARDA accounted for 13 to 15 percent of the FSP budget (and only about 4 percent of ICARDA's budget) over the last two years. Such research, together with socio-economic studies on barley production systems (ICARDA, 1982) and crop-livestock interactions (Nordblom, 1983 and 1983b), is now an integral part of the research of ICARDA. In October 1983, the inseparable nature of pastures and livestock research resulted in the transfer of the livestock research to the PFIP where the FSR approach will continue to be applied.

This paper reports on the 1982/83 joint managed forage and grazing on-farm trials. It is divided into five sections. The first three sections outline the objectives of the joint managed on-farm trials, the experimental methods and the results. In the fourth section the results and the implications of this research are discussed. A final section outlines the proposals for the 1983/84 season.

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The major objectives of the joint managed on-farm forage and grazing trials reported in this paper are to:

- develop a methodology, identify hindrances and extend our ability to conduct on-farm trials involving livestock,
- compare, under farmer management, the dry matter yield potential of three leguminous forage species as an alternative to fallow or barley in barley/fallow or continuous barley rotations which predominate in 200 to 350 mm annual rainfall areas of Syria,
- measure the liveweight gains of lambs grazing these forages, and
- assess farmers' reactions in terms of the acceptability of these forage crops and their utilization in the farming systems.

EXPERIMENTAL METHODS

Three villages in contrasting rainfall areas (200, 250 and 350 mm average annual rainfall) were visited in October 1982. Using a questionnaire, nine farmers were selected from within those villages depending on willingness to collaborate, suitability of land and ownership of sheep. At the driest location (200 mm, Hawaz) both sites had to be abandoned due to bird damage, and one site at Deir Qaaq (350 mm) was abandoned because of the theft of the crop. Thus, the results in this paper consider only six sites, two at Deir Qaaq (350 mm) and four at Breda (250 mm).

Agronomy Trial

A standardized experimental design was used at each site. The three species being tested in these agronomy trials were vetch (Vicia sativa), peas (Pisum sativum) and annual Medicago. These were planted in 500 m^2 main plots and 50 kg P_2O_5/ha was applied to half the area. Since farmers generally do not own tractors and hire seed broadcasters, a tractor and machinery for preparing the land and incorporating the seed and a skilled farmer for broadcasting the seed and fertilizer were hired. ICARDA provided the seed and fertilizer. Dry matter yield was estimated from harvesting five 1.5 x 1 m areas per sub-plot. The agronomic practices used in the trials are shown in Table 2.

Grazing Trial

One of these agronomy trials was modified to serve as a grazing trial by increasing the area of vetch and peas to 1500 m^2 per species (Figure 1). It was still possible to collect yield data for the two species since three 2 x 2 m areas within each sub-plot were protected from grazing using wire netting. Since the farmer did not own sufficient lambs for the grazing trial, twenty Awassi lambs about four months old and weighing initially about 15 to 18 kg liveweight were transported from ICARDA's research station to the site and divided between the two main plots. Lambs were weighed at the start and at the end of the trial. They were penned at night. The farmer was paid a wage to supervise the lambs.

In June 1983 follow-up interviews were held with collaborating farmers in order to solicit their views regarding the trials. This information was valuable for planning the 1983/84 trials. The data from Breda was analysed statistically as a split-plot design. The four sites within the location represented replicates.

RESULTS

Preliminary Interviews

The information from the preliminary interviews is shown in Table 2. Some differences in flock ownership, crop rotations and crop yields were noticeable between the Deir Qaaq and Breda sites. These results need careful interpretation because of the small size of the sample. The farmers in the sample owned from one to 54 sheep plus some goats. One farmer at Breda owned one cow and another three cows. Farm size varied from four to 38 ha with barley covering about 54 percent of the area, fallow about 20 percent and the other crops the remainder. The main rotations at Breda were barley/fallow, but at Deir Qaaq wheat, summer crops and cotton were more important. The two sites at Deir Qaaq and all four sites at Breda were on stony soils of varying depth. In 1981/82 cereal crops were grown on these plot areas and these were preceded by a fallow in five cut of the six sites in 1980/81 (Table 2). The 1981/82 harvest was poor; at the drier site crops were grazed.

Agronomy Trial

The dry matter yields (DM) from the sites are shown in Table 3. Dry matter yields of the Medics were not taken because of poor growth; this aspect will be discussed below. The mean DM yields at Breda were about 28 percent higher than at the wetter site Deir Qaaq. Peas generally yielded 25 percent ($P>0.05$) more than vetch in the unfertilized and 38 percent ($P>0.05$) more in the fertilized plots. While the response to phosphate application was variable, on average peas responded (21 percent) better than vetch (10 percent).

Grazing Trial

The results of the grazing trial are shown in Table 4. The lambs appeared to prefer the vetch to the peas. Lambs on vetch were observed to rest after grazing in the morning but lambs on peas appeared to be continuously in search of feed. It was observed that lambs found unfertilized vetch more palatable than fertilized vetch. These differences in animal preference for the two species were reflected in the daily liveweight gains of the two groups, animals grazing the vetch gained an average 55 g per day while those grazing peas gained only 10.

The different lengths of the grazing period were partly due to the different total levels of dry matter available. However, on a daily basis, dry matter availability per head was similar in the two groups. But the intakes of the two species differed since after 18 days grazing vetch lambs had removed all the crop. Even after 27 days considerable quantities of peas remained. It was then decided to end the trials since the lambs were losing condition.

Follow-Up Interviews

The follow-up interviews identified some very interesting observations. Farmers evaluated the three species for grazing in the order vetch, peas and medic. Asked whether they would consider growing the crops themselves, all the farmers seemed willing to allow ICARDA to plant 1.0 to 2.0 ha vetch in their fallow in 1983/84; they were indifferent to peas but none wanted to grow medic. However, it is unlikely that they are already sufficiently familiar with the forages crops to start growing them independently. Availability of cash was considered to be a constraint to the purchase of seed in 80 percent of the cases, although seed was available on the market and the crop yields were thought by farmers to cover the variable costs of production. The planting and grazing of the crops did not seem to conflict with other farm operations; sheep have to be herded anyway. However, harvesting the crops for seed and straw coincides with the cereal harvest when there are heavy demands on labour.

It is important to know how farmers would use a larger area of vetch and peas. Eighty percent said they would let it mature to produce straw and seed. Twenty percent said they would utilize it as spring grazing for ewes and lambs. This result probably reflects the absence of improved pastures and controlled grazing practices in the region. None of the farmers were interested in hay production.

Farmers were asked whether they could afford phosphate fertilizer, whether it was available and whether they felt that the extra production would cover the extra costs. Eighty percent said they could afford it, and all said it was available and that the extra yield would cover the extra costs. However, no farmers applied it to their barley field that year.

Farmers were unanimous in their opinion that the introduction of the forage crop would reduce the yield of the succeeding barley crop.

Regarding collaboration with ICARDA in 1983/84, all farmers but one with insufficient land expressed a wish to continue and offered 0.5 to 2.2 ha of fallow land for this year's trials. The farmers were satisfied with the collaboration and said scientists had explained the objectives of the trials well. They suggested that monthly visits by the team rather than visits every second month would be more appropriate.

DISCUSSION

The first major efforts to conduct on-farm joint managed forage trials were made during 1982/83 following a limited start in 1981/82. Certain important lessons were learned during the 1981/82 season, and these were incorporated into the design of the 1982/83 trials. These findings and lessons are discussed below.

Agronomy Trials

The higher dry matter (DM) yield of peas than vetch in those joint managed trials confirms the results from the scientist managed rotation trials being conducted by the FSP (ICARDA, 1983a). However, the overall DM yields in the joint managed trials were well below the yields of scientist managed trials in nearby plots. Such a finding is common when yield comparisons between experimental plots and farmer's fields are made. One reason for the difference is that the joint managed trials were conducted on stony soils, whereas the scientist managed trials were conducted on deep soils.

The mean DM yield of vetch and peas were 280 and 210 percent respectively higher than those found in 1981/82 at the Breda site. Part of this difference was certainly due to site and seasonal variations. But it is suggested that much of the increase in yield found in 1982/83 was due to the increase in the seed rate (140 vs 70 kg/ha) and P O level used (50 vs 25 kg/ha).

It has already been noted that the mean DM yield was higher at the drier compared to the wetter site (Table 3). Furthermore, with the exception of vetch at Deir Qaaq, there was a mean response of 21 percent to phosphate application (Table 3). There is insufficient knowledge of the soil and meteorological conditions at the various sites to explain the inconsistency of these results. A variable response of barley to phosphate fertilizer was reported in the 1981/82 barley on-farm trials (Nygaard, 1983). This was corrected in the next season and the responses in the trials in 1982/83 were more consistent largely due to greater care when selecting sites. Cropping history of the plots appears to be very important.

These inconsistencies in the results are a feature of both joint and farmer managed trials where the intensity of monitoring the climatic, soil and microbial environment, for example, is low. However, it is considered that the DM yields and the fertilizer responses in these trials are close to those that would be obtained by farmers.

Grazing Trial

The grazing trial was the first attempt at a joint managed grazing trial and even though modest it was very instructive. When conducting on-farm trials involving livestock, often a compromise has to be found between the need to measure the product, such as milk, weight gain, wool, dung, traction, etc., relevant to the farming system, and the difficulties in doing so. For this reason lambs were chosen because measuring liveweight gain poses fewer problems than measuring milk production, even though it is envisaged that pastures would also be utilized for lactating ewes. In retrospect it is now considered that a farmer would be more impressed by a new farming practice if he could see a change in performance of his flock over a short period of time. Thus, a change in milk yield would have been a better variable to determine

than the growth rate of lambs since changes in milk yield can be measured by farmers themselves. It is therefore proposed in 1983/84 to monitor the milk production of ewes in two flocks before, during and after they graze vetch or peas.

Although the average daily weight gains per lamb were very low on the vetch plots, expressing them as total weight per day per hectare gives a value of 3.7 kg. This is very close to the values of 3.8 kg found under experimental conditions in 1980/81 and 3.7 kg in 1981/82, (ICARDA, 1983b). The low average daily weight gains of the lambs was due to the high stocking rate chosen, 67 lambs per hectare, and low DM availability. Converting to 45 kg ewe equivalents, this represents a stock rate of about 25 ewes/hectare. A high stocking rate was chosen since it was desirable to graze the crop in 28 days. This would prevent the crop becoming too mature at the end of the trial. Of course, a grazing period of only 28 days has little practical benefit. In future, a lower stocking rate and an earlier initiation of grazing will be applied.

Applying the same argument to lambs' weight gains on the pea plots, a value of 0.67 kg liveweight per hectare per day is obtained, in spite of there being nearly 1 kg DM available per lamb per day (Table 4). The lambs apparent dislike of peas was responsible for their poor growth performance. Grazing studies by PFIP have also shown similar results. This is an important finding which has led to many discussions between scientists in the FSP and PFIP, particularly as peas have such a high yield potential (ICARDA, 1983a). This point illustrates the value of conducting animal evaluation studies as early as possible when designing new elements for a farming systems.

Several questions need to be asked regarding peas as a forage crop. Is green pea herbage really unpalatable? Do ewes as well as lambs find it unpalatable? What is the palatability of pea hay and pea straw? What is the nutritive value of these feeds? The PFIP grazing studies showed that adult sheep find mature peas more palatable. Hay from peas and vetch and mixtures of these containing barley are being fed to sheep to assess voluntary feed intake and digestibility. Furthermore, grazing studies are planned for 1983/84 to evaluate the palatability of green peas for ewes and, in view of farmer's preference to harvest forage crops for grain and straw, the nutritive value of pea straw should be assessed.

Farmers' Opinions

One particularly important aspect of these trials was the opinion of farmers expressed in the follow-up interviews. Although the yield of vetch was lower than peas, farmers preferred to grow vetch. This may be because they are more familiar with vetch as a forage crop., Also, some farmers were only able to sell their pea seed at an inferior price because of insect damage to the seed.

As is often the case when seeking to introduce new technology into a farming system, a shortage of cash was felt by 80 percent of the farmers to be a constraint to introducing a forage crop into the crop rotation. However, they did feel that crop yields were sufficient to cover the variable costs of production. The budget presented in Table 5 confirms this view which arises because of the high economic value of the straw. (It has been assumed that hay has the same market value as straw; from a nutritional standpoint this is not the case.) The desire of 80 percent of the farmers to use the forage crop for straw and grain production is thus understandable. Firstly, they like to grow a crop which provides them with seed for planting in the next season. This solves the problem of a shortage of cash to buy the seed. Secondly, the high economic value of straw, which constitutes an important component of sheep diets in winter (ICARDA, 1983b), makes it attractive for farmers to produce their own straw.

The lack of interest in hay production reflects farmers' relative ignorance of the concept. (But this should change with more on-farm trials if hay is seen by farmers as a viable alternative.)

One particular concern of farmers was the effect of a forage crop, which replaces a fallow, on the yield of the next barley crop. One farmer at Breda complained that the 1982/83 barley crop growing where the 1981/82 forage trial had been was poor. Unfortunately, the grain yield of this barley crop was not measured. However, the site of the previous year's forage trial could clearly be seen. It was apparent that the application of phosphate fertilizer had stimulated the growth of the indogenous Lolium species and some of the Lolium planted in 1981/82 had self-sown and regrown. Thus, even though the 1982/83 barley crop may have suffered -- it was hand-harvested anyway, as was the area surrounding the trial area -- the grazing value of the areas was well above that it would otherwise have been The farmer agreed with the point and was quite happy to give us all his fallow area (2.2 ha) for our forage trial in 1983/84.

It will be very important this year to monitor the 1983/84 barley yields of crops growing on the 1982/83 forage sites, together with the barley yields in the adjacent areas where no forage crops were grown.

Annual Medics

No mention has been made of medics even though ICARDA will continue to give priority to this species in its future pasture and forage research. The problems of medic are well known -- poor establishment in the first year, weeds, complex grazing management. Therefore it is not surprising that farmers were generally not interested in the species.

In spite of these production difficulties and the skepticism of farmers, some interesting findings arose from the 1982/83 trials. At one Breda site the seed production appeared to be moderate. (No measurements were made of DM yield or seed yield at any of the sites

because of the poor establishment.) This site will be monitored closely in subsequent seasons. A second interesting observation was that the medic was still flowering when the last visit to the sites was made on 15 June. If it has a late maturing habit, then the interesting possibility arises of sowing a mixture of medic with vetch or peas in the establishment year, so that the peas/vetch provide the early grazing and medic the late grazing. Certainly, in the establishment year medic will only find acceptance with farmers provided it can be accompanied by another pasture/forage species which provide the earlier grazing.

Lessons

Some lessons learnt from the 1982/83 season are presented below.

1. Plot size: The plot size was increased from 100 m^2 (1981/82) to 500 m^2 (1982/83). This led to more "realistic farming" conditions which the farmers were better able to appreciate. Furthermore, some farmers felt the area sufficiently large to make it worth their while harvesting the crop for straw and seed. This is an important step towards ensuring that farmers continue to grow the crop after the scientist has withdrawn his input.

2. Best Bet Approach: A major aspect of the 1982/83 season was the adoption of a "best bet" approach in joint managed trials rather than rigid adherence to agronomic recommendations arising from small plot trials. Such an intuitive and pragmatic approach uses a knowledge of local farming practices gained during initial survey work. For example, a seed rate of 140 kg/ha was chosen in 1982/83, based on the quantity of barley seed broadcast by farmers in the region. The 70 kg/ha seed rate used in 1981/82 was found to be optimal in scientist managed trials, because this level is suitable for drilling into a well prepared seed bed under high fertility conditions than are usually found in areas with less than 300 mm rainfall.

3. Fencing: A further major lesson from the 1982/83 season was the need to properly fence the plots unless the forage crop is enclosed within a border of barley. This practice was considered necessary even though farmers' fields are not fenced. Thus, five out of the six trials were fenced. The unfenced plot was close to the farmer's house. Wherever possible trials are now planted fairly close to the farmer's house. Farmers are thus better able to guard the crop and become familiar with them.

PROPOSALS FOR 1983/84

Trials will be repeated with the following modifications:

1. Ten farmers will be selected within one location (Breda) instead of at three. Consolidating the research will improve farmer/scientist contact.

2. Grazing studies will be conducted at two or three of these sites using ewes. Milk production of ewes will be measured before, during and after grazing the crop.

3. Farmers will be visited monthly by scientists and farmers opinions sought throughout the duration of the trials.

4. Medics will be sown in three furrows of the "fertilized" vetch and pea plots.

5. The area of vetch, and perhaps peas, will be increased at three of the 1982/83 sites with the farmer paying for the land preparation and broadcasting, and ICARDA providing the seed and fertilizer. The farmers will decide on the area of the plots.

6. The barley grain and straw yields on the 1982/83 sites will be measured.

7. Farmers will be invited to ICARDA's experimental station to discuss the trials and to comment on the on-station sheep and pasture research.

8. The national program will participate in the trials.

CONCLUSIONS

The first year of joint farmer-scientist on-farm forage and grazing trials has highlighted many socio-economic and agronomic problems which need further research at the second stage of the FSR process. Scientists were already aware of many of these problems but are now better able to define research priorities as a result of this research. Feed back of information from the trials leads to further research at the design and testing stage. This is an excellent example of the iterative nature of the FSR process. Solutions to these socio-economic and agronomic problems will provide livestock scientists with a more concrete framework for conducting on-farm testing of improved livestock husbandry practices. In 1983/84 efforts at ICARDA to develop and refine the on-farm pasture, forage and livestock trial methodology will continue.

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TABLE 1. Agronomic practices used in the trials

i.	Species:	Vicia sativa, Pisum sativum, and Medicago Rigidula.
ii.	Plot size:	500 m^2 per species (except one site where 1500 m^2 plots of V. sativa and P. sativum were planted for later grazing).
iii.	Seed rate:	140 kg/ha for Vicia and Pisum, 20 kg/ha for Medic (inoculated seed).
iv.	Fertilizer:	50 kg/ha of P O as triple-super-phosphate applied to half the plot area of each species.
v.	Date of planting:	Mid to late November 1982.
vi.	Land Preparation:	Ducksfoot cultivator; set up ridges.
vii.	Sowing method:	Vicia and Pisum hand broadcast, Medic in furrows.
viii.	Seed incorporation:	Vicia and Pisum by splitting ridges, Medic by hand covering or light cultivation.
ix.	Measurements:	Dry matter yield at about 100 percent flowering from five 1.5 x 1 m areas per plot. Three cages (2 x 2 m) per plot protected the crop in the grazing trial.
x.	Fencing:	All trials were well fenced.

Figure 1 Plot layout of on-farm grazing trial (Breda 1982/83) (excluding Medicago plot)

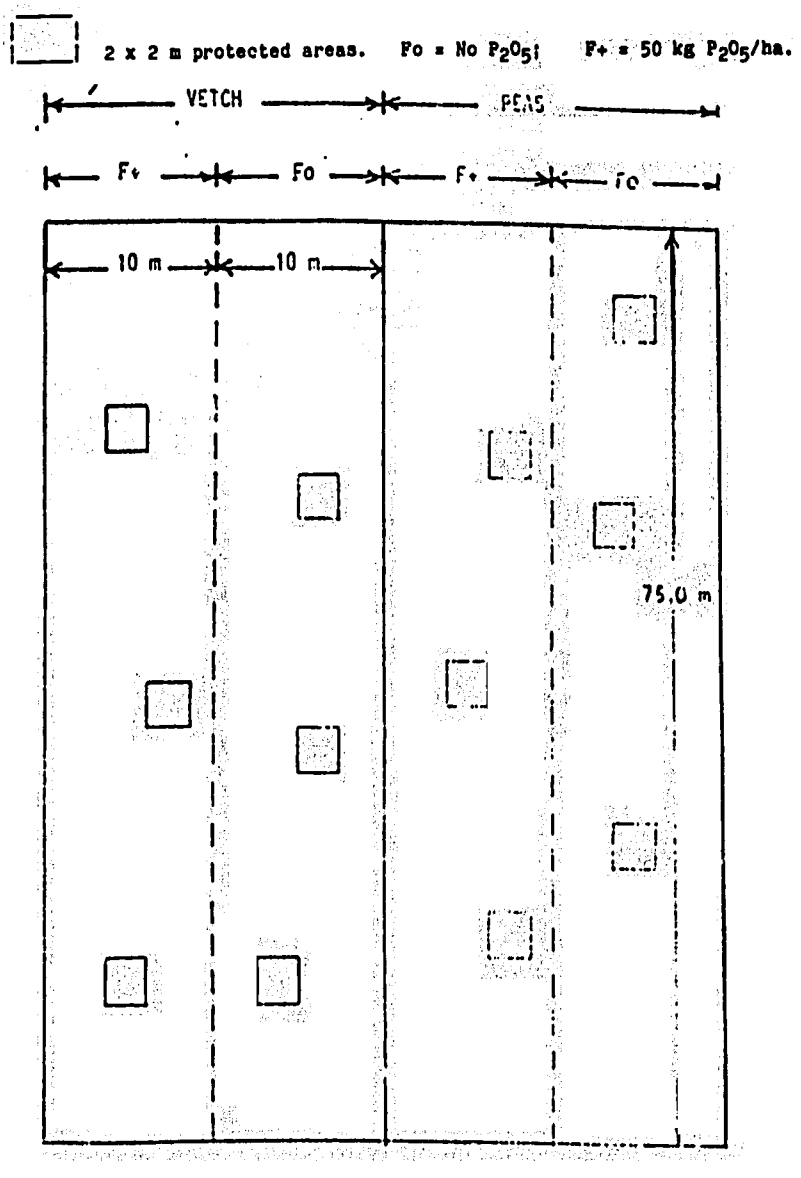

TABLE 3. Dry matter yields of vetch and peas with and without phosphate fertilizer. (kg per hectare)

Location	Farmer	Peas		Vetch	
		Fo[1]	F+[1]	Fo	F+
Deir Qaaq	1	1019	1285	780	731
	2	1069	1408	905	878
	Mean	1044	1347	843	804
Breda	3	1422	2113	932	1313
	4	806	1099	611	1072
	5	1612	1595	1341	1167
	6	1501	1453	1325	1326
	Mean	1335	1565	1052	1220
Overall Mean		1238	1492	982	1081

[1]Fo = No P_2O_5 applied
[2]F+ = 50 kg/ha P_2O_5 applied

TABLE 4. Liveweights and liveweight changes of lambs grazing peas and vetch pasture.

	Vetch	Peas
Dry matter yield,[1] kg/ha	1122	1768
Dry matter availability,[2] kg/hd/day	0.94	0.96
No. of lambs[3]	10	10
Start of grazing	4.4.83	4.4.83
End of grazing	22.4.83	1.5.83
Grazing days	18	27
Initial liveweight, kg	17.1	15.6
Final liveweight, kg	18.1	15.8
Av. daily liveweight gain, g	55	10

1 Mean of fertilized and unfertilized plots -- see Table 3, farmer 3 (Breda.
2 (Dry matter yield x 0.15) - (10 x grazing days).
3 Five males and five females; about four months old at start of experiment.

Table 2. Summary of flock structure, cropping patterns and history of experimental sites.

Name of Village (rainfall)(mm)	Deir Qaaq (350 mm)		Mean	Breda (250 mm)				Mean
Farmer	1	2	-	3	4	5	6	-
Flock Structure								
Ewes	40	9	25	1	10	12	4	7
Yrls.	12	0	6	0	0	0	0	0
Ram	2	0	1	0	0	0	0	0
Goat	6	0	3	0	0	1[1]	3[1]	0
1982/83 Farm Area (ha)								
Tot.	38[2]	4	21	8	20	28	4	16
Bar.	10	2	6	4	18	22	3	11
Fall.	16	1	8	4	2	6	0	3
Oth.	12	1	6	0	0	0	1	0
Main rotations[3]	2	2	-	1	1/3	1/3	1/3	-
Details Exp. Sites								
Soil type	2[4]	0	-	2	2	2	2	-
Crop 81/82	1,2[5]	1	-	1	1	1	1	-
Yield 81/82 (kg/ha)	450	180	315	720	G[6]	G	G	-
Crop 80/81	3[5]	1	-	3	3	3	3	-

Codes:

1 Cows

2 25 ha shared

3 Main rotations 1 = barley/fallow 2 = wheat + barley/fallow 3 = barley/barley

4 Soil types 1 = deep 2 = stony/variable deptb

5 Crops 1 = barley 2 = wheat 3 = fallow

6 Grazed

Table 5. Budgets comparing net benefit of fallow and vetch hay with and without phosphate application (SL per hectare)

	Fallow	Vetch	Vetch + P205	Peas	Peas + P205
REVENUE					
Dry matter yield (kg)	--	1052	1220	1335	1565
Hay	--	--	--	--	--
Grazing	301	--	--2	--2	--2
TOTAL REVENUE	30	1157	1342	1469	1722
COSTS					
First cultivation (Ayar)	--	35	35	35	35
Broadcasting seed + Fertilizer	--	14	28	14	28
Seed (140 kg p ha)	--	210	210	210	210
Fertilizer (108 kg TSP p ha)	--	0	130	0	130
Second cultivation (Rdad)	--	35	35	35	35
Harvest, cost, transport etc.3	--	650	650	650	650
TOTAL COSTS	0	944	1088	944	1088
NET BENEFIT (SL4 p ha)	30	213	254	525	634

1 Grazing value of fallow
2 No residual value since hand harvested
3 Hand harvested crop, estimate from cost of hand harvesting lentil crop.
4 SL 1.00 = approx. US$ 0.20.