PRODUCTION OF FORAGE CROPS , AND SOCIO - ECONOMIC FACTORS AFFECTING SHEEP PRODUCTION UNDER RAINFED CONDITIONS AT MADABA DISTRICT

BY

ISAM ADEL YOUSEF SAWAFTA

UNDER THE SUPERVISION OF

Dr. Abdel-Majid Tell

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FACULTY OF AGRICULTURE

UNIVERSITY OF JORDAN

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ABSTRACT

This research includes two interrelated subjects .

I. A socio-economic study of the sheep production in Madaba District of Jordan during the 1983 / 1984 Season.

It was found that the sheep production was low but financially viable . To develop the sheep production in the rainfed areas in Jordan, the following management practices are recommended :

1. The lowering of the number of sheep grazing per unit area.
2. To increase the production of forage crops by the introduction of forage legumes into the crops rotations in the dry land areas.
3. Providing stock with water at nearest locations and in sufficient amounts.
4. A programed selection of superior sheep is necessary to increase the meat and milk production.
5. The establishment of new cooperatives to provide the credit, feed and water .
6. The increase of farmers interest on animal health by spending more money on prevention health.

II. Two field experiments to study the yielding ability of different annual legumes grown as pure stands and in mixtures with wheat as follows:-

a. The first year experiment conducted at M'shaqar location-Madaba District include the study of the biological yield of wheat (Triticum durum : hourani), lentils (Lens culinaris), chickpeas (Cicer arientinum), common vetch (Vicia Sativa L.), bitter vetch (Vicia ervilia) and medic (medicago species), Plant characteristics of forage crops and wheat also studied . These include : Plant weight (g), plant height (cm), grain yield per plant (g) , straw yield per plant (g), number of seeds per pod, number of spikes or pods per plant and weight of 1000 seeds (g). Besides, the financial viability of the production of the abovementioned crops were studied. Several important conclusions could be drawn from this research as follows :-

1. Mixtures are recommended to provide higher yields which exceeds that obtained from the pure stands of forage legumes.
2. The medic growth and production were successfull as pure stand and in mixture with wheat, therefore it is recommended to be grown as a pasture crop, .
3. For the production of seeds and straw, the bitter vetch is recommended due to its higher yields under the rain fed conditions .
4. Forage legumes- wheat mixtures provided the highest returns , among sown crops, when grazed as green forage.

Therefore , farmers who keep sheep flocks are advised to grow forage-wheat mixtures.

5. Pure stands of bitter vetch and lentils gave higher returns than those obtained from wheat and chickpeas crops, thus they are recommended to be included in the cropping rotations of dryland areas,.

b. The second year experiment conducted at two locations mainly Zetouneh and Murijmah - Madaba District . The biological yield of common vetch (Vicia Sativa L.) , bitter vetch (Vicia ervilia) , narbon vetch (Vicia narbonensis) and pea (Pisum Sativum) when grown as pure stands and in mixtures with wheat (Tritccum durum : hourani) were studied . Seeding rates used for legume-wheat were12:0,9:3,6:6,and 3:9 kg/du . The effect of seeding rates on the number of plants per unit area were studied in addition to the yield of plant components mainly leaves, pods or spikes and stems at pod formation and full maturity stages of growth at the Murijmah location . Besides an evaluation of the costs and returns of the production and utilization of sown crops were studied . Several important conclusions could be drawn from this experiment .

1. Mixtures of bitter vetch-wheat , narbon vetch-wheat and pea-wheat showed good results with respect to dry forage yield, thus they are recommended to be grown in

INTRODUCTION

Livestock production in Jordan constitutes an important segment of the agricultural sector and a major source of animal protein in the diet of people in the forms of meat, milk and dairy products . However , Jordan produce only 40 % of its needs of meat and 30 % of its needs of milk and dairy products .(1) The production of meat and milk in 1983 was (10190) and (45550) tons respectively as shown in tables(1) and (2). The demand for these products is increasing due to the increase in population and the increase in per capita income; there is therefore a great need to increase the production of these products.

The most important constraint affecting livestock production is the limited resources of feed due to the low productivity of the range and the small area grown under forage crops , which at present , is about 3500 ha cmpared to more than 9000 ha during the late 60's .(2) This decrease

(1) Annual report 1983 ,Department of Animal Health and Production - Ministry of Agriculture (MoA).

(2) Agricultural Statistical Year books - Department of Statistics.

in production was due to the expansion of cereals and food grain legumes at the expense of forage crops .

At present , rainfed agriculture comprises about 92 % of approximately 529,000 ha , therefore the potential increase in feed supply must come from the rainfed areas.

The cereal-fallow system is one of the features of crop production in Jordan . The areas cultivated with wheat and barley were about 100,000 ha and 48,000 ha respectively , while the total fallow area were 58,000 ha classified as 8,000 ha left for rest and 50,000 ha as unused fallow. (1)

The production of more livestock feed is possible by improving the productivity of range and by making better use of fallow in the 250 - 400 mm rainfed areas and converting their present cereal-fallow cropping system to a cereal -forage legume rotation using pasture or forage crops and involving the close integration of crop and livestock production . Mixed legume-grass forages (for grazing green feed or hay) usually contain 12 to 15 % protein . This content of protein is higher than that of non-legumes crops such as cereals and grasses .

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(1) Agricultural Statistical Year book. Department of Statistics 1983.

On the other hand , Weber et al (1977) had summarized the specific advantages obtained from ley farming system that was adopted , over the last 30 years in Australia as followes :-

- Improve soil fertility and farming stability .
- Improve soil structure .
- Increase forage production resulting in higher better quality and more stable livestock output.
- A lengthened grazing season because of the provision of excellent quality dry pasture capable of carrying larger number of stock through the drier months of the year .
- Increase cereal crops yields, often with improved levels and greater cropping flexibility .
- Better soil erosion control .

The introduction of forage crops in the conventional crops rotation in rainfed areas has already given promising results in Algeria , Tunisia , Lybia and Iraq (Claimi 1979).

The objectives of this study were as follows :—

1. To find out the socio-economic factors which affect the sheep production in Madaba District .
2. To study the production performance of different forage crops and their mixtures with wheat at different stages of maturity , and to define the proper seeding rates

of forage-wheat mixtures and

3. To study the economics of forage crop production and utilization to develop an appropriate and low-input technology for increasing the utilization of fallow and rainfall , and promote the integration of animal production into the farming system .

Table 1

Red meat production in Jordan (ton) .

Year	Sheep	Goats	Cattle	Camels	Total
1976	2571	1604	1554	735	6464
1977	3672	1592	1596	945	7805
1978	3895	1604	1554	525	7578
1979	3381	1600	1550	575	7106
1980	3825	1980	1554	755	8114
1981	4050	2025	1525	945	8545
1982	4455	2381	1470	405	8711
1983	5557	2300	2078	255	10190

Source : Department of Animal Production and Health Ministry of Agriculture (MoA) , Annual reports 1976 - 83 .

Table 2 :

Milk production in Jordan (ton).

Year	Sheep	Goats	Cattle	Total
1976	10405	9220	15034	34659
1977	13715	9090	16805	39610
1978	13704	9176	21179	44059
1979	12159	9142	17407	38705
1980	13600	11112	21256	45968
1981	14400	11458	16112	41970
1982	15480	13608	18090	47178
1983	15680	11085	18785	45550

Source : Department of Animal Production and Health - Ministry of Agriculture
(Annual Reports 1976 - 1983).

REVIEW OF LITERATURE

For convenient presentation , the present review of literature will be divided into three main parts .

I. Production of forage legumes crops grown as pure stand and in mixtures .

II. Plant characteristics and componants .

III. Economic benefits of the production and utilization of forage crops.

I. Production of forage legumes crops grown as pure stands and in mixtures .

Donald (1951) mentioned that the trend is to use a small number of species with reduction in many instance to two species. He added that , at low density , no competition occurs at any stage of growth.

Pendelton (1953) found that decreasing the row spacing of oats resulted in increased associated red clover yields .

Burger etal (1954) found that orchardgrass (dactylis glomerata) mixture produced more herbage at the late compared to the early harvests and contained lower percentages of legume than the smooth bromegrass (Bromus inermis L.) mixtures yields of the various mixtures were greater and less, respectively ,at the hay and pasture frequencies than at the silage frequency of cutting .

Robinson (1961), in Minneosota found that oat (Avena sativa L.) - legume mixtures were superior to oats alone in both protein content and protein yield per acre . He reported the most favourable mixtures of oat - pea (Pisum sativum L.) was obtained from 1.5 bushels of each per acre . This mixture was superior to oats alone or oats-vetch on protein yield per acre . The yield was 7212 pounds per acre of forage which analyzed 11 . 4 % protein , both quoted on the basis of 15 % moisture . Weidn (1962), conducted an experiment at Minnesota to evaluate six early summer annual forage crops namely : oats-rape and oats-peas mixtures . However , a week delay in cutting resulted in significant yield increase of dry matter . Total seasonal yields were markedly increased for combinations including rape crop with notable recovery capacities . In USSR, Turbin (1965) found that mixtures of pea , vetch or chickling vetch (Lathyrus sativus L.) with oats gave higher fodder yields than oats sown in pure stand .

Swain et al (1965), in Maryland studied the sod seeding of annual forages into bermudagrass (Bromus arvensis L.) pasture . They reported a rye (Lolium multiflorum Law) - vetch (vicia villosa L.) mixture outielded either species alone by approximately 76 %.

In Bulgaria , Petrakieva and Naidenov (1968) obtained the highest dry matter yield from a maize (Zea mays L.)- sweet sorghum (Sorghum Vulgare) (Koren) - soybean (Glyeine max (L.)

clover (Trifolium subterranum) and annual ryegrass (Lolium risidum) and the volunteer weeds . He found that volunteer species compared favourably with the sown species in dry matter production and nitrogen content .

McGower et al , (1973) studied the factors affecting competition between subterranian clover and barley . They concluded that clover seed production was increased when barley seeding rate was reduced . They declared that the main factor limited the growth of the undersown clover was the competition for light .

Iannelli and Prunedu (1973) in Italy , pointed out that mixtures of hardinggrass (Phalaris aquatica L.) , tallfescus (Festuca aroundinacea schreb.) and Italian ryegrass (Lolium multiflorum lam) with lucern (Medicago sativa) yielded 32.2, 27.6 and 30.7 tons of green forage / ha respectively . The higest dry matter yields for two years were 16 tons / ha obtained from hardinggrass-lucern and 12.3 tons / ha from tall fescus - lucern while lucern alone gave 8.3 tons / ha only .

However , in Iraq , Raduan and Alfakhry (1975) found that the highest yields were produced by narbon vetch (Vicia narbonensis L.) which yielded 4.5 tons of fresh forage / ha and wollypod vetch (Vicia dasycarpa Ten .) which yielded 2.6 tons/ ha . They recommended the two species to be tested in mixtures with barley .

Scott and Brownless (1974) studied the establishment of barrel medic (Medicago truncatula) under cereals . They found that medic yields were suppressed at the heavier seeding rates of barley . In Romania , Simeta et al (1975) indicated that dry matter yields were higher from mixtures of grass with ladino clover than from the grasses grown in pure stands .

Saidoy and Soatov (1975) in USSR showed that sudan-grass-lucern mixture gave fodder yields of 41.0-47.2 ton/ ha compared with 34.2-36.2 tons /ha for sudangrass alone and 24.5-25.7 tons/ ha for lucern in pure stands .

Dobson and Beaty (1977), in Georgia - USA, demonstrated that the increase in yield, resulted from white clover grown with grass was equivalent to grass yield when fertilized with 96 kg N/ha in pure stand .

Working with mixtures of wollypod , narbon and chickling vetches with either barley or oat in Iraq, Tubaileh (1977) detected insignificant increase of the fresh and dry yields of forage mixtures over that of barley or oat in pure stands.

Guyer (1978) in Switzerland , recommended orchardgrass-clover mixtures for marginal arable area . The mixtures were all capable of high yields , but it showed differences in productivity under unfavourable conditions .

Recently , Osman et al, (1980) in Syria , studied the effect of some agronomic and management factors on yield and forage quality under rainfed conditions . He mentioned that

the advantages of harvesting annual legume and cereal forage mixtures at late 100 % flowering or pod formation stage instead of early flowering stage were reflected in significant improvement in drymatter yield, total crude protein and total digestible dry matter .

A study was conducted in Aleppo by ICARDA (1981) on barley sown in a mixture with common vetch (Vicia Sativa). Seeding rate for the mixture were 90, 120 , 150 and 180 kg/ha, cereal-legume ratio were 0.5 : 1, 1:1, 1.5:1 and 2:1. It was found that total hay yield of barley was 3.5 and 5 t/ha at 40 and 120 kg seeding rate respectively . The yield was increased with increasing cereal proportion in mixtures . The results from this experiment suggested that using higher seeding rates in cereal-legume mixtures and not pure stand barley can result in higher hay production .

More recently , at ICARDA (1982), barley , tritical, vetch and pea grown as grass-legume mixtures and as pure stands were studied for dry matter production . All forage mixtures were sown on high seed rates (140-180 kg/ha) for maximum dry matter of forage production . The highest dry matter production was obtained from mixtures containing 20% legume. In peatritricale it was found that dry matter production significantly increased with delayed harvest . An increase in dry matter of 46% and 66% were obtained when harvesting the crop at 100% flowering and at full pod formation , respectively, as

compared with the yield at 10% flowering . Also a significant increase in dry matter production resulted from increasing seeding rate up to 140 kg/ ha in a vetch-barley mixture , however, beyond that rate increments in yield was not statistically significant .

II. Plant Characteristics and Components :

Wilson and Swanson , (1962), in Kansas studied the effect of plant spacing on the development of winter wheat . He found that reduction of wheat population below 20 plants per square foot through systematic spacing of the individual plants produced progressively lower yields at each level. The adverse effect of reduced stand were reflected primarily in decreased head number per square foot was lowered by thining to any level, but test weight did not decrease until the population was reduced below 10 plants per square foot .

Also , Puckridge and Donald , (1967) in Western Australia studied the competition among wheat plants sown at a wide range of densities . They have shown that the optimum density for grain yield to be between 35 and 180 plants per square meter . They have emphasized the compensating effect of ears per square meter at these densities .

In Poland , Paprocki (1964), noticed that oats prevented lodging of spring vetch and make mechanical harvesting of vetch seed possiple when vetch sown at 10- 40 kg/ ha and oats at 100-

130 kg / ha . Vetch grow better and had more branches , pods and higher seed weight when sown at the lower rates. Oats grow better if associated with vetch , but tended lodge more and yield less grain .

In Iraq , Tubaileh (1977) found that mixing wollypod , narbon and chickling vetchs with either barley or oat caused insignificant increase in the height of barley and oat plants .

In Western Australia , Willy and Holiday (1977) studied the plant population , shading and thining in wheat . They obtained the maximum grain yield at 300 plants per square meter increased with plant density over the whole range , and that above 300 plants per square meter the decline in grain yield resulted from a reduction in grains per ear and weight per grain.

Later on , in Canada , Johnston et al showed that lodging of the small grain species was increased by an increasing percentage of peas in the mixture of barley , wheat or oats with peas . They added that larger pea seed was produced with decreasing pea populations .

Sullivan and Routley (1955), in Pennsylvania stated that early maturity orchardgrass plants were higher in percentage protein than late plants when all were harvested at a comparable stage of maturity . A high significant correlation $r = -0.86$ was obtained between the percentage protein of 29 individual orchardgrass plants at the emerged stage and the

date of harvest , independently of leafiness or chemical composition . Their equation for this relationship is $\hat{Y}$ (digestible dry matter). $= 85.0 - .48 x$ (days elapsed from April 30 to cutting).

Sosulski et al (1960) showed that leafiness is greatly considered to be an important factor in hay platability, quality and commercial value . Percentage leaf in grass varies greatly with stage of growth .

Minson et al (1960) found that organic matter digestibility dropped approximately 0.5 % per day after heading commenced .

Austeason (1963) found that the first harvest yields of orchardgrass , perennial ryegrass, tall fescue and timothy increased at nearly uniform rate up to full bloom and rose relatively little after that . Leaf percentage dropped rapidly as the plants developed to heading and full bloom. The correlation between percent of leaf and yield of dry matter was .89 . The correlation of protein with leaf percentage was .96 and the lignin leaf correlation was - .94 . Also , he found that digestibilities based on leafiness and chemical composition agreed closely in most instances .

Raymond (1969), stated that digestibility is usually high for young herbage and declines as the plants mature . For any one specie, leaf blades usually have higher digestibility than stems .

Mclover et al (1973), studied the changes in herbage production and quality of subterranian clover and annual ryegrass . He found that leaf % made the highest proportion at flowering stage followed by stem , the opposite trend was observed at maturity stage. The leaves contained the highest nitrogen content at both stages of growth .

nitrogen , improving soil structure and infiltration and greatly reducing the disease and weed problems in subsequent cereal crops . These advantages were stated also by Geytenbeek (1974) and Leeuwrick (1974).

Carter (1974) showed that increment of soil nitrogen from grazed leguminous pastures in South Australia, based on an assumed net input averaging 70 Kg / ha. He added that under south Australian conditions net nitrogen fixation frequently exceeds 100 Kg nitrogen / ha / annum or 3 to 4 Kg N/ Kg P_2 05 applied, especially in the higher -rainfall areas . This nitrogen is utilized by crops in the cereal rotation .

On an experimeat conducted by Auderson (1975) Vicia species were grown alone , or with oats , in a continuous cropping system for summer grazing . Ten cultivars were selected from the species (V. atropura ,V. dasycarpa , V. sativa and V. articulata.). Six month old sheep gained weight and these live weight gains were positively correlated with the yield of vetch dry matter . The yield of oats was significantly correlated in both 1970 and 1971 with the 1969 vetch yield.

Bakir (1967) has conducted series of experiments in Western Transition Zone of Turkey where the annual legumes-fenugreek (Trigonella foenum-graecum), Hangarian vetch (Vicia pannonica) , hairy vetch (Vicia villosa), black medic (Medicago lupuline), common vetch (Vicia sativa) and field pea (Pisum

arvense) were sown in mixtures with oats (Avena Sativa ,), barley (Hordeum vulgare) and rye (Secale cereale) as forage crops in the fallow year in rotation with wheat and barley . The results showd clearly that it was possible to grow small grain and annual - legume forage crop mixture without reducing the yield of the following wheat or barley grain crop. In fact, in three separate locations the most promising small-grain / legume mixture was rye plus field peas which averaged 2327 kg dry matter / ha and was considered to increase net income by US $ 30 to 50 /ha above the traditional wheat fallow system .

Alinoglu (1977) has conducted experiments using annual legumes (Vicia sativa , Vicia narbonensis and Pisum arvense in pure stands or mixed with oats have shown that wheat yield followed these crops increased and hay yields of 2 to 3 tons/ ha were obtained .

Mitchell and Teel (1977) compared no-tillage mulches of rye-oats and rye and oat mixtures with hairy vetch and crimson clover . They reported that corn growth without nitrogen fertilizer in mulches containing legumes yielded as high as corn grown in rye and oat mulces fertilized with 112 kg nitrogen/ha.

Blevins (1980) studied the use of annual legumes as winter cover for no-till corn . He estimated that hairy vetch will supply approximately 90 kg nitrogen / ha to no-tillage corn .

Recently , results from a grazing experiment conducted by ICARDA (1983) showed that over 200 kg live weight can be gained per hactare can be acheved from forage vetch.

Part I

SOCIO - ECONOMIC STUDY OF SHEEP PRODUCTION IN MADABA DISTRICT (1983 - 84) .

MATERIALS AND METHODS

The total number of sheep owners in the Madaba District was (440). They have (81600) sheep in all villages of the District in March 1984 as shown in table (3). The average size of sheep flocks were (185) sheep per owner.

A systematic stratified random sample with a sample fraction was drawn . The size of the sample was (74) sheep owners who constitute 17 percentage of owners . The distribution of sheep owners by villages and the flock size were taken into account in designing the sampling procedure . The distribution of sheep owners by villages and percentage allocated to the villages in the sample is shown in table (4). The number of sheep owners selected in the sample were allocated in percentage to the size groups as shown in table (5).

Farmers were interviewed during the months of March, April and May of 1984 using the questionnaire in Appendix (A). This questionare was administrated to study the following aspects:-

- General socio-economic status of the sheep owners.
- Size and utilization of the land.
- Pattern of cropping rotations .
- Livestock population and the flock size and structure.
- Selection of Sheep .
- Grazing and supplementary feeding.

— Sheep breeding .

— Production of lamb, milk and wool.

— Culling of sheep.

— Animel health and veterinary .

— Credit .

— Extending of the existing flock.

— Management of the flock .

— Problems .

The objective of this part of the research was to study the socio-economic factors which affect the sheep production in Madaba District .

Table 3 :

Number of sheep owners and number of sheep in Madaba District during the 1983 / 1984 season.

Village	No. of sheep owners x	No. of sheep	Average size
Netil	8	1,750	218.75
Bany Hamedah	26	2,345	90.19
Um Kseir	7	700	100.00
Huwarah	4	500	125.00
Kudeir	17	3,550	208.82
Kfeir Elwakhian	8	800	100.00
Um Elwaled	33	8,435	255.61
Greinah	24	1,285	53.54
Ma'in	19	4,310	226.84
Hisban	21	1,970	93.81
M'shaqar	22	3,115	141.59
Mureijmah	33	7,500	227.27
Manja	14	5,050	360.71
Jalul	6	1,950	325.00
Um Rummaneh	13	6,050	465.38
Thiban	83	12,005	144.64
Um Elrasas	36	9,055	251.53
Zetouneh	48	4,460	92.92
Madaba	18	6,770	376.11
Total	440	81,600	

x Source : Jordan Cooperative Organization (JCO)
- Project Department Records.

Table 4 :

Distribution of sheep owners by villages and percentage allocated to the village in the sample.

Village	No.of sheep owners	Percentage	No.ofselected owners	Percentage
Netil	8[x]	1.82	1	1.35
Bani Hamedah	26	5.91	4	5.41
Um kseir	7	1.59	1	1.35
Huwarah	4	.91	1	1.35
Kudeir	17	3.86	3	4.05
Kfeir Elwakhian	8	1.82	1	1.35
Um Elwaled	33	7.50	6	8.11
Greinah	24	5.46	4	5.41
Ma'in	19	4.32	3	4.05
Hisban	21	4.77	4	5.41
M'shaqar	22	5.00	4	5.41
Mureijmeh	33	7.50	6	8.11
Manja	14	3.18	2	2.70
Jelul	6	1.36	1	1.35
Um Rumaneh	13	2.96	2	2.70
Thiban	83	18.86	14	18.92
Um Elrasas	36	8.18	6	8.11
Zetouneh	48	10.91	8	10.81
Madaba	18	4.09	3	4.05
Total	440	100.00	74	100.00

x Source : Jordan Cooperative Organization -Projects Department Records.

Table 5 :

Distribution of sheep owners by size groups and percentage allocated to the village in the sample.

Size of Holdings	No. of sheep owners	Percentage	No. of selected owners in the sample	Percentage
1 - 50	92	20.90	15	20.27
51 -100	86	19.54	14	18.92
101 -150	61	13.86	10	13.51
151 -200	60	13.64	10	13.51
201 -250	27	6.14	5	6.76
251 -300	36	8.18	6	8.11
301 -350	12	2.73	2	2.70
351 -400	22	5.00	4	5.41
401 -450	5	1.14	1	1.35
451 -500	15	3.41	3	4.06
501 -550	7	1.59	1	1.35
551 -600	5	1.14	1	1.35
601 -650	5	1.14	1	1.35
651 -700	7	1.59	1	1.35
Totals	440	100.00	74	100.00

RESULTS

Socio Economic Status of the Farmers :

Farmers surveyed were on the average (50) years old . (Table 6) . They had relatively large families averaged to 8 persons (4.08 males and 3.92 females),(Table 7). 51 % of the families members aged 1 to 15 years old (Table 8). They are experienced in farming with an average of more than 22 years , while 63.5 % of them have more than 20 years of experience . It was found that 59.5 % of them can read and write . 52 owners (70%) are members of agricultural cooporatives .

Table 6 :

Age of Sheep owners in the sample.

Age Groups	Sheep Owners Frequency	Percentage
21 - 30 Years	5	6.8
31 - 40	12	16.2
41 - 50	17	23.0
51 - 60	23	31.0
61 - 70	17	23.0
Total	74	100.0

Table 7 :

Sheep owners family size in the sample .

Number of Persons groups	Sheep Owners Ferquency	Percentage
1 - 5	24	32.4
6 - 10	31	41.9
11 - 15	15	20.3
16 - 20	4	5.4
Total	74	100.0

Size and Utilization of the Land :

Only 30 farmers who constitute 40 % of the sheep owners have rights of land use . Among these farmers , there were 11 owners , 8 share croppers , 6 tenants and 5 mixed . The average cultivated area was 51 dunnms as shown in table 10 . 83 % of the farmers cultivate field crops , and only 7 % had grown olive trees. 72 % of the farmers apply continuons cropping pattern and only 28 % use the wheat- fallow crop rotation as can be seen in table 11 .

Table 10 :

Status of sheep owners as farmers and size of holdings in the sample.

Status of Farmers	No.of Farmers	Average area/du
Owners	11	64
Share Cropper	8	52
Tenants	6	40
Mixed	5	33
Total	30 Average	51

Table 11 :

Pattern of crop rotation in the sample .

Crop Rotation	No. of Farmers	Percentage
Cereals-fallow	7	28
Cereals-forage legumes	8	32
Cereals-summer crops	5	20
Cereals-food legumes	3	12
Cereals-forage legumes-summer crops	2	8
Total	25	100

Buildings and Equipment :

The sheep farm comprises a barn with an area of 150 to 300 square meters , a feed store of 20 to 30 square meters and a sheep holding pen of 1 to 3 dunums . Sheep farming equipment include feeders , water systems and milk utensils.

Flock Size and Structure :

Sheep flocks have the highest priority of all livestock enterprises.

Among sheep owners in Madaba District , 20 owners breed local goats , 10 owners breed shami goats and 7 owners raise cattle. The structure of sheep and goats flocks are shown in table (12) and (13).

Table 12 :

Sheep flock structure.

Type	Number	Percentage
Rams	8	4.32
Fertile ewes	114	57.08
Yearling	36	24.00
Lambs	27	14.60
Total	185	100.00

Table 13 :

Goats flock structure .

Type	Number	Percentage
Bucks	3	6.00
Goats	30	60.00
Kids	17	34.00
Total	50	100.00

Selection of Sheep :

Stock selected should be productive and have valuable heritable characteristics . Rams are usually selected from owners flocks but are sometimes brought from the market . Sheep breeders in the Madaba District like rams to be selected from known progeny , have large frame , productive , 2 to 3 years old and healthy . Ewes are usually selected from owners flocks . Characteristics which affected ewe productivity were : known progeny , body condition , age and the production of milk , lambs and wool of the mother . Selection characteristics are shown in tables (14) and (15).

Table 14 :

Rams selection criteria by farmers in the sample.

Major Selection Criteria	Sheep Owners Frequency	Percentage
- Known progeny	71	95.9
- Large frame	58	78.4
- Production	47	63.5
- 2 - 3 Years age	37	50.0
- Healthy	26	35.1

Table 15 :

Ewes selection criteria by farmers in the sample .

Major Selection Criteria	Sheep Owners Frequency	Percentage
- Known progeny	70	94.6
- Good body condition	64	68.5
- 1 - 2 Years age	58	78.4
- Milk production of mother	58	78.4
- Lambing production of mother	53	71.6
- Wool production of mother	37	50.0

Grazing :

Grazing usually takes place from December until June either in the steppe cultivated areas or after moving to the higher rainfall cropped areas. Sheep graze grass during winter and spring, cereal stubbels and crop residues at summer season. Natural grazing areas include unutilized lands , marginal lands, hilly areas with slopes and steepe areas. Sheep on average walk 3 to 10 Km daily for grazing and some times more than that.All sheep owners interviewed had difficulties in finding available range forage as shown from the grazing period (Table 16). Average period was 196 days. Because of the shortage of feed availability on range areas, sheep owner tend to rent lands sown to forage crops and pay up to 10 JD for the standing crop which will be grazed after renting .

Table 16

Annual grazing period (days)

Grazing Period (days)	Sheep flocks Frequency	Percentage
121 - 150	8	10.81
151 - 180	19	25.68
181 - 210	23	31.08
211 - 240	16	21.62
241 - 270	8	10.81
Total	74	100.00

Supplementary Feeding :

Supplementary feeding may begin in October and continue till March depending on the season . Sheep and goats receive supplements of barley, wheat bran lentil and cereal straws (tibin) which could be produced on the farm or purchased with other fodders from cooperatives and local markets. 55 % of the interviewed sheep oweners give supplements to pregrant ewes, they also provide the supplements to ewes after parturition but only 20 % of sheep owners add salt , vitamins and minerals supplements as shown in table 17 . The average prices paid by sheep owners to buy fodder crops are shown in table 18.

Watering the sheep

In summer and autumn , farmers obtain water by water tanks . The annual cost of watering sheep is about 1 to 1.3 JD / head .

Table 17 :

The addition of supplements to the sheep feed.

The use of Supplements	Farmes applying it		Farmers not applying it		Total	
	No.	%	No.	%	No.	%
- Provided to pregnant ewes and at parturation	41	55.4	33	44.6	74	100
- Add salt, vitamins and mineral supplements to the feed	15	20.3	59	79.7	74	100

Table 18

The average annual prices of fodder crops (JD / ton) as paid by the interviewed farmers .

Fodder crop	Price	Fodder crop	Price
Barley	72	Maize	70
Common vetch	110	Bitter vetch	97
White tibin	50	Red tibin	55
Bran	57	Green fodder (cereals-forages mixture).	70

Lambing :

The breeding season for Awassi sheep in Jordan ranges between June and August . The method of mating is natural and no A I is used . Parturation extends from October to January as shown in table 19 It was found that the fertility among the flocks range from 60 to 90 % with an average of 76% as shown in table 19 . Lambing ewes percentage was 85. Ewe lambing time is shown in table20 The age of ewes at first lambing was 2 years . The weaning age of lambs in Madaba District ranges from 2 to 5 months.

Table 19 :

Fertility percent in the sheep flocks.

Class Interval %	No. of flocks	Percentage
61 - 65	7	9.46
66 - 70	12	16.22
71 - 75	15	20.27
76 - 80	18	24.32
81 - 85	14	18.92
86 - 90	8	10.81
Total	74	100.00

Table 20 :

Ewe lambing time.

Month	Percentage ewe lambed
October	5
November	8
December	35
January	32
February	9
March	5
April - September	6
Total	100

The owners sell their lambs to livestock merchants, butchers or take their sheep to regional markets. The selling price of lambs range between 1.050 to 1.200 JD / kg live weight . The number of lambs sold varies from 50 to 90 % of the total lambs and averaged to 70%; a small rate of 3 to 5 % was consumed by the family . The rest was kept as replacements for culled sheep .

Table 22 :

Milk production per awassi ewe (kgs / year).

Class intervals (kgs)	No. of flocks	Percentage
51 - 60	15	20.27
61 - 70	17	22.97
71 - 80	21	28.38
81 - 90	12	16.22
91 - 100	9	12.16
Total	74	100.00

Wool Production :

Shearing takes place from May to June by using hand clippers by 88% of the farmers . The rest of farmers use electrical equipment . Some wool is kept for home use and more than 90 % is sold in the market. The annual production per animal is about 1.1 kg . The cost of shearing is about .30 to .40 JD / head.

Table 23

Culling of rams in the sample .

Reason for culling	Farmers Frequency	Percentage
Aged rams	67	90.0
The need of cash	63	85.1
Shortage of feed	48	64.9
Low productivity	36	48.6
Low progeny	30	41.0

Table 24

Culling of ewes in the sample.

Reason for culling	Farmers Frequency	Percentage
The need of cash	70	95.0
Aged ewes	63	85.1
Shortage of feed	68	91.9
Low milk production	55	74.3
Sheep faild to lamb	53	71.6
Sick and weak ewes	48	64.9

Herding Practices :

Herding practices depend primarily on flock size and agricultural production in the farming area and range. Three main practices can be identified as shown in table 25.

1. The sheep owner himself , or one of his family, herd the sheep . This practice applies to flocks of all sizes. 22 owners in the sample studied came under this category .
2. Farmers keeping low than 50 sheep cann't justify paying a shepherd to manage their flock . Their sheep join a big flock during the day and return to their respective owners at night . 40 % of the farmers interviewed came under this category .
3. Large flocks are herded by a hired shepherd . 29.7%of owners interviewed came under this catagory.

A shepherd is employed to herd sheep , particularly when they are grazing. He is paid 80 to 90 JD monthly , and also provided with food , clothing and tobacco, or payed 100 - 110 JD without any supply.

Women play an important role in the management of the flock; they milk the sheep and prepare the milk products.

Table 25

Herding practices of sheep flocks by farmers in the sample.

Herding Practices	Farmers	
	Frequency	Percentage
- The owner herd the flock.	22	29.7
- The farmer's flock joins a big flock	30	40.6
- Herded by hired Shepherd.	22	29.7
Total	74	100.0

Finance :

Most of the farmers don't have sufficient money needed for sheep production. 85 % of the owners have obtained loans from the JCO and ACC to buy their sheep and feed supplements . The loans ranged from 500 to 5000 JDs.

Problems :

All the farmers interviewed , in the sample, claimed that they had different problems which affected their sheep production . The most important problems were:

1. Shortage of feed :

All of the interviewed farmers showed that the range

Table 26 :

Problems facing the farmers in sheep breeding.

Problems	Farmers	
	Number	Percentage
- Shortage of feed	74	100.0
- Financial difficulties	44	59.5
- Shortage of water	40	54.0
- Shortage of shepherds	37	50.0

Extending the existing flock :

From the 74 owners interviewed 47 showed that they like to extend their existing flocks, while 27 owners showed that they were not able to breed more sheep than they owned due to different reasons . (Tables 27 and 28).

The resons behind extending the sheep flocks were as followes :-

1. Increasing the family income :-

   44 owners showed that they invested their money in sheep breeding aiming at increasing their incomes from selling sheep products to improve their standards of living .

2. Owning the sheep as a custom : -

   30 sheep owners considered owning the sheep as a custom . They like to practice the sheep management activities to increase the number of their sheep.

3. Provide the family with fresh sheep products :-

   27 owners liked to own some sheep to provide the family with fresh animal products at low costs all over the year .

The sheep owners who were not able to extend their existing flocks gave these reasons :-

1. Financial difficulties :

24 owner didn't have sufficient funds to build more stores and sheep yards needed to breed increased numbers of sheep .

2. Feeding sheep is costly :

22 owners claimed that there was a shortage of feed supplements in the market and feeding sheep was costly , resulting in a reduction of their income from breeding the sheep .

3. Management problems :

12 owners declared that they couldn't manage large flocks because they were old, their children selected other jobs and skilled labour was also not available in most cases.

Table 27 :

Number of farmers , in the sample, who were or were not able to extend their sheep flocks.

Extending the flock	No. of farmers	Percentage
- Desire to extend the flock.	47	63.5
- Not able to extend the flock.	27	36.5
Total	74	100.0

Table 28 :

Reasons why farmers , in the sample, were willing or unwilling to extend their sheep flocks.

Reasons for	No. of farmers
- Extending the flock	
- Increase family income	44
- Owning of sheep as a custom	30
- To provide the family with fresh diary products	27
- Not extending the flock	
- Financial difficulties	24
- Feeding problems	22
- Management problems	12

DISCUSSION AND CONCLUSION

Ruminants such as sheep , goats and cattle are raised by farmers in Jordan . The awassi sheep is considered as a good breed that produces meat , milk and wool under rainfed conditions . This breed is widely distributed in Madaba District.

Farmers surveyed were on the average 50 years old , had relatively large families average to (8) persons and average 22 years experience.

One of the most important problems facing farmers is that of obtaining sufficent feed . Only 40 percentage of the sheep owners utilize land, averaged at 51 dunums , for growing cereals and forage crops. Therefore there was no integration between crop and livestock production . The range condition is deteriorating due to overgrazing and due to conversion of marginal land into horticulture and forestry . (These problems also were reported by Harb, 1982). Therefore the grazing period was limited and adversly affected the milk production.

An important problem was the shortage of money needed to buy more sheep and feed. The cost of feed ranged from 6 to 10 JD / head depending on the season and range conditions . Few farmers paid more money to increase the amount of feed provided to the ewes and to improve the diet by the addition of vitamins and minerals resulting in higher production of lambs and milk.

Another problem is the shortage of water in summer which resulted in increased production costs through the difficulties of obtaining water from greater distances.

Inspite of these problems , sheep production is economically viable . Net income is estimated at 23.725 JD per head as shown in table (29). However this income is low due to the low productivity of the sheep when compared with the productivity obtained at the khanasri station of the MOA. (Table 30). The low productivity was also reported by Duayfi (1974) , Harb (1982) and Al shakh (1982) .

Table 29 :

Costs[x] and Returns of Sheep Production of 185 sheep .

Capital Investment	JD
- Buildings	5,000.000
- Feeders	520.000
- Water System	500.000
- Ewes	8,500.000
- Rams	1,200.000
Total	15,720.000
Fixed Costs	
- Depreciation on buildings	150.000
- Depreciation on equipment	102.000
Total	252.000
Running Costs	
- Feed	1.698.350
- Water	185.000
- Medicine	69.750
- Shearing	69.750
- Ram replacement	240.000
- Herding	660.000
Total	2,922.850
Annual Costs	3,174.850.

Returns	JD
- Lamb Production	3,630.000
- Milk Production	2,628.000
- Wool Production	192.450
- Manure Production	92.500
- Culled Ewes	1,360.000
- Culled Rams	135.000
Gross Returns	8,037.950
- Annual Cost	3,174.850
Gross Income	4,863.100
Annual Debt	484.000
Net Family Income	4,379.100

x
Assumptions

The following assumptions were made depending on the data obtained from the results.

1. Base flock size 185 heads of sheep made up of 170 ewes and 15 rams. The costs were 50 JD / ewe and 80 JD / ram.
2. Buildings costs for 500 m^2 was estimated by 10 JD / m^2 .
3. Equipment include 13 feeders bought at 40 JD / feeder and a water system costs at 500 JD.
4. Annual depreciation was estimated at 3 % for buildings and 10 % for equipment.
5. All sheep receive hand feeding at a rate of $\frac{1}{2}$ Kg barley : bran mixture for 5.5 months.
6. Water cost was 1 JD / head .
7. Medicin cost was estimated by .35 JD / head.
8. Shearing cost was estiated by .35 JD / head.
9. Ram replacement was 20% bought at 80 JD / ram. Ewes replacement was from the owner flock.
10. Herding time was estimated for 6 months.
11. Lambing percentage was 85 equals to 144 lambs. 34 lambs were kept as a replacement to culled sheep and 110 lambs were sold at 30 kgs live weight and by 1.1 JD / Kg.

Table (30) :

A comparison of sheep production in the sample with that obtained at the Khanasri Station of the **MoA** .

Production Criteria	Resource The Sample	Khanasri Station
- Weight of lambs (Kg)		x
- at birth		
- female	4.0	5.3
- male	4.4	5.7
- at weaning		
- famale	14.2	24.0
- male	16.1	26.4
- Annual milk production Kg / ewe	76.0	100.0
- Annual wool production Kg / head	1.1	1.4

Source : Department of Animal Production and Health - MoA

12. Milk production was estimated at 76 Kg/ewe , lactation ewes percentage was 85% equals to 144 ewes.

13. Annual wool production was 1.1 Kg / head sold at .70 JD / head.

14. Manure was estimated at .5 JD / head.

15. Culled rams were sold at 45 JD / ram, and culled ewes were sold at 40 JD / ewe, culling rate was 20%.

16. Average annual debt was estimated at 484 JD on a credit of 2000 JD obtained at an interest of 7 % to be repaid at 5 years installments.

17. Family income include the return of family labour and money invested from family fund.

Therefore the selection of productive sheep is important . Increasing of the percent of fertile ewes could increase the lamb and milk production.

The data collected from the sample showed that most of the farmers (77.8 %) depend on shepherd to herd their flocks. There is a shortage of skilled shepherds, but this can be compensated by expatriate labour. Members of large families could help in looking after the sheep and increasing the flock size . Farmers are advised to be organized in cooperative societies to obtain the credit , feed and different survices at low prices and to gain more experience.

Owing to the above mentioned problems, the number of sheep in Madaba District is increasing slightly while the number of goats was doubled in 1980 and counted for 15000 heads in 1984 (Table 31). Solving of these problems will result in increasing the number of sheep , and their productivity .

The various management practices that are worth consideration in order to increase sheep production should include the following :-

1. The development of new farming systems by the introduction of improved forage legumes that are adapted to the rainfed areas . This will enhance the integration of crop and livestock production aimed at increasing the farmers income and increasing soil fertility.
2. Adjusting the stocking rate to provide a balance between available forage and the number of sheep to be supported.
3. A planned program of selection of superior sheep for the improvement of sheep flocks should be followed.
4. Organization of new sheep production and range improvement cooperatives to protect and improve the range lands by providing credit, supplying feed in times of shortage to prevent overgrazing and provision of low costs watering points .
5. The improvement of sheep diets to obtain better results of lamb, milk and wool production.

Table 31 :

Sheep and goats in Madaba District .

Year	No. of sheep	No. of goats	Total	Annual Change from1976 in %
	x	x		
1976	57,200	8,000	65,200	-
1977	56,800	7,500	64,300	- 1.4
1978	57,000	7,000	64,000	- 1.9
1979	57,000	7,000	64,000	- 1.9
1980	66,000	14,000	80,000	+ 22.7
1981	67,000	14,000	81,000	+ 24.2
1982	55,000	15.000	70,000	+ 7.4
1983	50,000	15.000	65,000	- 0.3

x Source : Department of Animal Production and Health - MoA (Annual Reports).

SUMMARY

This part of the research was conducted to study the socio-economic factors affecting sheep production in the Madaba District . Farmers surveyed were on the average (50) years old, had relatively large families , average to 8 persons. Of these farmers 59.5 % can read and write and 70 % are members of agricultural cooperatives .

The majority of the sheep are owned by small farmers, 73 % of the farmers own less than 250 sheep with average flock size 185 heads. Sheep and goats are fed together on natural range and forage crops grown by the farmers in the area. 40% of the farmers cultivate land averaging 51 dunums with forages and cereals to provide some feed for their sheep.

The data collected showed a low production of milk , meat and wool due to the deterioration of obtaining sufficient water and the shortage of shepherds and skilled labour. Also bad management practices such as the weak of pre and post supplementary feeding of ewes , keeping a flock with a low percent of fertile ewes , and the low interest of sheep health.

Inspite of these problems , the raising of sheep is profitable enterprises due to the high prices of local awassi meat . The net income from breeding 185 sheep is about JD 4389 or JD 23.7 per head . Most of the farmers like to increase

their flock size but the sheep population was slightly increasing due to the abovementioned problems . The following management practices are recommended to improve the sheep production in Madaba District .

1. Adjusting the number of grazing livestock to provide a balance between available forage and the number of livestock to be supported .
2. The devlopment of new farming system by the introduction of improved forage legumes that are adapted to the rainfed areas to enhance the integration of crop and livestock production aiming at increasing the farmers income and increasing the soil fertility .
3. Providing stock with water at nearest locations and in sufficient amounts .
4. A planned program of selection of superior animals for the improvement of sheep flocks should be followed .
5. Organizing of new sheep breeding and range cooperatives in the steppe areas to protect and improve the range lands by providing credit , feedstuffs and water , at low cost .
6. The increase of farmers interest on animal health by spending more money on prevention sheep health .

Part II

PRODUCTION OF FORAGE CROPS UNDER RAINFED CONDITIONS OF MADABA DISTRICT .

MATERIALS AND METHODS

A field experiment was conducted under rainfed conditions in the Madaba District at M'shaqar (1982/1983).

The Madaba District is located in the central part of Jordan at 31° 43 north latitude and 30° 48 east longitude with 785 meters elevation, and an average annual rainfall of 338 mm for the period from (1966 - 1980).

The location was under legume-cereal crop rotation .

The crops used were 6 pure stands and 3 mixtures as follows:-

1. Wheat (Triticum durum : hourani).
2. Lentils (lens culinaris).
3. Chick peas (Cicer arietinum).
4. Common Vetch (Vicia Sativa L.).
5. Bitter Vetch (Vicia ervilia).
6. Medic mixture consists of the following Proportions:-

   Snail medic : Midicago Scutellata : Robinson, 4 Proportions.

   Barril medic : Midicago truncatula : Cyprus, 2 Proportions.

   Barril medic : Midicago truncatula : Jemalong, 4 Proportions .

   Strand medic: Midicago littoralis : Harbinger, 1 Proportion .

7. Wheat-medic mixture.

8. Wheat-common vetch mixture .

9. Wheat-bitter vetch mixture .

Seeds of wheat, lentils , chickpeas and bitter vetch were obtained locally, while common vetch was obtained from Turkey, and medic cultivars were obtained from Australia.

The Randomized complete block design (R C B D) with four blocks was used ; each block was divided into nine equal plots . The dimentions of each plot were 9 x 20 meters, and they consist of 45 lines at 18 cm apart. The alley between the plots was one meter wide, and the blocks were seperated by 9 meters . Seeds and fertilizer were sown on December 19th , 1982 by using an Australian combine drill . The Fertilizer used were 10 kg/du of triple super phosphate (47.5% P_2O_5). A light cover harrow was pulled behind the seed drill to cover the seeds.

The seeding rates used for all crops were as follows:-

1. Pure stands : 12 kg /du for wheat, common vetch , and bitter vetch, 8 kg /du for lentils and chickpeas and 2 kg /du for medics.

2. Mixtures :-

4 kgs wheat to 2 kgs medic for wheat-medic mixture and 4 kg wheat to 8 kgs of common vetch or bitter vetch for wheat-vetch mixtures. Medic seed was inoculated with a commerical strain of rhizobia (c c 169) and lime coated.

Five samples, at random,of forage crops and mixtures were clipped by hand using a handsickle five cm height from the soil surface. The size of each sample was 2 x .36 meters. Each sample , then, was kept in a plastic bag.

For the potanical composition, the samples were seperated by hand into its componants namely, wheat and legumes. Drying was carried out in a ventilated oven for 36 hours at 75° C. Then each componant was weighed by Mettler balance.

Other five random samples also were taken from different places within each plot at full maturity stage and weighed.

Grains of wheat, lentils and chickpeas were seperated into grains and straw by hand.

The following traits were recorded:-

1. Biological yield (kg / ha) : total vegetative groth above the ground.
2. Grain yield (kg / ha) : the grains of each crop were cleaned and weighed.

3. Straw yield (kg/ha): calculated by substracting item 2 from 1 .

Moreover , at full maturity , 10 single plants , at random , were labeled and the following characteristics were studied :-

- Plant weight .
- Plant height (cm) .
- Seeds weight per plant (g) .
- Straw weight per plant (g) .
- Total number of seeds per plant .
- Number of pods or spikes per plant .
- Number of seeds per pod or kernels per spike .
- Weight of one thousand seeds (g) .

Besides , an evaluation of costs and returns was made to show the economic returns of :

a- Producing and utilizing the green forage .

b- Producing and utilizing of grains and straw of forage crops , wheat , lentils and chickpeas .

Table 32

Production of forage legumes , wheat and total dry matter production obtained from growing forage legumes crops as pure stands and in mixtures with wheat and studied at pod formation stage at M'shaqar location during the 82 / 83 growing season.

Crops	Production (t / ha) Total	Forage legumes	Wheat
pure Stands	x	x	x
Medic	3.57 d	3.57 a	-
Common Vetch	2.44 f	2.44 c	-
Bitter Vetch	3.30 e	3.30 b	-
Wheat	2.49 f	-	2.49 a
Mixed With wheat			
Medic	4.41 a	2.09 a	2.32 a
Common Vetch	3.83 c	1.46 e	2.37 a
Bitter Vetch	4.14 b	2.03 d	2.11 b

x Means Within a column followed by the same letter do not differ at the .5 level of probability according to Duncan's Multiple Range Test (DMRT).

The green forage produced at pod formation stage , could be utilized as follows :

a- If the farmer own a sheep flock , the green forage could be used to feed the sheep and lambs . The costs and returns of fattening lambs are shown in table 33 . The assumptioms of this case were :

- All the production expenses were calculated as fixed by the JCO machinery station at M'shaqar .
- Lambs were bought at weight of 20 kgs in average at 1.1 JD/kg .
- Lambs were fattened on the standing crop for 60 days .
- The average daily increase in weight was 250 grams .
- The feed produced was sufficient to fatten 2 lambs fed with the pure stand of common vetch ; 3 lambs fed with the pure stand of medic , bitter vetch or the mixture common vetch-wheat or bitter vetch-wheat . The price per kg of extra forage was estimated at JD .065 to be used for sheep grazing .
- A shephered was employed for 2 months to look after a flock of 50 lambs for a monthly wage of 125 JD .
- The cost of veterinary and water was estimated at 1 JD per lamb .
- Mortality among lambs was estimated at 5 % .
- The cartage cost was estimated at .200 JD per lamb .

It can be seen from table 33 that mixtures produced higher incomes than the pure stands . The highest income was produced from the bitter vetch-wheat mixture .

Table 33

Costs and returns of forage crops and mixtures harvested at pod formation stage and utilized in lamb fattening during the 82 / 83 growing season.

Income and expenses (JDs)	Pure Stands			Mixtures with Wheat		
	Medic	Common vetch	Bitter vetch	Medic	Common vetch	Bitter vetch
Sale of lambs	115.50	77.00	115.50	154.00	115.50	154.00
Extra feed	2.85	2.20	1.50	2.05	1.50	.70
Gross income	118.35	79.20	117.00	156.05	117.00	154.70
Annual Expenses						
Forage Prod.						
-2 cultivations	.80	.80	.80	.80	.80	.80
- forage seeds	2.40	1.20	1.20	2.40	.80	.72
- wheat seeds	-	-	-	.42	.42	.42
- harrowing	.10	.10	.10	.10	.10	.10
- fertilizer	1.05	1.05	1.05	1.05	1.05	1.05
- interest	.30	.22	.22	.34	.22	.21
Lamb Prod.						
- buy of lambs	66.00	44.00	66.00	88.00	66.00	88.00
- labour's wage	7.50	5.00	7.50	10.00	7.50	10.00
- veterinary and water	1.50	1.00	1.50	2.00	1.50	2.00
- mortality	3.30	2.20	3.30	4.40	3.30	4.40
- cartage	.60	.40	.60	.80	.60	.80
- interest	1.90	.98	1.90	1.96	1.90	1.96
Total expenses	85.45	56.95	84.17	112.27	84.19	110.46
Family income	32.90	22.25	32.83	43.78	32.81	44.24

b) If farmer didn't own any sheep, the green forage could be baled and sold to sheep owners to be used in dry months during late summer and Autumn. The assumptions of this case were as follows :

- All the production expenses were estimated as fixed by the machinery station of the JCO at M'shaqar.
- A bale weight 17 kgs in average , bailing costs was .65 JD per bale ; cartage was estimated at .200 JD / bale.
- The extra feed after bailing was left for grazing at 2 JD /du.

Table 34 shows that the highest income was obtained from the bitter vetch-wheat mixture , while the lowest income was obtained from the pure stand of common vetch .

Table 34

Costs and returns of forage crops and mixtures harvested at pod formation stage and utilized in the forms of bales during the 1982 /1983 growing season (JD / du).

Income and Expenses (JD)	Pure stands			Mixtures with wheat		
	Medic	Common vetch	Bitter vetch	Medic	Common vetch	Bitter vetch
-Sales of bales	28.56	19.04	25.84	34.00	29.92	32.64
- Sheep grazing	2.00	2.00	2.00	2.00	2.00	2.00
- Gross Income	30.56	21.04	27.84	36.00	31.92	34.64
Annual Costs						
- 2 Clutivetions	.80	.80	.80	.80	.80	.80
- Forage seeds	2.40	1.20	1.20	2.40	.80	.72
- Wheat seeds	-	-	-	.42	.42	.42
- Harrowing	.10	.10	.10	.10	.10	.10
- Fertilzer	1.05	1.05	1.05	1.05	1.05	1.05
- Mowing and raking	1.10	1.10	1.10	1.10	1.10	1.10
- Baling	1.37	.91	1.24	1.62	1.43	1.56
- Cartage	4.20	2.80	3.80	5.00	4.40	4.80
- Interest	.77	.56	.65	.88	.91	.74
Total costs	11.79	8.52	9.94	13.37	10.81	11.69
Family Income	18.77	12.92	17.90	22.63	21.11	23.35

I. B. Full Maturity Stage

The data , at full maturity stage, are presented in tables 32 and 33. The data indicate that there were significant differences between the pure stands crops and the mixtures in the total yield . The highest value was obtained from medic-wheat mixture while the lowest yield was obtained from the common vetch in pure stand.(Table 32).Meanwhile the bitter vetch and medic in mixtures significantly produced higher yields than the common vetch , the wheat as pure stand outyielded the wheat production in mixtures , however not all the differences were significant . (Table 35) . The highest value of seed production, among the pure stands , was obtained from wheat, followed by the bitter vetch while the lowest yield was obtained from the common vetch. Table 35 shows that the highest value of straw production was obtained from the bitter vetch , followed by the medic while the lowest yield was obtained from the common-vetch (Table 35).

Table 35

Production of forage legumes , wheat and total dry matter production obtained from growing forage legumes crops as pure stands and in mixtures with wheat and studied at full maturity stage at M'shsqar location during the 1982 /1983 growing season.

Crops	Production (t / ha) Totals	Forage legumes	Wheat
Pure Stands	x		
Medic	5.15 c	5.15 b	–
Common Vetch	3.71 d	3.71 c	–
Bitter Vetch	5.56 c	5.56 a	–
Wheat	4.34 d	–	4.34 a
Mixed with wheat			
Medic	6.83 a	2.80 d	4.03 ab
Common Vetch	5.96 b	1.92 e	4.04 ab
Bitter Vetch	6.71 a	2.97 a	3.74 b

x Means within a column followed by the same letter do not differ at the.05 level of probability according to Duncan's Multiple Range Test (DMRT).

CHARACTERISTICS OF THE PLANTS

A. PLANTS OF FORAGE LEGUMES

The analysis of plant characteristics is summerized in table 36 . The mean values of plant weight showed that there were siguificant differences among the crops and their mixtures. The highest plant weight was calculated from the bitter vetch followed by the common vetch as pure stands and the differences were significant . Meanwhile the lowest plant weight was obtained from the medic when it was in mixture . (Table 36). This table also showed that the highest value for plant height was associated with the medic when it was as pure stand, whereas the lowest value was obtained from the bitter vetch when it was in mixture.

The highest seed weight per plant was calculated from the bitter vetch when it was in pure stand , and it was significantly different than the other crops . But the lowest seed weight was obtained from the medic when it was in mixture. (table 36).

In term of the straw weight , there were significant differences existing among the treatments; the highest straw weight was calculated from the bitter vetch as pure stand and the lowest value for straw weight was obtained from medic in mixture.

The data for the number of seeds per plant showed that there were significant differences existing among the treatments tested . The highest number of seeds per plant was associated

with the medic while the lowest number of seeds per plant was calculated from the common vetch when it was in mixture (Table 36).

The highest number of pods per plant was obtained from the medic and bitter vetch as pure stands . On the other hand , the lowest number of pods per plant was obtained from the common vetch when it was in mixture.

The data for the number of seeds per pod showed that there were significant differences for all the treatments tested . The highest value was obtained from the medic when it was in pure stand and the lowest number of seeds per plant was calculated from the common vetch when it was in mixture.

In term of one thousand seeds weight , the same table also indicated that there were significant differences among their values. The highest weight of one thousand seeds was obtained from the bitter vetch as pure stand , and the lowest value was calculated from the medic when it was in mixture .

Table 36

Measurments of some plant characteristics of forage crops grown as pure stands and in mixtures with wheat , and studied at full maturity stage at M'shaqar location during the 1982 / 1983 growing season .

Forage Crops	Plant Characteristics							
	Weight (g)	Height (cm)	Seeds (g)	Straw (g)	No. of seeds/ plant	No.of pods/ plant	No. of seeds/ pod	Weight of 1000 seeds (g)
Pure Stands								
Medic	2.37 b [x]	25.31 a	.47 d	1.90 c	32.81 a	7.56 a	4.34 a	14.30 d
Common Vetch	3.43 b	25.6 ab	.79 ab	2.64 b	15.38 e	4.62 d	3.33 b	51.30 b
Bitter Vetch	4.09 a	24.23 c	1.21 a	2.88 a	21.60 c	7.50 a	2.88 cd	56.30 a
Mixed With Wheat								
Medic	1.68 e	24.50 bc	.41 d	1.27 d	26.00 b	6.50 c	4.00 a	12.45 d
Common Vetch	1.95 d	22.42 d	.59 cd	1.36 d	13.20 f	4.40 c	3.00 bc	44.70 c
Bitter Vetch	2.88 c	21.25 e	.86 b	2.02 c	17.20 d	6.88 b	3.50 d	50.10 b

x Means within a coloumn followed by the same letter do not differ at the .05 level of probability according to Duncan's Multiple Range Test (DMRT) .

2. B PLANTS OF WHEAT

The analysis of plant characteristics is summerized in table 37 . The mean values of plant weight showed that there were significant differences existing between the plant weight of wheat when it was in pure stand and in mixtures . The highest weight was obtained from the wheat grown in mixture with medic.

This table also revealed that there were significant differences between the mean values for the plant height per plant; the greatest value was obtained from the wheat as pure stand and in mixture with medic .

In term of seed weight per plant , there were significant differences existing among the wheat treatments used . The highest seed weight per plant was obtained from the wheat when it was in mixture with medic (Table 3 7).

In term of straw weight per plant , no significant differences were obtained among the treatments .

For the number of kernels per plant , the highest number was obtained from the wheat when it was in pure stand.

For the characteristics of number of spikes per plant,number of kernels per spike and weight of 1000 seeds, the highest values were obtained from the wheat when it was in mixtures . No significant differences were obtained among the treatments.

Table 37

Measurments of some plant characteristics of wheat crop grown as pure stand and in mixtures with forage legumes, and studied at full maturity stage at M'shaqar location during the 1982 / 1983 growing season .

Treatments of wheat	Weight (g)	Height (cm)	Seeds (g)	Straw (g)	No. of Kernels/ plant	No. of spikes/ plant	No.of Kernels/ spike	Weight of 1000 seeds (g)
Pure Stand	9.88 d [x]	77.33 a	4.14 c	5.74 a	34.85 a	2.65 a	88.94 a	52.52 a
Mixed With . .								
- Medic	10.50 a	77.40 a	4.73 a	5.77 a	28.69 b	3.06 a	90.14 a	54.50 a
- Common Vetch	10.24 b	75.88 b	4.66 a	5.58 a	30.52 ab	2.79 a	85. 06 a	54.60 a
- Bitter Vetch	10.10 c	74.64 c	4.48 b	5.62 a	34.38 a	2.44 a	83.44 a	54.15 a

x Means within a column followed by the same letter do not differ at the .05 level of probability according to Duncan's Multiple Range Test (DMRT) .

The production of pure stands of forages , wheat, lentils and chickpeas could be utilized as seeds and hay. The costs and returns were estimated as shown in table 38 .

The assumptions of this case were as follows :-

1. The prices of grains per ton were 110 , 180 , 165 , 90 and 100 JD for wheat , lentils , chickpens , common vetch , and bitter vetch respectively . The prices of grains of common vetch and bitter vetch reflected the market prices. Other prices were fixed by the Government .

2. The prices of " tibin " in JD per ton were 50 for wheat , 55 for lentils and chickpeas , and 65 for common and bitter vetch.

Table 39 shows that the highest income was obtained from bitter vetch followed by lentils while the lowest income was obtained from chickpeas .

Table 38

Production of seeds and straw of crops grown as pure stands at M'shaqar location during the 1982 / 1983 growing season .

Crops	Production (ton / ha) seeds	straw
Medic	1.57 ab[x]	3.58 b
Common Vetch	1.09 b	2.61 c
Bitter Vetch	1.69 a	3.87 a
Wheat	1.73 a	2.61 c
Lentils	1.55 ab	2.22 d
Chickpeas	1.32 ab	1.70 e

x Means within a column followed by the same letter do not differ at the .05 level of probability according to Duncan's Multiple Range Test (DMRT).

Table 39

Net return of wheat, food legumes and forage legumes harvested at full maturity stage at M'shaqar location in the 1982 / 83 growing season (JD / du).

Income and Expenses	Wheat	Food Legumes		Forage Legumes	
		Lentils	Chick-peas	Common vetch	Bitter vetch
Income					
- Grains	19.03	27.90	21.78	10.70	15.21
- Tibin	13.05	12.21	9.35	16.96	25.15
- Total Income	32.08	40.11	31.13	27.66	40.36
Annual Expenses					
- 2 cultivations	.80	.80	.80	.80	.80
- Seeds	1.26	2.00	2.00	2.00	2.00
- Harrowing	.10	.10	.10	.10	.10
- Seeding	.55	.55	.55	.55	.55
- Fertilizer	1.05	1.05	1.05	1.05	1.05
- Weed Control	.50	.50	.50	.50	.50
- Hand Picking & Collecting	5.00	5.00	4.00	4.00	5.50
- Transport	2.00	2.00	1.50	1.50	2.00
- Bags & Sewing	1.80	1.80	1.30	1.30	1.50
- Threshing	1.00	1.00	.65	.65	1.00
- Interest	.98	1.14	.98	.95	1.10
- Total Expenses	15.04	15.94	13.43	13.40	16.10
- Family Income	17.04	24.17	17.70	14.26	24.26

The mixtures could be harvested mechanically to sell the wheat seeds , and sell the crop residuals for grazing, as shown in table 40 .

Here are the assumptions of this case :-

1. The costs of the mechanical harvest of wheat was 1.5 JD / dunum.
2. The crop residuals was sold for stock grazing at 5 JD / du.
3. The interest was 7 % on the annual costs.

The highest income of the mixtures was obtained from the common vetch -wheat mixture , but the lowest income was obtained from the bitter vetch-wheat mixture .

Table 40

Costs and returns of forage - wheat mixtures harvested at full maturity stage and utilized in the forms of wheat seeds for human consumption and residuals of mixtures for stock grazing.

- Costs and Expenses (JD)	Mixtures with wheat Medic	Common Vetch	Bitter Vetch
- Returns			
- Sale of wheat seeds	17.49	17.38	15.40
- Grazing of residuals	5.00	5.00	5.00
- Gross returns	22.49	22.38	20.40
- Annual Costs			
- 2 Cultivations	.80	.80	.80
- Forage seeds	2.40	.80	.72
- Wheat seeds	.52	.42	.42
- Harvowing	.10	.10	.10
- Fertilizer	1.05	1.05	1.05
- Harresting of wheat	1.50	1.50	1.50
- Bags & sewing	1.50	1.50	1.50
- Interest	.55	.43	.43
- Total Costs	8.42	6.60	6.52
- Family income	14.07	15.78	13.88

DISCUSSION AND CONCLUSION

The ultimate aim of this research was to help in increasing the animal production in Jordan . Shortage of feed supply particularly during late summer and early winter is an important constraint for livestock production . Any improvement in the amount of feed production under legumes-cereal system to make maximum use of rainfed area is considered the main factor for the promotion of red meat production.

The results obtained from this experiment revealed the superiority of the mixtures over the pure stands . This was because the respond of forage - cereals mixture to the environmental factors was greater in utilizing the raw materials of the growth which were available in the area . This means that there was an interrelation between the species in utilizing the different layers of soil since wheat has a shallow root ; whereas legumes have deep tap roots. Therefore , for crops there was more effectively utilized water, there was better competition to weeds and soil fertility improved. This can also be explained by the fact that the high yield of forage- cereals mixtures probably was related to the release of nitrogen fixed by the leguminous crops for the benefit of the growth of wheat . This was agreed with the results obtained by Dubbs (1971) , Webster and Wilson (1980) ; Hovyland and Monson (1980). The superiority of forage -cereal mixtures over the pure stands was also in good agreement with the findings obtained by Robinson (1963) in Bulgaria , Turbin (1965) in USSR,

Swain (1965) in Maryland , Strelkov (1969) in USSR , Dovydaitis (1973) in USSR , Iannelli and Pruneddu (1973) in Italy , Saidoy (1975) in USA , Johonston (1978) in Canada, and ICARDA (1982) in Syria .

When the two growth stages were studied , there was an increase in dry matter yield for each crop wether it was under pure stand or in mixture as the growth was proceeded . This was also stated by Wedin (1962) , Strickland and Jackson (1968), and Osman (1980). Pure stands of bitter vetch and medic produced higher yields than common vetch . This was so because the common vetch was used appeared to be less well -adapted to the environment than the other legumes.

In order to clarify the influence of mixing wheat with forage legumes crops, several characteristics were studied at full meturity Stage . A general tendency was detected for most of the characteristics studied , legumes crops grown as pure stands were better than those in mixtures with wheat . This is because the tall wheat plants shaded associated legumes , reducing its photosynthesis and consequently nitrogen fixation and a marked reduction in plant weight , plant height, number of seeds per plant and number of pods per plant were adversly affected . The opposite trend was observed with wheat plants in mixtures with legumes were better than those grown as pure stands . This was because wheat plants benefited from forage legumes plants in obtaining nitrogen . Therefore , the weight

of wheat plants were higher when it was grown in mixtures with forage legumes crops . Some of these characteristics were studied and the findings were agreed by several researchers such as Wilson and Swanson (1962), Paprocki (1964) , Puckridge and Donald (1967), Tubaileh (1977), Willy (1977) .

The utilization of forage as green forage in the late winter and spring by grazing the farmer's sheep or by selling it in the forms of bales showed to be profitable .

The higher production of mixtures over the pure stands resulted in higher incomes . Also grazing provided more income than utilizing the green fodder as bales due to saving the harvest and bailing costs and the high prices of lambs . The utilization of forage crops at full maturity stage in the forms of seeds and hay proved to be profitable . The bitter vetch grown as pure stand provided good yield of seeds and straw resulting in a higher income more than that obtained at pod formation stage . The mixtures of forage-wheat provided low incomes compared with those obtained at pod formation stage due to low prices of mixture residuals after benefiting from the harvested seed wheat .

Several important conclusions could be drawn from this research as follows :-

1. The mixtures of medic-wheat and bitter vetch wheat showed promising results with respect to dry forage yield. Therefore, they are recommended in the areas receiving annual rainfull above 300mm .

2. The medic growth and production were successfull as pure stand and in mixture with wheat, therefore , it is recommended to be grown as a pasture crop because it has a hard seed characteristic which enables it to regenerate each year over a number of years once adeqate seed supplies have been built up in the soil surface .

3. For the production of seeds and straw , the bitter vetch is recommended due to its higher yields under the rainfed conditions .

4. In a good season such as 1982 / 1983 , the mixtures of forage-wheat, when harvested as green forage and utilized in grazing the farmers sheep, have resulted in higher returns which exceeded that obtained from the pure stands of forage legumes crops due to the increase in yield. Therefore , farmers who keep sheep flocks in the Madaba District are advised to grow forage-wheat mixtures.

5. The farmers who don't own sheep could sell the green forage produced , at pod formation stage, in the form of bales . Incomes obtained from forage-wheat mixtures were higher than those obtained from the pure stands of forage legumes due to the increase in yield.

6. The delay harvest of mixtures for benefiting from wheat seeds for human consumption and the increased yield of total dry matter, at full maturity stage, resulted in a lower income compared to that obtained at the pod formation stage . This was due to the low prices of mixtures residuals. The increase of the total dry matter didnot compensate the loss of feed quality . Therefore, the delay of harvesing these mixtures can't be justified .

SUMMARY

To study the yielding performance and the financial viability of growing forage legumes crops under rainfed conditions , a field experiment was conducted in the Madaba District at M'shaqar location during the 1982 /1983 growing season . The crops used were six pure stands (medic , common vetch , bitter vetch , wheat , lentils and chickpeas) , and three mixtures (medic-wheat , common vetch-wheat and bitter vetch-wheat). The randomized complete block design (R C B D) with four blocks was used . seeding rates per dunum for the pure stands were 12 kgs per dunum for the common vetch , bitter vetch and wheat , 8 kgs for lentils and chickpeas and 2 kgs for medic .

Seeding rates for the mixtures were 2:4 kgs per dunum for medic-wheat mixture and 8:4 kgs per dunum for common or bitter vetch-wheat mixtures . The fertilizer used at the planting date , was 10 kgs per dunum of triple super phosphate (47.5 % P_2O_5).

Here are the traits that were recorded :-

1. Biological yield (kg / ha).
2. Grain yield.
3. Straw yield.
4. plant characteristics studied at full maturity stage, that is , plant weight (g), plant height (c m), seeds

weight per plant (g) straw weight per plant (g), total number of seeds per plant , number of pods or kernels per plant , number of seeds per pod or kernels per spike and weight of 1000 seeds (g). Also an evaluation of costs and returns of dry matter produced at pod formation and full maturity stages were studied . The returns obtained from the grains and straw of forages were compared with those obtained from wheat , lentils and chickpeas .

The main results obtained could be summerized as follows :-

1. Generally the superiority of the mixtures of forage-wheat over the pure stands was obvious at the pod formation and full maturity stages of growth.
2. The present results revealed the superiority of medic-wheat and bitter vetch -wheat mixtures over the common vetch-wheat at both pod formation and full maturity stages of growth .
3. Comparing the two stages of growth studied; it was clear that an increase in the dry matter yield for each crop was clear wether it was as pure stand or in mixture as the growth proceeded .
4. Mixing the forage legumes crops with wheat proved to influence the yield of both forage crops and

wheat . A general tendency was detected for most of the characteristics studied . An increase in the yield components of forage crops were observed for forage legumes when grown as pure stands . An opposite trend was observed with wheat where the highest increases in yield components of wheat plants was detected for the wheat plants when it was mixed with forage legumes crops.

5. At pod formation stage , the utilization of green forage in grazing the farmes sheep provided higher returns than bailing the green forage to sell it to sheep owners .

6. At pod formation stage , the mixtures provided higher incomes than pure stands.

7. The delay hervest of mixtures resulted in the increased yield of dry matter , but lowering the feed quality thus reducing returns .

8. The bitter vetch and lentils provided higher returns from selling the grains and straw .

RECOMMENDATIONS

In light of the above mentioned results, the following recommendations seem useful and important : -

1. The mixtures of bitter vetch-wheat and medic-wheat showed higher yields than the pure stands when tested in the Madaba District . Thus they are recommended to be grown in dryland areas with similar conditions.
2. The mixtures of forage-wheat are recommended to be utilized as green forage, at the pod formation stage, to provide higher incomes due to the higher prices paid for good quality feed. The delay harvesting resulted in lower incomes due to the low prices paid for lower quality feed .
3. The present results indicated the great importance of the forage crops grown in mixtures with wheat in the integration between field crops and livestock production under the rainfed conditions of Madaba District, because the integrated production of forage and lambs resulted in the highest income . (Table 33).
4. Harvesting of the pure stands of bitter vetch and lentils as grains and hay in good season such as 1982 / 1983 is recommended.
5. Forage crop production offers a sound soil management system , can be a source of high quality

protein feed , and provides the greates flexibility in livestock programs .

6. Experimental researches on forage crops shoud be conducted at different locations and under different rotations so as to furnish reliable information under the variable rainfed conditions .

MATERIALS AND METHODS

A field experiment was conducted under rainfed conditions in the Madaba District at Mureijmah and Zetouneh locations during the 1983 / 1984 growing season .

The Madaba District is located in the central part of Jordan at 31° 43 north latitude and 30° 48 east longitude with 785 meters elevation and an average rainfell of 338 mm for the period from (1966 - 1980).

The locations were under legume-cereal crop rotation.

Crops sown at Mureijmah and Zetouneh locations at 1983 / 1984 growing season were : -

1. Wheat (hourani).
2. Common Vetch .
3. Bitter Vetch .
4. Narbonne Vetch (Vicia Norbonensis).
5. Peas (Pisum Sativum).

Common vetch seeds were obtained from Turkey , while the narbon vetch were obtained from the West Bank of Jordan and other crops seeds were obtained locally .

Randomized complete block design (RCBD) with 4 blocks was used, each block was divided into 16 plots. Each plot

The following traits were recorded :

1. Biological yield (kg / ha).
2. Total number of plants (forage legumes and wheat plants) per square meter .

In addition to these, two samples from those taken at pod formation and full maturity stages were seperated by hand into leaves, stems and pods or spikes and weighed .

An evaluation of the costs and returns of the production and utilization of the forage crops at Mureijmah location was conducted .

Experimantal Results :

The main objectives of this experiment were as followes :-

1. To study the potential productinity of three annual vetches and peas when grown as pure stands and in mixtures with wheat.
2. To study the production of the plant componants .
3. To study the effect of seeding rates over the no. of plants per square meter (unit area).
4. To analyze the costs and returns of these crops.

The results will be divided into three main headings.

I. Biological yield .

II. Number of plants per square meter.

III. Plant componants .

I. BILOGICAL YIELD :

I. A. FLOWERING STAGE

The data collected from the two location at the flowering stage were analyzed and the results were summerized in table (41). From the first glance, it can be detected that the values obtained from Mureijmah location were higher than the values obtained from Zetouneh , and this probably because it

has received more rainfall than the second location by 84 mm. The table showed that the seeding rates of the mixtures has an effect upon the performance of the treatments tested. The table also revealed that there were significant differences among the total yield of crops used at the two locations except for common vetch-wheat mixture grown at Zetouneh location.

The highest total yield obtained from Zetouneh location was associated with bitter vetch-wheat mixture at 9: 3 kg seeding rate (Table 41).

The mean values for forage crops at the two locations showed that there were significant differences existing among the treatments used . The table also indicated that the highest yield of forage legumes was calculated from pure stands, and this was true for both locations. Also the greatest value among the pure stands, at both locations , was obtained from narbon vetch. In case of forage legumes in pure stands and in mixtures the highest yield was calculated from bitter vetch as pure stand, followed by medic and the differences were significant.

As the seeding rate of forage legumes per unit area increased the yield of forage crops increased , and this was true for both locations . The same trend was detected for the yield of wheat , and this was true for both locations (Table 41).

I. B. POD FORMATION STAGE :

The data calulated for yield, at pod formation stage , were summerized and appeared in table (42) . The highest mean value of yield for pure stands was associated with the narbon vetch at both locations . The production of mixtures , at this stage, in general for both locations were just plus minus around the pure stands production . The results also showed that the highest yield of forage crops was found at the highest seeding rate.. The same pattern was followed for wheat, and this was true for both locations .

I . C. FULL MATURITY STAGE :

The data for the total dry weight yields, at full maturity stage , were calculated and analysed and the results are shown in table (43) . Generally , this table showed that the mean values of total yields were higher at Mureijmah location as it was compared with those obtained from Zetouneh location ; and this was probably because the rainfall amount was higher at the Mureijmah location .

Table 42 :

Total dry yield (t / ha) of forage legumes grown as pure stands and in mixtures with wheat at differnt sowing rates and studied at pod formation stage at Zetouneh and Mureijmah locations during the 1983 /1984 growing season.

Seeding Rate (kg/ du)		Location					
		Zetouneh			Mureijmah		
		Total	Wheat	Forage legumes	Total	Wheat	Forage legumes
Common vetch	Wheat	x	x	x	x	x	x
12	0	.82 e	-	.82 d	1.03 c	-	1.03 a
9	3	.96 cde	.33 gh	.63 e	1.05 c	.58 e	.47 bc
6	6	.89 de	.46 de	.43 fg	1.10 bc	.57 bc	.35 cd
3	9	.86 de	.64 a	.22 h	1.06 c	.81 bc	.25 d
Bitter vetch	Wheat						
12	0	1.14 abc	-	1.14 b	1.13 bc	-	1.13 a
9	3	1.36 a	.40 efg	.96 c	1.14 bc	.79 bc	.35 cd
6	6	1.07 bcd	.43 def	.64 e	1.13 bc	.83 b	.30 cd
3	9	.89 de	.49 bcd	.40 fg	1.09 bc	.85 b	.24 d
Narbon vetch	Wheat						
12	0	1.27 ab	-	1.27 a	1.19 ab	-	1.19 a
9	3	1.27 ab	.38 fg	.89 cd	1.14 bc	.61 de	.53 bc
6	6	1.01 cde	.55 bc	.46 fg	1.12 bc	.70 bc	.42 bc
3	9	.94 cde	.56 b	.38 g	1.13 bc	.82 b	.31 cd
pea	Wheat						
12	0	1.15 abc	-	1.15 ab	1.03 c	-	1.03 a
9	3	1.16 abc	.27 h	.89 cd	1.26 a	.56 e	.70 b
6	6	1.00 cde	.48 cd	.52 ef	1.29 a	.62 de	.67 b
3	9	.96 cde	.70 h	.26 h	1.25 a	.75 bc	.48 bc

x Means with in a column followed by the same letter do not differ at the .0 5 level of probability according to (DMRT).

The mean values of the yield for vetches as pure stands were lower than mixtures, this was true for both locations. The results also indicated that the highest yield for forage legumes was calculated from the highest seeding rate for all vetches used . The highest yield was associated with 9 : 3 seeding rate, and this was true for both locations. (Table 43).

II . NUMBER OF PLANTS PER SQUARE METER

The data for plant number per square meter were calculated and analyzed . The results are shown in table (44). The results indicated that there wer significant differences existing among the treatments used. This was true for both locations . As pure stands and overall, the highest mean value was associated with bitter vetch at both locations . Meanwhile the highest values , as overall , was calculated from bitter vetch - wheat mixtures . Generally , the highest plant number per square meter was calcultated from the highest vetch seeding rate , this was true for both locations . Also the same trend was followed for wheat in the mixture . (Table44)

3. PLANT COMPONANTS

The data for plant componants for Mureijmah location, at pod and full maturity stage for legumes and wheat were measured, analyzed and presented as a percentage. The results were summerized in table 45 and 46 for forage legumes and wheat respectively.

3. A. FORAGE LEGUMES

The highest percentage of leaf production , at pod formation stage , was increased as the vetches seeding rate increased , and this was true for full maturity stage too, where the highest yield was calculated from the lowest seeding rate. This was true for full maturity stage, too. (Table 45).

The highest pod produced was measured from the highest seeding rate . This was true at both growth stages. (Table 45).

Leaves for common and bitter vetches only, produced greater percentage than stems and pods, while narbon vetch and pea produced higher percentage of stem than leaves and pods.

The highest yield of leaf percentage at pod formation stage was obtained from common vetch, and this was also true at full maturity stage . However , leaves and

Table 45 :

Production of leaves , stems and pods (expressed in percentage) of forage legumes grown as pure stands or in mixtures mixtures with wheat at different seeding rates and studied at pod formation and full maturity stages at Mureijmah location during the 1983 / 1984 growing season .

Seeding Rate (kg/ du)		Stage of Growth: Pod Formation			Full Maturity		
		Leaves	Stems	Pods	Leaves	Stems	Pods
Common vetch	Wheat	x	x	x	x	x	x
12	0	58.0 a	30.3 h	11.7 h	48.2 a	24.2 h	27.6 gh
9	3	57.1 ab	32.2 g	10.7 hi	46.0 b	28.0 fg	26.0 hi
6	6	56.2 bc	35.0 f	8.8 ij	45.3 b	30.4 ef	24.3 hi
3	9	54.8 c	37.0 e	8.2 j	43.7 c	33.7 d	22.6 i
Bitter vetch	Wheat						
12	0	45.0 d	35.1 f	19.9 e	42.2 d	17.7 j	40.1 ab
9	3	43.8 d	36.9 e	19.3 ef	41.2 de	21.5 i	37.3 bcd
6	6	43.3 de	39.1 cd	17.6 fg	40.5 e	24.0 h	35.5 def
3	9	42.4 ef	40.4 bc	17.2 g	39.1 f	27.2 g	33.7 def
Narbon vetch	Wheat						
12	0	40.4 ef	36.8 e	22.8 bc	25.7 j	31.5 e	42.8 a
9	3	38.4 g	39.0 cd	22.6 bc	24.0 k	36.5 c	39.5 abc
6	6	37.7 gh	40.7 b	21.6 cd	23.1 k	40.8 b	36.1 bcd
3	9	36.3 hi	43.3 a	20.4 de	22.0 l	46.0 a	32.0 ef
Pea	Wheat						
12	0	37.2 gh	38.0 de	24.8 a	30.6 g	31.4 e	38.0 bcd
9	3	36.1 hi	40.2 bc	23.7 ab	30.0 g	34.2 d	35.8 def
6	6	35.1 ij	42.0 a	22.9 bc	28.2 h	37.5 c	34.3 def
3	9	34.4 j	42.2 a	23.4 ab	26.9 i	41.6 b	31.5 fg

x Means whithin a coloumn followed by the same letter do not differ at the .05 level of significancy according to Duncan's Multiple Range Test (DMRT).

stems production , at full maturity stage, declined while the pod percentage increased (Table 45).

3 . B. WHEAT

The data measured for wheat showed that the highest mean values percentage was obtained from leaf production followed by stem and spike . This was true only for wheat mixed with common and bitter vetch. However , the stem percentage production was higher than leaf percentage when wheat mixed with narbon vetch and pea . As the wheat seeding rate increased, the leaf percentage production increased while the stems and spikes percentage decreased . The same trend was observed at full maturity stage . This table also showed that the spike percentage, at full maturity stage, was higher than that at pod formation stage, and this was expected (Table 46).

Table 46

Production of leaves , stems and spikes (expressed in percentage) of wheat grown in mixture with forage legumes crops at different seeding rates and studied at pod formation and full maturity stages at Mareijmah location during the 1983 / 1984 growing season .

Seeding Rate (kg / du)		Stage of Growth: Pod Formation			Full Maturity		
		Leaves	Stems	Spikes	Leaves	Stems	Spikes
Common vetch	Wheat	x	x	x	x	x	x
9	3	44.2 bc	39.0 c	16.8 bc	28.8 g	30.5 d	40.7 a
6	6	45.4 b	38.3 c	16.3 bc	31.8 ef	30.0 de	38.2 b
3	9	47.0 a	38.0 e	15.0 c	36.7 bc	28.3 f	35.0 c
Bitter vetch	Wheat						
9	3	42.5 cd	38.1 c	19.4 a	32.7 de	30.2 d	37.1 b
6	6	44.1 bc	36.7 d	19.2 a	36.0 c	29.5 def	34.5 cd
3	9	45.7 b	36.0 d	18.3 ab	40.0 oa	28.7 ef	31.3 ef
Narbon vetch	Wheat						
9	3	39.2 e	42.0 a	18.8 ab	33.3 d	28.7 ef	38.0 b
6	6	41.0 de	41.0 ab	18.0 ab	37.8 b	28.0 f	34.2 cd
3	9	42.7 cd	40.2 bc	17.1 abc	42.7 a	26.3 g	31.0 f
Pea	Wheat						
9	3	39.5 e	41.4 ab	19.1 ab	26.5 h	40.5 a	33.0 de
6	6	42.3 cd	39.3 c	18.4 ab	30.6 f	38.2 b	31.2 f
3	9	43.0 cd	39.0 c	18.0 ab	36.0 c	36.0 c	28.0 g

x Means within a column followed by the same letter do not differ at the .05 level of significancy according to (DMRT).

In general , the total dry production was low and could-n't be utilized as seeds and straw. The only alternative was to graze the green forage, at pod formation stage, by the farmers sheep or by selling it to shepherds . Costs and benefits of these two alternatives are shown in tables 47 and 48 . Assumptions of these cases were as follows :-

- All the production expenses were calculated as fixed by the JCO machinery station at M'shaqar .
- Cost of seeds in JDs per ton were 120 , 90 , 110,150 and 110 for common vetch, bitter vetch ,narbon vetch, peas and wheat respectively.
- Lambs were bought at weight of 20 kgs in average and at 1.1 JD /kg.
- Lambs were fattened on the standing crop for 60 days . The average daily increase in weight was 250 gams.
- The feed produced from the forage legumes grown as pure stand or in mixture with wheat, at 9 : 3 kg seeding rate per dunnm , was sufficient to fatten one lamb . The price per kg of extra forage was estimated at JD. 0.065 to be used for sheep grazing .
- A shepherd was employed for 2 months to look after a flock of 50 lambs for a monthly wage of 125 JD , that is . 2.5 JD per lamb.
- The cost of veterinary and water was estimated at 1.0 JD per lamb .

- Mortality among lambs was estimated at 5 %.
- Sale of standing crop to shepherds to let their sheep graze it was estimated at 10 JD / du.

The net income obtained when farmers utilize the green forage to fatten their lambs ranged from 7.97 to 9.17 JD / du. The net income obtained from selling the crop to the shepherds ranged from 5.79 to 6. 82 JD/ du .

Table 47 :

Costs and returns from grazing the standing crop at pod formation stage , at Mureijmah location by the farmer's sheep during the 1983 / 1984 growing season .

Income and expenses (JD)	pure stands Common vetch	Bitter vetch	Narbon vetch	Pea	Mixed with Common vetch	Bitter vetch	Wheat Narbon vetch	pea
- Sale of lambs	38.50	38.50	38.50	38.50	38.50	38.50	38.50	38.50
- Extra feed	00.20	00.85	01.24	00.20	00.33	00.91	00.91	01.69
- Gross Income	38.70	39.35	39.74	38.70	38.83	39.41	39.41	40.19
Annual expenses								
Forage Production								
- 2 cultivations	00.80	00.80	00.80	00.80	00.80	00.80	00.80	00.80
- forage seeds	01.44	01.08	01.32	01.80	01.08	00.81	00.99	01.32
- wheat seeds	-	-	-	-	00.36	00.36	00.36	00.36
- Harrowing	00.10	00.10	00.10	00.10	00.10	00.10	00.10	00.10
-Fertilizer	00.90	00.90	00.90	00.90	00.90	00.90	00.90	00.90
-Interest.	00.23	00.20	00.22	00.25	00.23	00.21	00.22	00.25
Lamb Production								
- Buy of a lamb	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
- Shepherd wage	02.50	02.50	02.50	02.50	02.50	02.50	02.50	02.50
-Veterinary and Water	01.00	01.00	01.00	01.00	01.00	01.00	01.00	01.00
- Mortality	01.10	01.10	01.10	01.10	01.10	01.10	01.10	01.10
- Cartage	00.20	00.20	00.20	00.20	00.20	00.20	00.20	00.20
- Interest	00.46	00.46	00.46	00.46	00.46	00.46	00.46	00.46
Total Expenses	30.73	30.34	30.60	30.11	30.73	30.44	30.63	30.99
Family Income	07.97	09.01	09.14	08.59	08.10	08.97	08.78	09.20

DISCUSSION AND CONCLUSION

To identify the best seeding rates of annual forage crops grown as pure stands and in mixtures with wheat and to study its effects on number of plants , dry matter production and the best method of utilizing the forage to obtain heigher incomes .

The mean values calculated from total dry weight of the forage legumes, were higher in Mureijmah location than Zetouneh location. This was true for the three stages of growth. This was expected because of the higher rainfall received at Mureijmah location. The highest total dry weight was obtained from the 9 : 3 forage - wheat seeding rate for the three stages of growth at Zetouneh location . This was only true for the same seeding rates at Mureijmah location at full maturity stage (Table 43). This was because wheat growth at Zetouneh was affected by the low rainfall which reduced the tillering of wheat .

The results also indicated that the yield of forage legumes increased as its ratio in the seeding rate were increased per unit area. The same trend was obtained with wheat, and these findings were true for all growth stages tested at both locations. (Table 43).

The greatest yield at the flowering stage was obtained from bitter vetch-wheat mixture for the 9 : 3 kg seeding rate treatment at Zetouneh location and from the pea-wheat mixture of the 6 : 6 kg seeding rate treatment at Mureijmah . This was also true at pod formation stage , while the highest yields, at full maturity stage , were obtained from the 9 : 3 kg seeding rate treatment at both locations.

Narbon vetch produced the highest yield among the pure stands at the three stages of growth tested at both locations, while common vetch produced the lower yield because it flower earlier when the plants were small and appeared to supress further plant development .

The number of plants per square meter for total plants, forage legumes, and wheat were higher at Zetouneh than Mureijmah location (table 44). This probably was due to the weeds which competed with the forage crops grown as pure stands and in mixtures with wheat at Mureijmah location. The table also showed that the increase in seeding rate of forage legumes has resulted in increasing the number of plants per unite area at both locations. Also it can be observed that bitter vetch produced the highest number of plants for all seeding rates used at the two locations , followed by common vetch , narbon vetch and pea respectively .

The highest componant yield of legumes in percentage at pod formation stage , were obtained from leaves followed by stems and pods. (Table 45).

Also it can be observed from the table 45 that as the seeding rate of forage legumes increased, the percentage of its leaves and pods increased while the percentage of stems decreased. This was true also at the full maturity stage , (Table 45). It can be detected from the same table also that the percentage of pods were increased at full maturity stage at the expense of leaves and stems percentage and this was expected due to the growth of seeds. Consequently the feed quality will be lowered . These findings were stated by Reid and also were agreed by Austenson who mentioned that leaf percentage dropped repidly as plants developed to heading.

The greatest yield expressed in percentage of wheat componant was calculated from leaves followed by stems and spikes, at pod formation stage. (Table 46). It can be noticed from the same table that the increase of wheat seeding rate has resulted in an increase of wheat leaves, and a decrease in wheat stems and spikes. This was also true at full maturity stage. It was observed also that at full maturity stage the percentage of spikes were increased, at the expense of leaves and stems. This was expected due to the growth of seeds .

The dry matter production at flowering stage was very low, therefore if it was grazed, the returns would be below the costs . The dry matter production at pod formation stage provided some returns. Delay grazing to full maturity stage may not provide returns due to the decrease in the feed quality despite the little increase in the dry matter production. Farmers who own sheep , and utilized the yield obtained in fattening their lambs obtained more income than those who sold the standing crops to shepherds as shown in tables 53 and 54.

The following conclusions could be drawn, :-

1. Generally , the dry matter production at Mureijmah location was higher than that obtained at Zetouneh location due to the rainfull effect .
2. Delay harvest from flowering stage at pod formation and then full maturity stage was resulted in an increase of total dry matter production of the forage crops when grown as pure stands or in mixtures with wheat.
3. Mixtures of bitter vetch-wheat , narbon vetch- wheat and pea-wheat showed promising results with respect to dry forage yield.

4. Mixtures of forage legumes-wheat produced higher yields at pod formation and full maturity stages of growth when the seeding rate of forage legumes were 3:1.

5. Increasing the seeding rate of forage legumes in the forage-wheat mixtures resulted in increasing of the number of plants and the dry matter produced of forage legumes . The same trend was obtained with wheat.

6. The 3:1 forage legumes-wheat seeding rate provided the highest yields of leaves of common and bitter vetches and the highest yields of wheat at pod formation stage, thus imporving the feed quality .

7. Net income from utilizing the green forage, at pod formation stage, in fattening the farmer's lambs where higher 22 % to 48 % than returns obtained from selling the standing crop to shepherds.

SUMMARY

To study the seeding rate effects of annual legumes crops grown , as pure stands and in mixtures with wheat, on the dry matter production , number of plants per unit area (m^2) plant componants , a field experiment was conducted at Zetouneh and Mureijmah locations during the 1983 /1984 growing season.

The crops used were four pure stands of annual forage crops namely common vetch , bitter vetch , narbon vetch and pea. Also each of these crops were grown in mixtures with wheat at different seedings rate . The randomized complete block design (RCBD) with four blocks was used . Seeding rates, for the pure stands , were 12 kgs per dunum. Seeding rates for mixtures were 9 : 3 , 6 :6 , and 3 : 9 kgs per dunum for forage-wheat mixtures. Inoculation of seeds were done immediately prior to sowing . Fertilizer applied , at the planting date, was 10 kgs of diamonium phosphate per dunum . The following traits were recorded:-

1. Biological yield (ton/ ha), studied at flowering, pod formation and full maturity stages of growth .
2. The yield of plant components of forage crops and wheat (leaves, pods or spikes and stems).

The main results obtained could be summerized as followes :-

1. The data of mean values showed that the total dry matter yield of the forage crops were higher in

Mureijmah location than that obtained at Zetouneh location at the three stages of growth studied.

2. Comparing the yield at the three stages of growth, it was obvious that the delay of harvest resulted in an increase of each crop or mixture.

3. The results of studing the biological yield of forage legumes showed that as the seeding rate of forage crops were increased its yield increased too. The same trend was true for wheat.

4. Generally , the 9: 3 kgs seeding rate of forage legumes-wheat mixture at both locations produced the highest yields at full maturity stage.

5. Comparing the yields of pure stands , narbon vetch produced the highest yield among the pure stands studied at the three stages of growth tested at the two locations.

6. The study of the number of plants per unit area showed that the increase in seeding rate of forage legumes has resulted in increasing the number of forage plants per unit area at both locations. The same trend was observed with wheat.

7. The data recorded showed that bitter vetch produced the highest number of plants for all seeding rates followed by common vetch, narbon vetch and pea.

8. The present results revealed the superiority of narbon vetch-wheat , bitter vetch-wheat and pea -wheat over the common vetch-wheat at the three stages of growth at the two locations studied.

9. The data showed that the highest component yield of forage legumes crops, expressed in percentage, at pod formation stage , was obtained from leaf production followed by stem and pod production. This was true, at full maturity stage, for common and bitter vetches.

10. The data analyzed showed also that as the seeding rate of forage legumes increased, the percentage of its leaves and pods increased while the percentage, of stems decreased at the pod formation and at the full maturity stages of growth.

11. The data calculated for wheat grown with common and bitter vetch showed that the highest mean values expressed in percentage , were obtained from the leaf production followed by stem and spike production at the pod formation stage,.

12. The net income obtained from utilizing the green forage at pod formation stage in fattening the farmer's lambs by grazing the standing crop where higher than selling the standing crop.

RECOMMENDATIONS

In light of the above mentioned results , the following recommendations seems important:

1. The introduction of forage legumes crops such as narbon vetch , bitter vetch and pea into the cropping system of the dryland areas by growing them as pure stands and in mixtures with cereals under the rainfed conditions of Madaba District and other dry land areas with similar conditions is recommended because these crops could be grown under drought conditions.
2. The seeding rate 3: 1 forage legumes-wheat is recommended for both high dry matter production and good quality.
3. The utilizing of forage crops at pod formation stage is recommended to provide more feed with good quality.
4. Mixtures of forage legumes-wheat are a viable alternative which should be considered by farmers in Madaba District and other rainfed areas .
5. Grazing of forage crops and their mixtures is recommended in dry seasons to save harvesting costs and to provide reasonable income to the farmer.
6. Farmers are strongly advised to own sheep to increase their income from growing forage crops and from the fattening of lambs because integrated enterprises of crops and sheep production provided higher incomes than that obtained from selling the forage crop.

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UNIVERSITY OF JORDAN

FACULTY OF AGRICULTURE

PLANT PRODUCTION DEPT .

QUESTIONNAIRE

SOCIO-ECONOMIC STUDY OF SHEEP PRODUCTION IN MADABA DISTRICT (1983 - 84) .

- Date of interview :
- Name of person conducted the interview :
- Number :

1. Socio-economic status of the farmer
   - Name of the sheep owner :
   - Age : - Knowledge :
   - Experience in sheep breeding (years) :
   - Membership of cooperatives :
2. Family size and structure :

Age groups	Male	Female	Total
- Less than 15 years old			
- 16 - 30	=	=	
- 31 - 45	=	=	
- 46 - 60	=	=	
- 61 and above			
Total			

3. The right to utilize a land :
   - No right - Owner - Share-cropper
   - Tenant - Mixed
4. Present land use :

Crop	Area/du	Crop	Area/du
- Fruit trees		- Forage crops	
- Cereals		- Vegetables	
- Fodder legumes		- Others	

5. Pattern of cropping rotations:

Year	Winter crop	Summer crop
- First year		
- Second year		
- Third year		

6. Livestock Population (heads) :

- Sheep - Goats - Cattle
- Others

7. Buildings and Equipment

- Area in dunums - Sheds in m^2
- Sheds value/JD - Stores m^2
- Stores value/JD - Yards m^2
- Yards value /JD - Equipment used
- Equipment value

8. Flock size and structure :

Sheep	Number	Goats	Number
- Rams		- Bucks	
- Ewess		- Goats	
- Yearlings		- Yearlings	
- Lambs		- Kids	
Total		Total	

9. Selection of sheep :

Major selection criteria :

- Ram selection
-
-
-
-
- Ewe selection
-
-
-
-

10. Grazing :

- Availability of natural pasture :
- Size (sheep/du) :
- Costs JD/du (if payed) :
- Daily movement of the flock (km) :
- Grazed plants :
- Period of grazing in months during :

Winter Spring Summer Autumn

11. Supplementary feeding :

Feed used	Price (JD/ton)	Resource
-		
-		
-		
-		

16. Marketing of lambs :

- Number of sold lambs :
- Age (months) : - Weight/kg :
- Price (JD/kg): - Place of selling :
- Number of lambs consumed by the family :
- Number of kept lambs :

17. Milk production :

- Number of milking ewes :
- Average yearly production (kg / ewe) :
- Annual period of milking (days / year) :
- Sold milk (tons) : - Price (JD/ton) :
- Milk consumed by the family (%) :
- Milk products produced and price JD/kg :
  - Yoghort
  - Ghee
  - Cheese
  - Butter
  - Labneh
  - Jameed

18. Wool production :

- Annual production (kg/head) :
- Shearing method :
- Place of shearing :
- Cost of shearing ((JD/head) :
- Price per Kg if sold :

19. Manure production :

- Quantity produced ;
- Price / JD , if sold :
- Quantity utilized on the farm , if any :

20. Animal health and veterinary :

- Are the veterinary survices available :
- Do the sheep owners meet the vet ?
- Important diseases known by the sheep owner:

21. Culling of sheep :

- Age of culled rams : - Number :
- Reasons behind culling the rams :
-
-
-
-
- Age of culled ewes : - Number :
- Reasons behind culling of ewes :
-
-
-
-
-

22. Management of the flock :

- Who is herding the flock ?
- Number of Shepherds :
- Wages paid :
- Activities carried out by family members :

23. Credit :

Loans obtained for the sheep production

Loans amount (JD)	Interest %	Resource	Purpose
-			
-			
-			
-			

24. Problems :

-
-
-
-
-
-

25. Extending of exesting flock :

- Do the owner like to extend the exesting flock?
- Yes - No
- Reasons :
-
-
-
-
-
-

26. Annual income :

Resource	Income / JD
- Sheep production	
- Other resources	
- Total	

APPENDIX B

ANNUAL RAINFALL AT THE FIELD EXPERIMENTS LOCATIONS .

Table 1

Rainfall for 1982/83 season at M'shaqar with monthly distribution .

Month	Amount of rainfall (mm)
November	58.0
December	25.7
January	183.9
February	154.3
March	163.6
Total	585.5

Table 2

Rainfall for 1983/84 season at Mureijmah and Zetouneh locations with monthly distribution .

Month	Amount of rainfall (mm) Location	
	Mureijmah	Zetouneh
November	19.9	5.5
December	4.3	1.0
January	95.1	62.2
February	17.5	16.0
March	94.3	62.4
Total	231.1	147.1

APPENDIX C

TABLES OF ANALYSIS OF VARIANCE FOR THE CHARACTERISTICS STUDIED .

Table (1) :

Analysis of variance for the production of forage legumes , wheat and total dry matter production obtained from growing forage legumes crops as pure stands and in mixtures with wheat and studied at pod formation stage at M'shaqar location during the 1982/1983 growing season.

Source of variation	Production (t / ha) Total df	Total ms	Forage legumes df	Forage legumes ms	Wheat df	Wheat ms
Blocks	3	0.85 xx	3	0.55 xx	3	.033 x
Treatments	6	2.36 xx	5	2.60 xx	3	.100
Error	18	0.005	15	0.02	9	.018

x , xx Significant at the .05 and . 01 levels of probability respectively.

Table (2):

Analysis of variance for the production of forage legumes , wheat and total dry matter production obtained from growing forage legumes crops as pure stands or in mixtures with wheat and studied at fall maturity stage at M'shaqar location during the 1982 / 1983 growing season.

Source of variation	Production (t/ha)					
	Totals		Forage legumes		Wheat	
	df	ms	df	ms	df	ms
Blocks	3	1.07 xx	3	0.48 xx	3	.36 xx
Treatment	6	4.97 xx	5	8.05 xx	3	.24 x
Error	18	0.21	15	0.07	9	.54

x , xx Significant at the . 05 and .01 levels of probability respectively .

Table (3) :

Analysis of variance for the production of seeds and straw of forage legumes and wheat obtained from growing forage legumes crops as pure stands or in mixtures with wheat at Mushaqar location during the 1982 / 1983 growing season .

Source of variation	Production							
	Forage legumes				Wheat			
	Seeds		Straw		Seeds		Straw	
	df	ms	df	ms	df	ms	df	ms
Blocks	3	.61 xx	3	0.023 x	3	.03	3	.19 x
Treatment	5	.57 xx	5	4.360 xx	3	.07 xx	3	.05
Error	15	.09	15	0.005	9	.01	9	.04

x , xx Significant at the .05 and .01 levels of probability respectively .

Table (4) :

Analysis of variance some plant characteristis of forage legumes crops grown as pure stands and in mixtures with wheat , and studied at full maturity stage at M'shaqar location during the 1982 / 1983 growing season.

Source of Variation	df	Mean Square Plant Characteristics							
		Weight (g)	Height (cm)	Seeds (g)	Straw (g)	No. of seeds/ plant	No.of pods/ plant	No.of seeds/ pod	Weight of 1000 seeds (g)
Blocks	3	0.003	01.420	.003	0.003	000.013	0.007	0.003	0018.620
Treatments	5	3.370 xx	12.650 xx	.360 xx	1.710 xx	217.920 xx	7.850 xx	1.970 xx	7669.410 xx
Error	15	0.009	00.940	.020	0.003	000.054	0.003	0.005	0045.400

xx Significant at the 0.01 level of probability .

Table (5) :

Analysis of variance for some plant characteristies of wheat crop grown as pure stand and in mixtures with forage legumes , and studied at full maturity stage at M'shaqar location during the 1982 / 1983 growing season .

Source of Variation	df	Mean Square of characteristics						
		Weight (g)	Height (cm)	Plant Seeds (g)	Straw (g)	No .of Kernels/ plant	No.of spikes/ plant	No.of kernels/ spike	Weight of 1000 seeds (g)
Blocks	3	.003	1.000 x	.010 x	.007 x	02.220	.440 x	389.950 x	0.123
Treatment	3	.270 xx	6.950 xx	.277 xx	.037 x	35.950 xx	.303	037.500	3.843
Error	9	.002	0.170	.002	.008	04.000	.085	079.530	1.084

x , xx Significant at the .05 and .01 levels of probability respectively .

Table (6):

Analysis of variance for the total dry yield (t /ha) of forage legumes grown as pure stands or in mixtures with wheat at different sowing rates and studied at flowering stage at Zetouneh and Mureijmah locations during the 1983 / 1984 growing season.

Source of	Zetouneh				Location	Mureijmah			
	Total	Forage	Legumes	Wheat	Total	Forage	Legumes	Wheat	
Variation	df ms	df	ms	df ms	df ms	df	ms	df	ms
Blocks	3 .016 xx	03	0.003	3 .020	3 .123 x	03	.017	03	.146 x
Treatment	15 .095 xx	15	2.780 xx	11 .054 xx	15 .045	15	.242 xx	11	.085 x
Error	45 .002	45	.011	33 .009	45 .041	45	.050	11	.038

x , xx Significant at the .05 and .01 levels of probability respectively .

Table (7) :

Analysis of variance for the production of seeds and straw of crops grown as pure stands at M'shaqar location during 1982 / 1983 growing season.

Source of variation	df	ms
Blocks	03	.53[x]
Treatments	05	.24[x]
Error	15	.10

x Significant at the .05 level of probability .

Table (8) :

Analysis of variance for the total dry yield (t/ha) of forage legumes grown as pure stands and in mixtures with wheat at different sowing rates and studied at pod formation stage at Zetouneh and Mureijmah locations during the 1983 / 1984 growing season .

Source of	Location											
	Zetouneh						Mureijmah					
	Totals		Forage Legumes		Wheat		Totals		Forage Legumes		Wheat	
Variation	df	ms	df	ms	df	ms	df	ms	df	ms	df	ms
Blocks	03	.013	03	.003	11	.003	03	.003	03	.003	03	.003
		xx		xx		xx		xx		xx		xx
Treatments	15	.073	15	.442	11	.065	15	.040	15	.464	11	.048
Error	45	.017	45	.005	33	.002	45	.003	45	.021	33	.003

xx Significant at the .01 level of probability .

Table (9) :

Analysis of variance for the total dry yield (t / ha) of the forage legumes grown as pure stands or in mixtures with wheat at different sowing rates and studied at full maturity stage at Zetouneh and Mureijmah locations during the 1983 / 1984 growing seasm .

Source of Variation	Zetouneh Totals df	Zetouneh Totals ms	Zetouneh Forage df	Zetouneh Forage ms	Zetouneh Legumes df	Zetouneh Legumes ms	Zetouneh Wheat df	Zetouneh Wheat ms	Mureijmah Totals df	Mureijmah Totals ms	Mureijmah Forage df	Mureijmah Forage ms	Mureijmah Legumes df	Mureijmah Legumes ms	Mureijmah Wheat df	Mureijmah Wheat ms
Blocks	03	.027 xx	3	.013 x	03	.010 xx	03	.013 xx	03	.003 xx	03	.007 xx				
Treatments	15	.156 xx	15	.540 xx	11	.047 xx	15	.046 xx	15	.059 xx	11	.065 xx				
Error	45	.001	45	.006	33	.001	45	.001	45	.007	33	.004				

x, xx Significant at the .05 and .01 levels of probability .

Table (10) :

Analysis of variance for the total number of plants per square meter obtained from growing forage legumes as pure stands and in mixtures with wheat at different seeding rates and studied at flowering stage at Zetouneh and Mureijmah locations during the 1983 / 1984 growing season.

Source of	Location											
	Zetouneh						Mureijmah					
	Totals		Forage Legumes		Wheat		Totals		Forage Legumes		Wheat	
Variation	df	ms	df	ms	df	ms	df	ms	df	ms	df	ms
Blocks	03	0039.00	03	896.10^{xx}	03	039.85	03	208.43	03	0095.12	03	043.76
Treatments	15	4989.40^{xx}	15	5163.65^{xx}	11	890.29^{xx}	03	3568.57^{xx}	3	4215.88^{xx}	11	793.45^{xx}
Error	45	0299.40	45	0141.08	33	213.05	45	0333.76	45	0156.45	33	131.76

xx Significant at the .01 level of probability .

Table (11) :

Analysis of variance for the production of leaves , stems and spikes (expressed in percentage), of forage legumes grown as pure stands and in mixtures with wheat at different seeding rates and studied at pod formation and full maturity stages at Mureijmah location during the 1983 / 1984 growing season.

Source of Variation	df	Stage of Maturity: Pod Formation Mean Squares			Full Maturity		
		Leaves	Stems	Pods	Leaves	Stems	Pods
Blocks	03	001.80	02.37^{xx}	003.20	001.30^{x}	000.50	000.63
Treatments	15	282.90^{xx}	53.48^{xx}	125.86^{xx}	343.30^{xx}	240.75^{xx}	121.75^{xx}
Error	45	000.97	00.67	001.56	000.39	000.93	006.36

x , xx Significant at the .05 and .01 levels of probability , respectively .

Table (12) :

Analysis of variance for the production of leaves , stems and spikes (expressed in percentage), of wheat grown in mixtures with forage legumes crops at differnt seeding rates and studied at pod formation and full maturity stages at Mureijmah location during the 1983 / 1984. growing season .

Source of Variation	df	Stage of Growth: Pod Formation Mean Square			Full Maturity		
		Leaves	Stems	Pods	Leaves	Stems	Pods
Blocks	03	4.73	1.03	6.67	00.36	00.73	00.23
Treatments	11	22.98^{xx}	13.14^{xx}	7.10^{x}	87.82^{xx}	79.66^{xx}	597.02^{xx}
Error	33	2.44	00.64	2.87	00.57	00.92	042.16

x, xx Significant at the .05 and .01 levels of probaility , respectively .

LIST OF ABBREVIATIONS

Word or Sentence	Abbreviation
And others	et al
Arab Center for the Studies of Arid Zones and Dry Lands .	ACSAD
Artificial Insemination	AI
Centimeter	cm
Degrees of freedom	df
Dolar	S
International Center for Agricultural Research in the Dry Areas	ICARDA
Jordan Cooperative Organization	JCO
Jordan Dinar	JD
Kilogram	kg
Kilometer	km
Meter	m
Ministry of Agriculture	MoA
Millemeter	mm
Number	No.
Percent	%
Square meter	m^2
Veterinary	vet

وارتفاع اسعار الاعلاف وعدم توفر الاموال الكافية للمربين لشراء الاغنام والاعلاف ،ومشكلة عدم توفر المياه بشكل كاف في فصل الصيف ، ونقص الرعاة والعمال المهرة .

وبالرغم من هذه المشاكل فان تربية الاغنام مجدية اقتصاديا نتيجة لارتفاع اسعار لحوم الاغنام العواسي المرغوبة لدى المستهلك حيث ان متوسط حجم القطيع (١٨٥) رأسا يعطي دخلا صافيا يقدر ب (٤٣٧٩) دينارا وبمعدل(٢٣,٧) دينارا للرأس الواحده. لذا فان معظم المربين يرغبون في زيادة حجم قطعانهم من الاغنام، ان الاعمال الادارية لزيادة عدد الاغنام وزيادة انتاجيتها تشمل التكامل بين الانتاج النباتي وانتاج الاغنام بادخال المحاصيل العلفية في الدورات الزراعية في المناطق البعلية ، وتنمية المراعي وذلك بتنظيم الرعي من خلال تخفيض عدد الاغنام في المرعى الواحد واراحة المراعي للسماح بنمو الاعشاب الرعوية ، كما ان اختيار الاغنام المنتجة مهم ،وينصح بتأسيس جمعيات تعاونية تقوم بزيادة انتاج المراعي وحمايتها وتوفير الاعلاف والمياه وتقديم الخدمات المختلفة لمربي الاغنام بتكاليف مخفضة .

٢. لدراسة الكفاءة الانتاجية والجدوى المالية لزراعة المحاصيل البقولية العلفية تحت ظروف الزراعة البعلية ،تم اجراء تجربة ميدانية في موقع المشقر في لواء مادبا خلال الموسم الزراعي ١٩٨٢/١٩٨٣م. استخدم في التجربة ستة محاصيل زرعت مفرده وهي (الميدك ، البيقيه ، الكرسنه ، القمح ،العدس،والحمص) وثلاثة مخاليط (ميدك – قمح ، بيقيه – قمح ، كرسنه – قمح) . واستخدم في التجربة تصميم المكررات العشوائية التامة بأربعة مكررات . كانت كمية البذار المستخدمة للدونم للمحاصيل المفرده ١٢ كغم للبيقيه ، الكرسنه ،والقمح ،و ٨ كغم للعدس والحمص ، و ٢كغم للميدك ، اما كمية البذار المستخدمة للمخاليط فكانت

٢ : ٤ كغم للدونم لمخلوط الميدك – قمح ، و ٨ : ٤ كغم لمخلوط البيقيه او الكرسنة مع القمح . تم التسميد مع زراعة البذور باستخدام ١٠ كغم من السوبر فوسفات الثلاثي (٤٧٫٥ ٪ فو ٢أ ٥) للدونم .

تم دراسة الصفات الآتية :–

١ . الانتاج الكلي (كغم / هكتار) .

٢ . انتاج البذور .

٣ . انتاج التبن .

٤ . الصفات الانتاجية الآتية لنباتات البقوليات العلفية والقمح : وزن النبات (غم) ، ارتفاع النبات (سم) ، وزن البذور للنبات (غم) ، وزن التبن للنبات (غم) ، عدد البذور للنبات ، عدد القرون او السنابل للنبات ، عدد البذور للقرن او السنبله ، ووزن ١٠٠٠ بذره (غم) . وعلاوة على الصفات المذكورة اعلاه ، فقد اشتملت التجربة على تحليل للتكاليف والايرادات النقدية المتحققه من انتاج واستغلال الاعلاف في طور تكوين القرون . ومقارنة التكاليف والايرادات النقدية المتحققة من انتاج واستغلال البذور والتبن لكل من المحاصيل العلفية ، القمح ، العدس والحمص .

وفيما يلي ملخص لاهم نتائج التجربة :–

١ . لوحظ بصفة عامة تفوق معنوى واضح لمخاليط الاعلاف البقولية مع القمح على الاعلاف البقولية المفردة في طور تكوين القرون وفي طور النضج الكامل .

٢ . تبين النتائج الحالية تفوق مخلوط الميدك – قمح ، الكرسنه–قمح على مخلوط البيقيه – قمح في طور تكوين القرون وطور النضج الكامل .

٣. بمقارنة الانتاج المتحقق في طور تكون القرون وطور النضج الكامل ، تبين بوضوح زيادة المحصول من المادة الجافة لكافة المحاصيل البقولية العلفية سواء كانت مزروعة مفردة او مخلوطة مع القمح .

٤. ان زراعة المخاليط العلفية مع القمح كان لها تأثير على انتاج كل من الاعلاف والقمح . وبصفة عامة ، تم التوصل الى اتجاه لمعظم الصفات الانتاجية التي كانت موضع الدراسة . فقد كان هناك تفوق للنباتات المزروعة في المخاليط العلفية مع القمح . أما بالنسبة لنباتات القمح فقد كان الاتجاه معاكسا لذلك ، حيث لوحظ تفوق النباتات المزروعة في المخاليط العلفيه مع القمح على نباتات القمح في الزراعة المفردة وذلك لمعظم الصفات الانتاجية موضع الدراسة .

٥. ان استغلال الاعلاف الخضراء المنتجة في طور تكوين القرون من خلال السماح لاغنام المزارع برعي المحصول القائم حققت ايرادات نقدية اكثر من تلك المتحققة من بيع المحصول على شكل بالات علفيه .

٦. تفوقت المخاليط العلفية المستغلة في طور تكوين القرون في الايرادات النقدية على المحاصيل العلفيه التي زرعت مفرده .

٧. ان تأخير الحصاد من مرحلة تكوين القرون الى مرحلة النضج التام للمحاصيل العلفية ادى الى زيادة الانتاج من المادة الجافة ولكن نقص العلف في النوعية أدى الى نقص في الايرادات النقدية المتحققه في طور النضج التام عن تلك المتحققه في طور تكوين القرون .

٨. تفوقت محاصيل الكرسنه والعدس في الايرادات النقدية من مبيعات البذور والتبن على بقية المحاصيل المستخدمة في التجربة .

على ضوء النتائج المذكورة اعلاه ،فان التوصيات الآتي ذكرها تبدو مفيده وهامه :—

١. ان مخاليط الكرسنه مع القمح ،والعدس مع القمح تفوقت على زراعة المحاصيل العلفية المفردة عند اختبارها في منطقة مادبا .

لذا يوصي بزراعتها في المناطق البعلية ذات الظروف المشابهة .

٢. يوصي باستغلال مخاليط المحاصيل العلفية البقولية على شكل اعلاف خضراء في طور تكوين القرون وذلك لاعطاء مردود نقدي عالي نتيجة لارتفاع أسعار الاعلاف ذات النوعية الجيدة . ان تأخير الحصاد ينتج عنه نقص في الايرادات النقدية وذلك لانخفاض أسعار الاعلاف بسبب الانخفاض في نوعية الاعلاف كلّما تأخر الحصاد .

٣. بينت النتائج أهمية مخاليط المحاصيل العلفيه البقولية مع القمح في التكامل بين المحاصيل الحقلية والانتاج الحيواني تحت ظروف الزراعة البعلية في منطقة مادبا ، حيث حقق التكامل في انتاج الاعلاف وتسمين الحملان أفضل الايرادات (جدول رقم ٣٣) .

٤. يوصى باستغلال المحاصيل المفردة للكرسنه والعدس في شكل بذور وتبن في المواسم الجيدة .

٥. ان انتاج المحاصيل العلفية البقولية توفر نظاما مجديا لاستغلال التربه ، ويمكن ان تكون مصدرا لنوعية جيدة من الاعلاف ،كما وتوفر اكبر مرونه في برامج الانتاج الحيواني .

٦. يوصي باجراء مزيد من التجارب على المحاصيل العلفية في عدة مناطق وفي دورات زراعية مختلفة لتوفير مزيد من المعلومات الموثوقة عن زراعة الاعلاف في المناطق المختلفة الامطار .

لدراسة تأثير كمية البذار (كغم/ للدونم) للمحاصيل العلفية البقولية المزروعة مفرده وفي مخاليط مع القمح على انتاج المادة الجافة وعدد النباتات في وحدة المساحة (نبات / م٢) ومكونات النباتات. تم اجراء تجربة ميدانية في موقعي الزيتونه والمريجمه في لواء مادبا خلال الموسم الزراعي ٨٣/١٩٨٤م. استخدم في التجربة اربعة محاصيل علفيه بقوليه مفرده (البيقيه ،الكرسنه ،الجلبانه ، والبازيلاء العلفيه) . كما تم زراعة كل من المحاصيل المذكورة في مخاليط مع

القمح باستخدام معدلات مختلفة من البذور . استخدم في التجربة تصميم المكررات العشوائية التامة بأربعة مكررات. كانت كمية البذار المستخدمة للمحاصيل المفرده ١٢ كغم للدونم، اما للمخاليط فقد استخدمت النسب ٩ : ٣ ، ٦ : ٦ ، ٣ : ٩ (كغم/ دونم) من مخلوط المحصول العلفي البقولي مع القمح .

تم دراسة الصفات الاتية :—

١. الانتاج الكلي (طن / هكتار) وذلك في اطوار الازهار، تكوين القرون ، والنضج التام .

٢. عدد النباتات لوحدة المساحة (نبات/ متر مربع) .

٣. المحصول الناتج من مكونات النباتات العلفية والقمح (أوراق ، سيقان وقرون او سنابل) .

وعلاوة على ذلك فقد تم دراسة الجدوى الماليه لزراعة واستغلال الاعلاف الخضراء في طور تكوين القرون وفيما يلي ملخص لأهم النتائج :—

١— بينت النتائج أن الانتاج من المادة الجافة للاعلاف المزروعة في موقع المريجه كانت أفضل منها في موقع الزيتونه لتفاوت الامطار الساقطة بين الموقعين .

٢— بمقارنة الانتاج المتحقق في اطوار الانتاج تحت الدراسة ، تبين بوضوح أن تأخير الحصاد أدى الى زيادة في انتاج المادة الجافة لكل محصول علفي مزروع بصورة مفرده او في مخاليط مع القمح .

٣— بينت نتائج دراسة الانتاج الكلي للمحاصيل العلفية تحت الدراسة ان انتاج المحاصيل العلفية البقوليه زاد لكل محصول بزيادة نسبة البذور المزروعة (كغم/للدونم) ،ولوحظ اتجاه مشابه بالنسبة للقمح .

٤. تبين بصفة عامة أن زراعة المخاليط العلفية مع القمح باستخدام نسبة بذار ٩ : ٣ (كغم/ دونم) من الاعلاف البقولية ـ قمح ، قد حققت افضل انتاج من المادة الجافة في مرحلة النضج التام .

٥— بمقارنة الانتاج المتحقق من زراعة الاعلاف المفردة ،تبين تفوق الجلبانه في الانتاج على بقية المحاصيل العلفيه المستخدمة في التجربة .

٦— بدراسة عدد النباتات لوحدة المساحة (نبات/متر مربع) تبين أن زيادة كمية بذور الاعلاف المزروعة أدت الى زيادة عدد النباتات في الموقعين الذين تم فيهما اجراء التجربة ،ولوحظ نفس الاتجاه بالنسبة للقمح .

٧— تبين المعلومات المتوفرة من التجربة تفوق الكرسنه على بقية المحاصيل العلفيه في عدد النباتات لوحدة المساحة وباستخدام كميات البذور المختلفة في الزراعة المفردة وعند زراعتها في مخاليط مع القمح يليها البيقيه ثم الجلبانه فالبازيلاء العلفيه .

٨— تفوقت مخاليط الجلبانه ــ قمح ، الكرسنه ــ قمح ، والبازيلاء العلفيه ــ قمح على مخلوط البيقيه ــ قمح في جميع اطوار النمو موضع الدراسة .

٩— بينت النتائج ان أعلى انتاج لمكونات نباتات المحاصيل العلفية في طور تكوين القرون قد تحقق من الاوراق يليها السيقان ثم القرون . كما كان ذلك صحيحا ايضا في مرحلة النضج التام للبيقية والكرسنه فقط .

١٠— تبين من نتائج التحليل الاحصائي ان زيادة نسبة بذور المحاصيل العلفية المزروعة (كغم/ للدونم) أدت الى زيادة النسبة المئوية للاوراق والقرون ونقص النسبة المئوية للسيقان وذلك في طور تكوين القرون وكذلك في طور النضج التام .