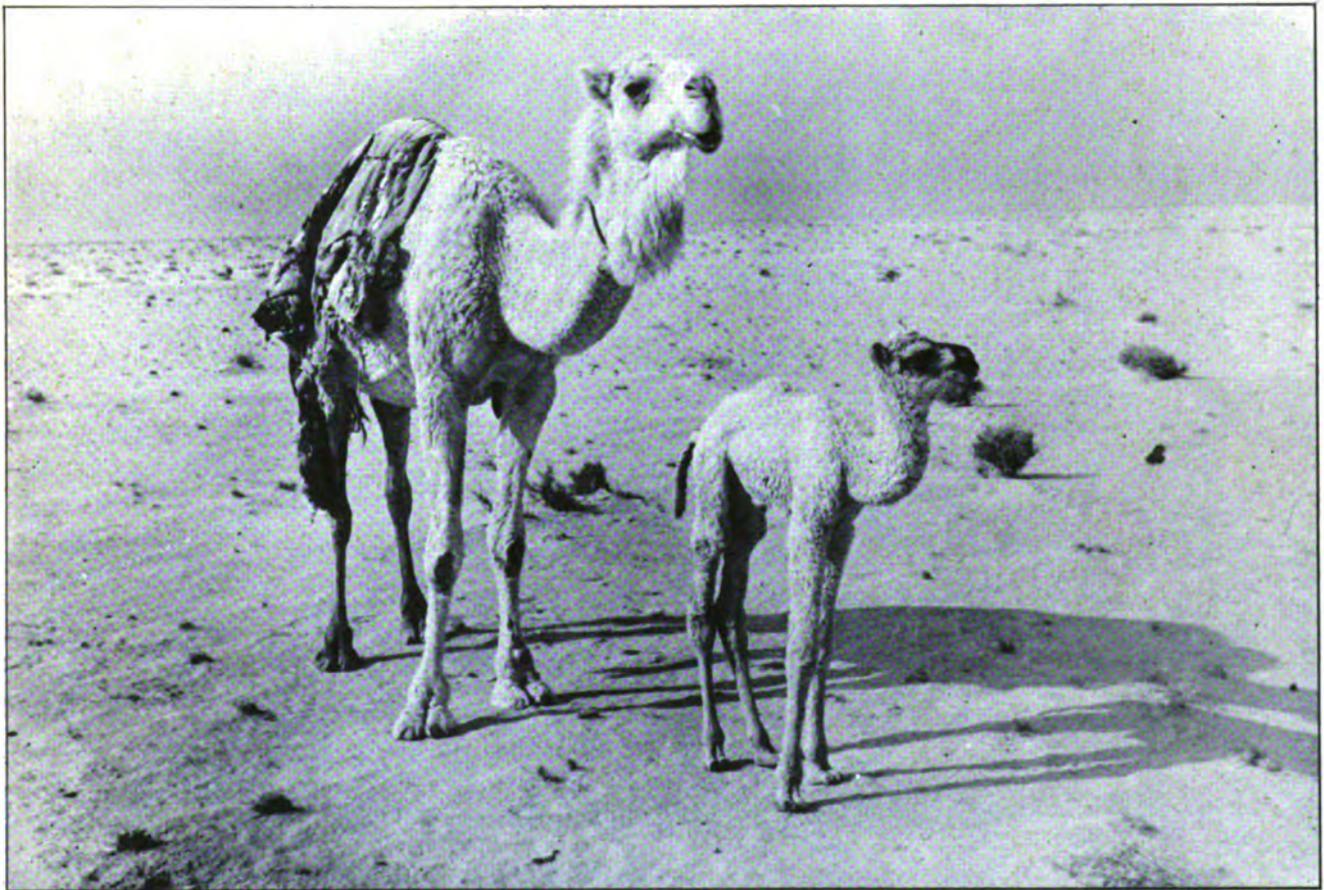


**FORAGE PROBLEMS  
AND  
RESOURCES OF IRAQ**



**INTERNATIONAL COOPERATION ADMINISTRATION  
Washington 25, D. C.**



FORAGE PROBLEMS AND RESOURCES OF IRAQ

by

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## FOREWORD

Iraq is a new country established on an old site under British mandate after World War I. It is now an autonomous kingdom. It is the land of the Caliphs romantically described in Arabian Nights. Mesopotamia of the Greek and Romans; Babylonia of Old Testament day; Sumeria of Abraham's time, and, according to local tradition, the site of the Garden of Eden. The recorded history of the land covers more than 5,000 years.

Iraq asked the United States to help show how to care better for livestock and still protect a limited and hard-pressed grazing resource. The request to advise Iraq in grazing matters was accepted with some misgivings. Range men from the United States -- a land where livestock grazing is only from 100 to 400 years old -- might be advising the descendants of those who first domesticated the horse, cow, sheep, goat and donkey. The prospect was challenging.

The ministries of Iraq are manned by educated, energetic men who are using income from taxes and oil to build facilities for health, education, improved agriculture and other advantages for the people. Such works were very limited until recently when the discovery of oil made funds available for public expenditure.

In common with other countries of the Middle East, the forage resources of Iraq have been under pressure for centuries. Livestock are everywhere; practically no land is left ungrazed. Pressure on the forage resources comes not only from grazing animals but also from the people, who gather the browse plants for fuel. The range lands for the most part are in a deteriorated condition, producing only a fraction of their potential. Cultivated forages are not commonly grown; improved pastures, almost unknown.

One of the acute problems is the imbalance between livestock numbers and seasonal forage supplies. Though an abundance of forage usually is available during the spring season, forage supplies often become critically short in other seasons, with the result that the nearly 13 million head of livestock are kept at low nutritional levels several months of the year.

This report is intended to aid agricultural workers in Iraq to grow and manage the more important adapted forages and at the same time serve to afford a fuller appreciation of the country's forage problems and resources.



## INTRODUCTION

The 12.5 million head of livestock in Iraq need great quantities of forage <sup>2/</sup> for maintenance, growth, and production. As a conservative estimate, based on standard nutritional requirements in the United States, these animals need about 30 million kilograms of dry forage per day, irrespective of TDN, protein, or mineral requirements. This is equal to about 900 million kilos per month, or about 11 billion kilos a year.

The general belief among animal husbandry specialists is that the livestock of Iraq are on deficient rations for many months of each year. The opinions of the specialists are based on the observations of livestock conditions as well as forage conditions. It is common knowledge that the animals of Iraq become very thin during certain seasons. It also is a common observation that the forage supplies become very scarce in the different regions at certain times. The available information on forage deficits is presented in summary form on the attached map and chart (Figure I). To facilitate presentation of this information, the country was divided into five "agro-climatic" regions. These regions were delimited on the basis of climate, natural vegetation, topography, and land use. Inspection of the chart shows that, in general, forage supplies are adequate from February through June for most regions in Iraq. The most critical forage shortage usually occurs during the August--January period, although in the northern and western steppes green forage may be available for a short time in late fall.

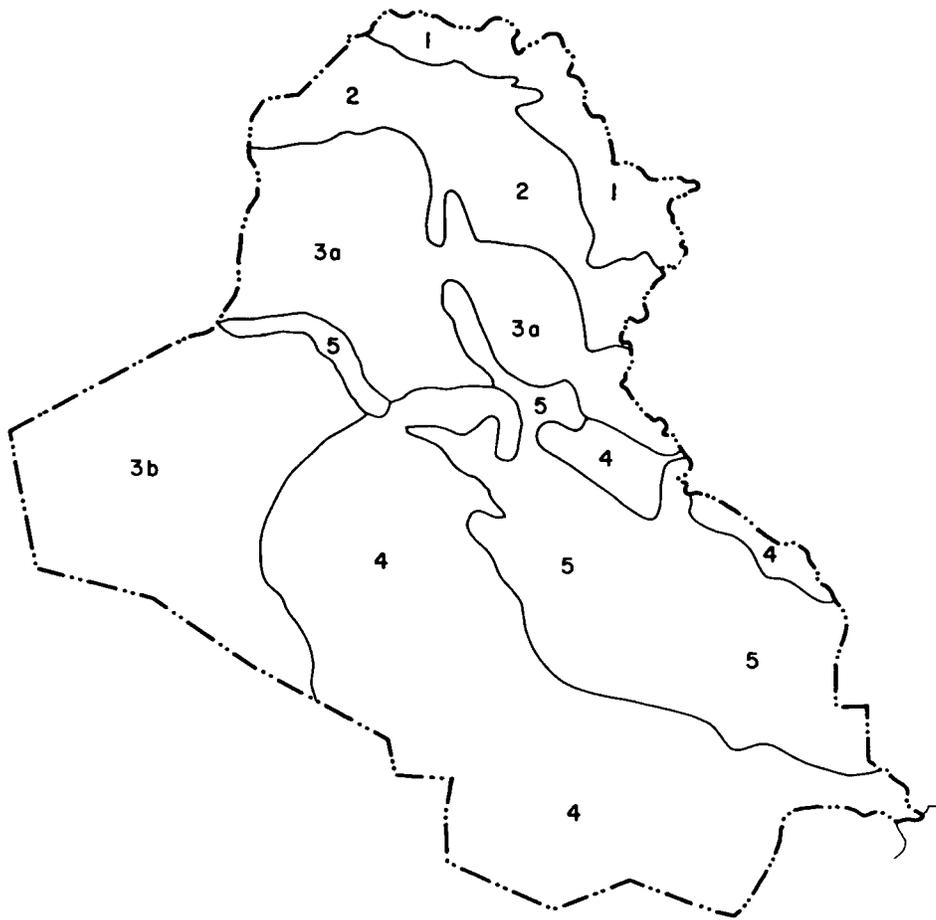
Beginning in winter and continuing through the spring an abundance of native forage is produced on the deserts and steppes of Central and Southern Iraq. On the other hand, development of the native plants in Northern Iraq is delayed because of relatively cold temperatures. The January-February period is sometimes one of critically short forage supplies in the Northern Steppe and Desert Region.

The periods of forage deficit and abundance of supply are well defined in the Northern Mountain Region. Forage supplies are less erratic from year to year in this region than in the other regions. Although the people cut the native plants for hay

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<sup>2/</sup> The word "forage" when used in the broadest sense refers to anything eaten by livestock; but, in the usual sense it means roughages such as pasture, hay, silage, and straw. This is in contrast to concentrate feeds, for example, the grain of wheat, barley, sorghum and maize, which ordinarily are not considered as forage.





NO. OF REGION	NAME OF AGROCLIMATIC REGIONS (BASED ON CLIMATE, TOPOGRAPHY, LAND USE, VEG.)	PERIODS OF FORAGE DEFICIT												TOTAL NO. OF MOS.	
		JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.		
1	Northern Mountain	■	■	■	■									■	5
2	Northern Cultivated	■	■											■	3 1/2
3a	Northern Stepp and Desert	■	■					■	■	■	■		■	6 1/2	
3b	Western Stepp and Desert	■				■	■	■	■	■			■	6 1/2	
4	Central and Southern Desert					■	■	■	■	■	■	■	■	6 1/2	
5	Central and Southern Irrigated							■	■	■			■	3	

Figure 1 - Agroclimatic regions and forage deficits in Iraq.

in some localities and store it for the long winter seasons, this practice is not widespread. As a consequence of not storing adequate forage supplies, many livestock die from exposure and starvation during severe winters. Forage deficits during winter can be marked and the results disastrous in the northern regions. The same applies in the central and southern regions except that summer and fall, instead of winter and early spring, are the seasons of deficit.



Figure 2. During the spring the desert and steppe ranges are at their peak in forage production. An unusually lush growth of spring vegetation was encountered near Khanaqin in March, 1953, following a season of abundant moisture. Most of the vegetation is annual and literally "burns up" when the summer heat begins.

## SOURCES OF FORAGE

Feed for livestock comes from both the native and cultivated forage plants. Agricultural statistics are not available for forage crops, but estimates can be made of the contribution of the various kinds of forage to the total year-round feed supply. Estimates of forage contributed by cultivated and native forage plants are as follows:

<u>Agro-climatic region</u>	Forage contributed by	
	<u>Cultivated plants</u> Percent	<u>Native plants</u> Percent
1. Northern Mountain	10	90
2. Northern Cultivated	20	80
3. Northern and Western Steppe and Desert	2	98
4. Central and Southern Desert	0	100
5. Central and Southern Irrigated	30	70

### . Native Forage Plants

Native forages contribute nearly 100 percent of the total supply in the desert and steppe regions as compared to a smaller percent in regions where most of the land is cultivated. Even in the cultivated regions the native vegetation supplies the bulk of the forage. Shok, camelthorn, Bermuda grass and many legumes, grasses, and other plants on the fallow lands and in the stubble fields contribute substantial quantities of forage. Weeds along the irrigation canals and roadsides also supply considerable forage. The native plants are, in fact, the mainstay of the animal population for many months of the year.

The native forages of Iraq can be divided into five main groups 3/ according to where they occur.

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3/ Based on the classification by J. B. Gillet in the Pastures and Wild Fodder Plants of Iraq, a typed manuscript, 1947.

- (1) Deserts and dry steppes remote from cultivation .
- (2) Irrigated cultivated land in the plains .
- (3) Cultivated lands in the rainfed areas of the less arid steppes and lower mountains .
- (4) Pastures of the oak forest zone .
- (5) Mountain pastures above the upper limits of oaks .

These groups of forage are described briefly below.

### Deserts and Dry Steppes

Three classes of forage may be recognized on the deserts and dry steppes:

- (a) Perennial herbs, such as bulbous bluegrass<sup>4/</sup> and sedge
- (b) Annuals, such as the common annual Stipa, little barley, Plantago, mallow, Erodium, and many legumes
- (c) Perennial woody and semi-woody plants, such as Haloxylon, Sueda, and Atriplex.

The first class, owing to their ability to respond quickly to favorable moisture and temperatures, are especially valuable as forage immediately after the first winter rains. They provide much needed forage at a critical season.

The annuals develop more slowly, after the temperatures are warmer. In the south the cold weather does not check their growth, but in the north they do not develop until spring. In the north, therefore, there often is a critical period between the fall grazing of bulbous bluegrass and the development of spring annuals.

The third class--woody perennials--are important because they provide grazing in summer and fall when the other plants are absent or dormant. The Bedouins report that the most valuable of the woody plants have disappeared within the last 40 years. This is due partly to the building up of livestock numbers since tribal warfare has been suppressed and partly to the cutting of shrubs for fuel.

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<sup>4/</sup>  
Common and scientific names for the plants may be found in Notes on Plants and Plant Products with their Colloquial names in Iraq, by Evan Guest, U. S. Department of Agriculture Bulletin No. 27, 1933.



**Figure 3. Extensive areas of the Jezira in northwestern Iraq are relatively smooth and covered with a short growth of bulbous bluegrass and sedge.**

#### **Grazing on the Irrigated Lands in the Plains**

Because the perennial vegetation on the steppes and deserts has been depleted, many of the Bedouins are now forced to move to the fallow and stubble fields in summer and fall. This means that a greater grazing pressure is being put on the cultivated lands for forage. In order to balance livestock numbers and forage supplies, it will be necessary to produce more forage on the farms of the irrigated regions.

At the present time all the irrigated lands of Iraq, including the marshlands, are grazed at some season during the year. The vegetation of the irrigated lands may be classified as follows (after Gillet, 1947):



Figure 4. Sparse pasturage is the rule in Iraq, except during the spring. This closely grazed moist steppe range is west of Sulaimaniyah in a region of relatively high precipitation.

1. Aquatic and semi-aquatic vegetation is extensive in southern Iraq. A common practice is to burn accumulations of marsh vegetation to provide fresh young shoots for water buffalo. *Phragmites communis* and *Typha angustata* are the main forage species, but they are of value for grazing only when young and succulent.
2. The vegetation of river banks and irrigation canals includes weeds of the croplands and such species as *Tamarix pentandra* and *Capparis spinosa*.

3. The weeds and stubble of spring crops provide useful grazing for several months. Species of legumes are probably the most valuable of the weedy plants. Among the legumes common in the fields in spring are *Medicago hispida*, *Melilotus indica*, *Trigonella* spp., *Vicia* spp. and *Lathyrus* spp.
4. The weeds and stubble of summer crops likewise provide useful grazing. However, weeds are relatively less abundant in the summer-crop fields. *Lotus tenuifolius* is one of the valuable weeds where it occurs. Among the grasses, Bermuda and Johnson grass are the most useful for grazing; these two grasses are undesirable, however, because they spread and compete with cash crops.



Figure 5. Rocky overgrazed hillsides do not provide ideal grazing for growing animals. Nevertheless, nearly all the natural forage is "stripped" from most hillsides before the end of summer.

5. The plants of saline areas in the irrigated plains of Iraq are of particular importance. In addition to their value as forage they also serve as indicators of soils which are either high in salt content or which pose drainage problems. For example, camel thorn generally indicates a saline soil. Species of Sueda and Schanginia also are indicators of salinity. Aeluropus repens, which bears a superficial resemblance to Bermuda grass, is the most salt-tolerant grass of grazing value, but it often is so salty as to be unpalatable.

Grazing on Rainfed Lands of the Steppes and Lower Mountains

Many different plants of grazing value grow as weeds in the cultivated fields of rainfed areas. The following is only a partial list.

Legumes:

Trifolium procumbens

Vicia narbonensis

T. tomentosum

V. sativa

Medicago orbicularis

V. tenuifolia

M. rigidula

Lathyrus cicera

Grasses:

Alopecurus arundinaceus

Bromus squarrosus

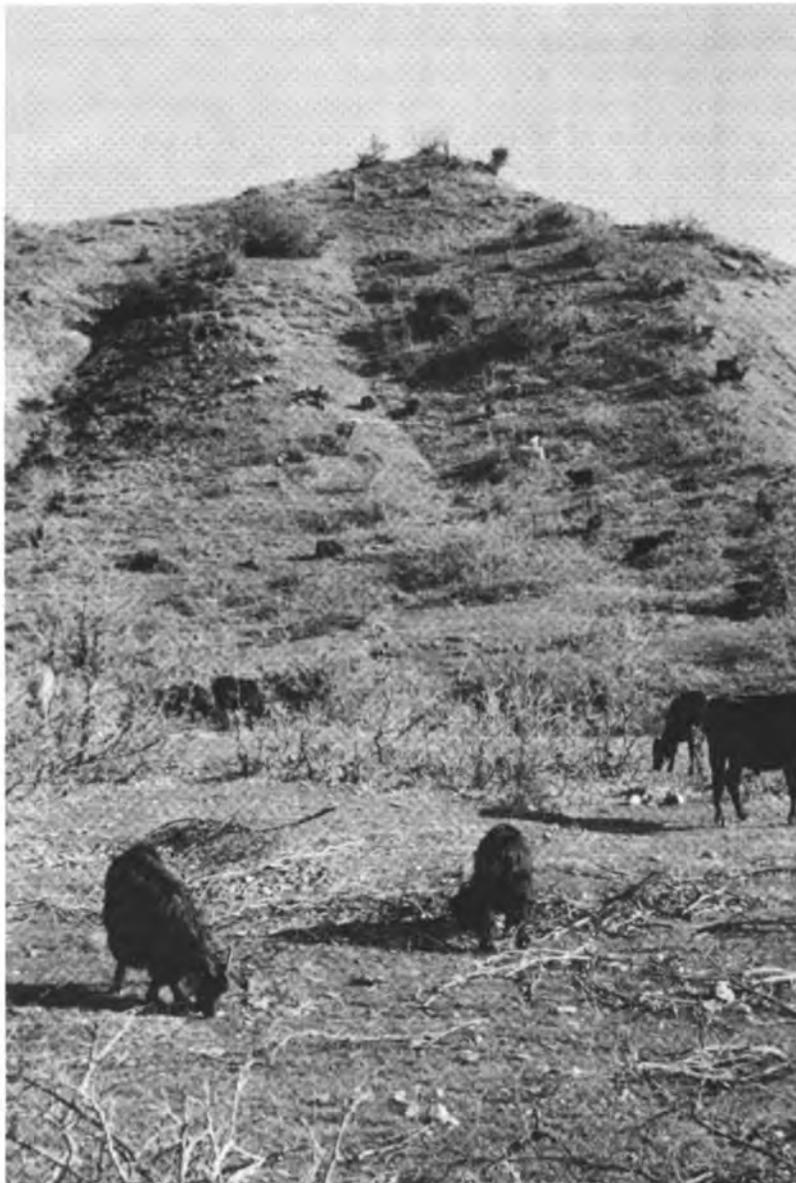
Avena wiestii

Aegilops spp.

These species flower in the spring or early summer at the same time the crops are growing. After the stubble is grazed over in late summer there usually is a shortage of forage. About the only plant which remains green is Prosopis stephaniana, the common shok, a thorny deep-rooted perennial legume that provides a limited amount of grazing.

Grazing in the Oak Forest Zone

Oak forests occur between 800 and 1800 meters elevation in the mountains of northern Iraq. This zone is rich in valuable grazing



**Figure 6. Shrubby growth in the mountainous parts of Iraq furnishes useful grazing for goats though the goats often do damage to the oak trees.**



Figure 7. Village flocks usually are grazed near the village itself under the care of a young boy or girl. This is a small flock of lambs and kids grazing on short spring vegetation near Asi in Mosul Liwa.

species, but little is known about their abundance or frequency of occurrence. The following list of forage species indicates, to some extent, the value of the oak forests for grazing:

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Grasses

Chrysopogon gryllus

Cymbopogon schoenanthus

Phalaris paradoxa

Poa bulbosa

Lolium rigidum

Hordeum bulbosum

Legumes

Medicago sativa

Trifolium campestre

T. resupinatum

Medicago radiata

Trigonella spp.

Onobrychis squarrosa

Others

Salvia cristantha

Teucrium parviflorum

Plantago lanceolata



Figure 8. Some of the natural grazing lands in northeastern Iraq pose problems of management due to rough topography.

Because of forage shortages in winter, the people in the oak forest zone collect plants or plant parts in summer and autumn and store them as hay or dry forage. Oak branches are widely used as stored forage. They are lopped, dried and usually stored in the forks of trees. Other plants are cut and cured as forage, including Prangos ferulacea, P. crenata, Carduus pycnocephalus and Hordeum bulbosum. Hay is cut from the wet meadows to a limited extent.

#### Pastures Above Tree Limit

These pastures which occur above 1700 meters elevation furnish many valuable forage plants. Along the streams and in the wet meadows the principal forage plants are legumes such as red, white, Persian, and strawberry clovers. On well drained lands wild alfalfa is common. This wild type spreads by a well developed lateral root system and is ideally suited for grazing. The shepherds of Northern Iraq recognize it as a valuable grazing plant.

Many other valuable forage legumes and grasses are found in this treeless zone. Often mixed with the alfalfa and clovers are orchard grass, Lolium spp. and Sanguisorba minor. Agropyron intermedium is a common species on the slopes. Other perennial grasses are Agropyron trichophorum, A. elongatum, Bromus spp. and Stipa spp. Annual and ephemeral perennial species such as Poa bulbosa, and Elymus spp. are also found.

The extent of this zone is not well defined, but it has been estimated at 2,575 square kilometers. Many livestock are herded into these areas during June, July, August, and September when the vegetation is at its peak of growth.

#### Improvement of the Native Forage Plants

A great wealth of superior pasture and forage plants grows naturally in Iraq. These plants can be improved and developed through intensive research. As Dr. O. S. Aamodt, international authority on forage, pointed out during his trip through Iraq in May, 1953:

"The plants that persist naturally in any given region over a long period of time are those that have been successful in adjusting themselves to the factors that limit the growth of vegetation in their particular

environment. In order to survive in any given region, plants have to withstand the extremes in drought, cold, wind, insects, diseases, and competition with other plants common to the region in which they are grown. The species and varieties of plants that can grow to maturity and reproduce in competition with other plants are those that are selected by Nature's 'trial and error' process to cover that land."

These indigenous materials should be used in developing pastures and other forage for livestock. To the student in Iraq who would render his country an invaluable service, there is a vast number of superior pasture legumes and grasses to be discovered and developed.



Figure 9. A common practice in the oak forest regions of northern Iraq is to pollard the oak trees. Pollarding consists of lopping the branches but leaving the main trunk alive. The branches and leaves are dried and used as forage. Oak leaves and branches are a principal forage during winter in many northern areas.

### Cultivated Forage Crops

Cultivated forages do not have a prominent place in Iraq. Probably not more than 5 percent of the cultivated land is devoted to growing forage for livestock. This is in sharp contrast to the situation in many other countries where 20-75 percent of the cultivated land is planted to forage crops.

Among the more important cultivated forage crops are barley, alfalfa, sorghum, millet, maize, berseem, sudangrass, chickling vetch, lentils, and lubia. Alfalfa and green barley are undoubtedly the most important cultivated forages in Iraq.



Figure 10. Green barley is an important source of supplemental forage. High in protein, green barley furnishes valuable grazing at a time when forage is especially needed. The young lambs usually born at this time need much milk to give them a good start. However, if the stand of barley is over grazed the yield will be substantially reduced.

## Barley (Hordeum vulgare)

Barley is grown primarily for grain, but as a green forage it contributes significantly to the total feed supply for livestock. It is a common practice to graze barley stands once early in the season in central and southern Iraq where it is grown under irrigation. Cutting the barley and feeding it as a green forage is also a rather common practice. These practices are less commonly followed in the rainfed areas of the north.

Light or early grazing or harvesting probably causes no serious reduction in grain yields, but heavy grazing or late grazing definitely reduces the yield of barley. Preliminary experimental findings indicate that reductions in grain yields are of the following magnitude:

<u>Number and time of pasturing or harvests</u>	<u>Reduction in yield of grain (in percent)</u>
One (early)	0 to 10
One late)	20 to 30
Two	40 to 50
Three	70 to 90
Four	95 to 100

As the above figures show, barley stands produce practically no grain when they are grazed several times. The figures also indicate that a substantial reduction in grain yield results when the barley is grazed or harvested late in the growing season.

Barley usually is sown the last half of October if it is to be pastured green. The seeding rate is 20 to 25 kilograms per donum. Livestock should not be turned on to graze until the plants are 25 to 30 centimeters tall. If planted only for forage, it is possible to get three cuttings or pasturings. The total yield of green forage under these conditions is about 4 to 6 metric tons per donum.

Estimates of the contribution of green barley to the total forage supply of the country are:

Region 2	--	3 percent
Region 5	--	8 percent

## Alfalfa (Medicago sativa)

Though well adapted, alfalfa is not as extensively grown as barley. It is estimated that less than one-tenth of one percent of the irrigated cultivated land in Iraq is devoted to alfalfa. Nearly the entire production of alfalfa is harvested and fed as green forage. Little attention is paid to stage of growth in harvesting; the plants are customarily cut in a pre-bloom stage but sometimes the plants have set seed before being harvested. Alfalfa is seldom grazed and practically none is stored and fed as hay or silage.

Alfalfa contributes the following estimated amounts to the total forage supply:

Region 2 -- 1 percent

Region 5 -- 5 percent

Seeding usually is done either in March or in October. The rate of seeding is 6-8 kilograms per donum. An alfalfa stand can be expected to persist for 4-6 years under good management. During the summer the alfalfa grows rapidly and can be cut for forage every five weeks, whereas in winter the growth is slower and cuttings are spaced 60-80 days apart. The principal growing season is from March to November, but alfalfa produces forage the year round in Central and South Iraq. Under good management adapted varieties of alfalfa can be expected to yield 3 to 4 metric tons of air dry forage per donum from 5-6 cuttings in Central Iraq, if time of cutting is based on the one-tenth to one-fourth bloom stage. When the usual practice of cutting and feeding green is followed, a total of 12-14 tons of green forage is obtained from 8 to 10 cuttings.

At the Abu Ghraib Experiment Station, where tests of different alfalfas have been carried on for several years, the following introduced varieties appear to be best adapted: Peruvian, Buffalo, Arizona Chilean, Kansas Common, New Mexico Common, Hairy Peruvian, Indian, and African. Highest yields of forage came from the Buffalo and Peruvian varieties (see Tables 1 and 2). However, these yields must be judged in light of the short-term nature of the experiments and the fact that the tests were not replicated. Observational data indicates that the Indian and African varieties are as productive as the varieties for which reasonably reliable yield results are available.

Several local strains or types are recognized and grown in various parts of the country. Based on preliminary trials the local

strains appear well adapted to soil and climatic conditions in Iraq and may indeed be more productive than the introduced varieties. Excellent opportunities exist for doing selection work with the local strains. At present the alfalfas grown locally appear to be composed of a divergent mixture of types, probably due to mixing of seeds.

Table 1. Air-dry forage yields of three alfalfa varieties planted at the Abu Ghraib Experiment Station in 1948.

<u>Variety</u>	<u>5 / Air-dry forage yield per donum</u>		
	<u>1950</u> kg.	<u>1951</u> kg.	<u>1953</u> kg.
Peruvian	4400	5550	1911
Kansas Common	3100	3750	1452
Buffalo	5700	6450	879

5/ 1950 and 1951 yields were probably not completely air-dry.

Table 2. 1953 forage yields of six introduced alfalfa varieties planted at the Abu Ghraib Experiment Station in November 1952.

<u>Variety</u>	<u>Air-dry yield per donum</u> kg.
Buffalo	4949
Peruvian	4496
Arizona Chilean	3922
New Mexico Common	3880
Kansas Common	3742
Hairy Peruvian	2276

### Other Forages

Other forages considered collectively are important in the forage supply picture. Sorghum, berseem, maize, and cereal straw and stubble are perhaps the most important. It is estimated that forages other than alfalfa and green barley contribute the following to the total supply:

Region 2 -- 16 percent

Region 5 -- 17 percent

### Sorghum or Durra (Sorghum vulgare)

The local white durra is well adapted, productive, and rather extensively planted on irrigated lands in southern Iraq and to a lesser extent in Central Iraq. It probably should be classed as a dual-purpose sorghum. However, the usual practice is to let the plants mature fully before harvesting them. By then, the stalks are dry, woody, unpalatable, and low in nutrient content. If harvested earlier, when the seeds are in the dough stage, the local durra is an excellent forage, suitable for ensiling or storing as dry fodder.

Sorghum can be planted for forage anytime from April to August. The usual seeding rate is 6 kilograms per donum for broadcast planting. Row planting is more desirable but sorghum is usually broadcast seeded in Iraq.

Experimental results obtained at the Abu Ghraib Experiment Station provide some interesting comparisons and, in general, indicate which varieties can be expected to be most productive. A June 1953 planting of four varieties gave the following yield results:

<u>Sorghum Variety</u>	<u>Yield of green forage per donum</u>
Honey	10240
Hegari	6440
Local Durra	5300
Red bine	5670

As the above figures show, the Honey variety produced nearly twice as much forage as the local variety. It would be useful for silage if cut before it becomes too rank in growth.

Based on two years' experimental results the following varieties rank highest as dual-purpose sorghums for irrigated lands in Central Iraq: Hegari, Early Hegari, Local Durra, Double Dwarf 38, Kalo, and Cody. As further information is obtained, the ranking of these varieties will undoubtedly change, but it may be significant that Hegari has outyielded the local variety in both grain and forage in all trials to date. Hegari produced more than 600 kilos of grain per donum in 1952 and eleven tons of green forage per donum in one test in 1953 (see Table 3).

**Table 3.** Comparative grain and forage yields of seven sorghum varieties grown in 1952 and 1953 under irrigation at the Abu Ghraib Experiment Station.

<u>Variety</u>	<u>Air-dry forage yield per donum from April 1953 planting</u> kg.	<u>Grain yield per donum from 1952 planting</u> kg.
Hegari	11420	610
Early Hegari	9418	406*
Local Durra	10135	250**
Double Dwarf No. 38	8646	375
Kalo	8080	417
Cody	9288	265
Waxy Combine Milo	5803	700

\* Results of a separate experiment.

\*\* Obtained from farm records.



**Figure 11.** Several varieties of sorghum have proved well adapted for seeding on irrigated lands in Central Iraq. This June 1953 planting of the Honey variety produced more than 10 tons per donum of sorghum suitable for silage. High yields were also recorded for the Hegari and local varieties of sorghum.



**Figure 12. Mixtures of berseem and oats or berseem and barley provide an abundance of high quality forage during the winter and spring.**

**Berseem (*Trifolium alexandrinum*)**

Often called Egyptian clover, berseem is not widely grown in Iraq though it is well adapted to the climate and soils of the central irrigated region. It thrives in a warm climate but does not withstand excessive heat or cold. Optimum temperatures for growth appear to be between 11 and 25°C. Berseem is adapted to a wide variety of soil types and is tolerant of moderately high salt concentrations.

Its production comes from late fall to early spring. Under irrigation it is possible to obtain 4 to 7 cuttings and a total yield of

about 10-12 metric tons of green forage per donum. Usually the first cutting is made 60-70 days after planting. Succeeding cuttings are made 30-40 days apart. In Iraq, berseem is usually managed strictly as pasture. It can also be used for silage or hay. Its succulent stems, however, are difficult to dry and hence its value as hay is somewhat less than for pasture or green forage. Excellent pasture was developed at the Abu Ghraib Experiment Station by seeding a mixture of berseem and oats at the rate of 5 and 40 kilograms per donum, respectively.



**Figure 13.** The winter annual legume which shows outstanding adaptability for Central Iraq is berseem. It produces an abundance of palatable nutritious forage and is suited for pasture and silage as well as for green forage.

The best time to plant berseem is in October and the usual seeding rate is 6 kilograms per donum.

The green forage is palatable, nutritious, and readily digestible. Moisture content ranges from 78 to 85 percent. It is lower in digestible protein and TDN than green alfalfa, but it is also lower in crude fiber content than alfalfa.

#### Sudangrass (Sorghum vulgare var sudanense)

As an annual which thrives in hot, dry climates, sudangrass is well suited to the irrigated plains of Central and Southern Iraq. Under trial at the Experiment Station, it has yielded about 6 to 9 metric tons of green forage per donum. Despite its adaptability and productivity, sudangrass is not widely grown, and its use should be expanded.

Sudangrass is especially valuable because it provides forage during mid-summer when forage generally is deficient. It is better for pasture than hay because the large juicy stems dry out slowly and make it difficult to cure. Moreover, it is much lower in feeding value than alfalfa hay.

Sudangrass seeds should be sown in March or April at the rate of 8 kilograms per donum. It will grow 3 to 8 feet tall if not pastured, but for most efficient use it should be grazed three to six times during the growing season. Livestock should not be turned in on sudangrass until the plants are 50 to 60 centimeters tall if prussic acid poisoning is to be avoided. Though drought resistant, sudangrass is most productive when well watered (see Table 4). Moreover, the danger from prussic acid is less from plants which are irrigated frequently.

#### Millet (Panicum miliaceum)

While grown primarily for grain, millet is sometimes sown in parts of Central and Southern Iraq to provide green forage in summer. Ordinarily the grain is fed to poultry and livestock as a concentrate. Millet is a fast-growing, hot weather crop which is suitable as a "catch crop" on irrigated lands in Iraq. Only 60-80 days are required from time of planting to seed maturity.

Millet is usually seeded in late March or early April at the rate of 5 to 6 kilograms per donum. It should be cut before the first heads appear for the best quality forage. If it is planted mainly for pasture, millet should be grazed when about 30 centimeters tall. Three pasturings can be gotten in a season.

### Maize or Corn (Zea mays)

Maize yields a substantial quantity of good quality forage if planted thickly. It is a rather common practice in Iraq to graze maize that has been seeded at a high rate. Maize forage is rich in nutrients, but it should be allowed to reach a mature stage of growth that it may obtain the maximum of nutrients. It makes excellent silage and will yield 5 to 7 metric tons per donum under irrigation in Central Iraq. Silage from well-matured maize makes a good succulent feed for sheep.

Maize generally is planted in March to provide pasture in May and June, or in September for November pasture. June plantings have given the highest yields for silage or fodder. It should be seeded at 15 kilograms per donum. The Lalton variety is commonly planted. However, other varieties under test at the Experiment Station promise to be more productive. Several Texas Hybrids in particular are high in yields.

Table 4. Air-dry forage yields of five varieties of Sudangrass grown under four different intensities of water stress.

<u>Variety</u>	<u>Air-dry yield per donum by intervals between irrigations</u>			
	<u>7-10 days</u> kg.	<u>10-15 days</u> kg.	<u>25-40 days</u> kg.	<u>50-60 days</u> kg.
Common	2152	3107	1012	584
Wheeler	3043	2100	1985	812
Tift	2056	2194	1164	929
Piper	2156	2013	784	902
Sweet	1959	1679	734	679

### Oats (Avena sativa)

A very common forage crop in most countries, oats is hardly known in Iraq. It has proved to be well adapted and highly productive at the Experiment Station. Mixed with berseem or vetch it makes an excellent green forage, hay, or silage crop.

Oats for pasture should be seeded at the rate of 25 to 40 kilograms per donum in October or November. A yield of about 4 to 7 tons of green forage can be expected under irrigation in Central Iraq. On the basis of preliminary information the Palestinian variety appears somewhat more productive for areas similar to the Abu Ghraib Station, whereas the Canadian variety may yield slightly more green forage in the region near the Hawija Station. (See Table 5)

Table 5. Yields of green forage of three varieties of oats grown under irrigation at the Abu Ghraib and Hawija Stations and clipped one to four times during the growing season.

<u>Station</u>	<u>Variety of Oats</u>	Yield of green forage per donum* by number of clippings per season.			
		1	2	3	4
		Kg.	Kg.	Kg.	Kg.
Abu Ghraib	Palestinian	6780	6130	4060	5620
	Russian	6330	5950	3440	3490
	Canadian	4650	4430	1910	4120
Hawija	Canadian	881	1648	2715	3049
	Russian	472	1264	2862	2585
	Palestinian	359	1197	2294	1925

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\* A donum is approximately .6 acre.

### Soybeans (*Glycine max*)

Soybeans are not grown in Iraq except at the Experiment Station. On the basis of several years testing they appear to have a place in Iraq's agriculture as a hay and soil improving crop. Several varieties have shown promise for forage, among them the Laredo and Ogden varieties.

Seedings made during the period May 15 to July 15 have been most productive, based on preliminary results. Seeds should be planted at the rate of 15 kilos per donum on small ridges 50-75 cm. apart. The plants should be thinned to a distance of 10-15 cm. in the rows. Plants may be cut at any time from pod formation until the leaves are nearly dry. When the beans are well formed, the hay contains about 60 percent leaves. Yields of from 1 to 2 tons of soybean hay per donum can be obtained under irrigation.

### Lubia or Cowpeas (*Vigna sinensis*)

This legume is widely planted for beans and is sometimes used for forage in Iraq. It is well adapted and will yield 7 to 9 tons of green forage per donum under irrigation. Hay made from lubia is rich in nutrients and highly digestible. It can be planted anytime from April to September. Seeding rates should be about 25 kilos per donum when broadcast seeded or 10 kilos per donum when seeded in rows 90 centimeters apart. An excellent hay crop can be obtained by seeding a mixture of 15 kilos of lubia and 4 kilos of sudangrass per donum.

### Broad Bean (*Vicia faba*)

Like lubia, this legume is also grown chiefly for the beans. It is widely grown as a winter crop, usually under irrigation. Very little use is made of it as forage, though it yields 6 to 7 tons of green forage per donum under irrigation.

Broad beans are often seeded in mixture with barley. The green barley is cut by hand from around the bean plants and used as green forage. This mixture should make good silage.



**Figure 14.** Because of greater yields and better palatability, oats may be more suitable for temporary pastures than barley. In mixtures with berseem it produced substantially more forage than barley in Central Iraq. The Palestinian variety produced more forage than the Russian or Canadian varieties in 1953 tests at the Abu Ghraib Station.

#### Chickling Vetch (*Lathyrus sativus*)

Chickling vetch is rather extensively planted, especially in northern Iraq. In the 1949-50 season a total of 35,000 donums were seeded to this crop. It is mainly planted for the seeds, but it also furnishes a good quality forage when harvested before the vines dry up and turn brown. The usual seeding rate is 12 to 15 kilograms per donum. It is an annual cold season crop and should be seeded in the fall.



**Figure 15.** Soybeans promise to become an important forage crop in Iraq. The Laredo and Ogden varieties have given the best results in experiments at the Abu Ghraib Experiment Station.

**Lentil (*Lens esculenta*)**

Lentils are cultivated in the upper plains and mountains where they are well adapted. They are grown to a lesser extent in the Central irrigated region. In the 1949-50 winter season about 45,000 donums were planted to lentils.

The main use of this crop is for human food, however, it provides excellent forage. It is also good for soil improvement in rotations with cereal grains. Based on observational evidence, lentils should succeed in legume-cereal rotations in those parts of the rainfed zone where the average annual precipitation is 450 mm. or more.

### Green Gram (*Phaseolus aureus*)

Green gram is one of the most important leguminous summer crops in Iraq. It is seeded mostly in the irrigated regions. Green gram is a valuable forage or green manure crop, but in Iraq it is primarily planted to provide human food. It will yield 1-1/2 tons of dry forage per donum under irrigation. In 1950 a total of 70,000 donums were seeded to green gram.

Seedings should be made from April 1 to July 1. Cultural requirements are nearly the same as for lubia.

### Chick Pea (*Cicer arietinum*)

This winter legume is cultivated to a somewhat limited extent in Northern Iraq. The seeds are used for human food and the rest of the plant for forage after threshing. It should be seeded between October 1 and November 15 and is ready for harvest in April or May. Chick peas are a good soil improvement crop. The forage is not high quality, however, because of the presence of oxalic acid in the leaves.

### Rape (*Brassica napus*)

Though not extensively grown, rape is nevertheless a well adapted crop. It is cultivated chiefly for its seed, but small patches are sometimes grown for forage. Rape furnishes excellent forage for sheep. It should be grazed when 25-30 centimeters tall. If seeded in October, it can be pastured from December 1 to April 1. Mixtures of rape with oats or barley provide good quality pasture. Observations indicate that it may be possible to pasture rape until as late as February and still obtain a satisfactory seed crop.

### Sesbania (*Sesbania spp.*)

This plant is widely grown in Iraq, not so much for forage but rather for windbreaks. The leaves and young stems are sometimes stripped and fed as green forage. Occasionally the mature plants are cut and fed. However, the usual practice is to let the plants dry in order to use them for fuel. Greater use could be made of sesbania in Iraq as a forage and green manure crop.

### Cereal Straw and Stubble

Cereal straw and stubble are unquestionably among the most important forages in Iraq. In spite of their low feeding value they

supply a large amount of the total digestible nutrients required by the livestock of the country. Practically all the straw and stubble is fed; virtually none is returned to the land. Sometimes the animals appear to be subsisting almost entirely on cereal straw. This probably accounts for their relatively low productivity and thin condition.

Cereal straw is very low in protein and starch but high in lignin and fiber. It is also low in calcium, phosphorus and vitamins. Although it can form a large part of the maintenance rations for idle animals, it is less suitable for producing or working animals and is especially unsuited for sheep. Very poor results can be expected from feeding breeding ewes on a ration high in cereal straw.

### UTILIZATION OF FORAGE CROPS

The three primary uses of forage crops are hay, silage and pasture. In most countries of the world all three of these uses are widely known and practiced. In Iraq, however, they are hardly known at all. On the contrary, forages are usually managed as "soiling crops" in Iraq. That is, the plants are cut and fed in a fresh, green condition. Under this practice a donum of land will usually furnish more feed than if it were managed as pasture because none of the forage is wasted by trampling of the animals. But, the number of man hours of labor required to harvest a soiling crop is considerably greater than for harvesting an equivalent amount of nutrients for hay, silage, or pasture. However, this is not a serious disadvantage in a country like Iraq where labor is relatively cheap. Hay and silage have advantages over soiling, on the other hand, because they furnish forage of uniformly high quality throughout the season, whereas soiling crops often vary widely in quality from one harvest to the next.

#### Hay and Hay Making

Hay is probably the most important harvested roughage throughout the world and should definitely find an important place in Iraq's agriculture. As legume hays are highly palatable to livestock and rich in protein, calcium, and other nutrients, they are especially valuable.

Of the several forage legumes grown in Iraq, alfalfa deserves first consideration for hay making. Alfalfa hay should eventually

become the most important forage in Iraq not only because alfalfa is so well adapted and productive, but because climatic conditions are so favorable for curing and storing hay throughout most of the year.

Alfalfa must be cut at the right stage to obtain a high quality hay that is leafy and green in color. The importance of cutting at the right stage of growth is illustrated in Figure 16, the total yield of protein per donum being substantially more when alfalfa is cut at about the one-tenth bloom stage. In curing, loss of leaves will be great if alfalfa is allowed to become too dry. For best handling and storage, the moisture content should range from 15 to 25 percent.

Other forage crops can be made into hay--eudangrass, soybeans, lubia, oats, and vetch to name a few. But, in general, these crops are either somewhat more difficult to cure or lower in nutritive value than alfalfa hay. Difficulties in curing and excessive loss of leaves, for example, make berseem less suitable for hay making than alfalfa. Nevertheless, where practicable such crops as Sudangrass, lubia, soybeans, etc. should be cured and stored as hay because when properly managed these crops can be converted to a palatable, nutritious dried forage with good keeping qualities.

### Silage

Silage is especially valuable for feeding livestock in Iraq when the natural pastures and stubble fields are grazed down and dried up. Silage is generally cheaper and more satisfactory than green soiling crops for providing emergency or supplemental forage.

Sorghum and corn make excellent silage. More feeding value is usually obtained from these crops as silage than if they were fed any other way. Moreover, the sorghum and corn silage are very palatable and eaten with a minimum of waste. These silages are excellent forage for both dairy cattle and sheep. They give somewhat better results if fed in combination with a legume or mixed hay. Sorghum or corn should produce 7 to 8 metric tons of silage per donum under irrigation.

Many other crops can be ensiled, for example, alfalfa, Sudangrass, and other grasses, legumes, and weeds. It is a good practice to add some material high in carbohydrates to aid the fermentation process when ensiling alfalfa or Sudangrass. At the Experiment Station, date molasses has been used successfully as a source of carbohydrate in silage making. The best grass

silage is made when the forage contains 60 to 75 percent moisture.

Trench or pit silo provide a cheap way of storing silage in Iraq. The main points to keep in mind are:

1. The soil must be well drained.
2. The top of the silo should be wider than the bottom of the silo to permit adequate settling and packing.
3. The forage must be packed thoroughly and covered with a layer of dirt to exclude the air from the plant material.



**Figure 16.** Excellent opportunities exist for developing permanent pastures under irrigation in Central Iraq. These pastures at the Abu Ghraib Experimental Station have provided much needed green forage when other livestock feed was scarce. The mixture above is composed of tall fescue and birds-foot trefoil.



**Figure 17.** Of several species of perennial grass tested, tall fescue (3 rows in the center) has given consistently good results for permanent pasture. It has proved well adapted, easy to establish, and highly productive in mixtures with legumes and other grasses. At the extreme right in this photo is a row of tall wheatgrass, a species well adapted for seeding on moderately saline soils.

matter, as well as providing large quantities of forage. Harding grass and large canary grass have made exceptionally vigorous growth during the winter and promise to be valuable species for late fall-winter pasturage.

Of the adapted legumes listed for irrigated pastures, alfalfa is perhaps the most dependable. It should be grown in mixtures with grasses to avoid bloat in cattle and sheep. Another well adapted perennial legume is birdsfoot trefoil, which has a long growing season and produces an abundance of high quality forage.



Figure 18. Birdsfoot trefoil is one of the best adapted legumes to the irrigated plains of Central Iraq. It is tolerant of moderately saline and poorly drained soils and withstands the high temperatures of summer. Another important property of birdsfoot trefoil is that it does not cause bloat in ruminants. It has been outstanding in all trial plantings and should certainly be considered as one of the most valuable of forage species for developing permanent pastures in Iraq.

In contrast to alfalfa, it will grow on soils that are moderately saline and poorly drained. Another advantage of this species over alfalfa for pasture is that it does not cause bloat in cattle or sheep. Mixed with tall fescue and orchard grass it makes an excellent

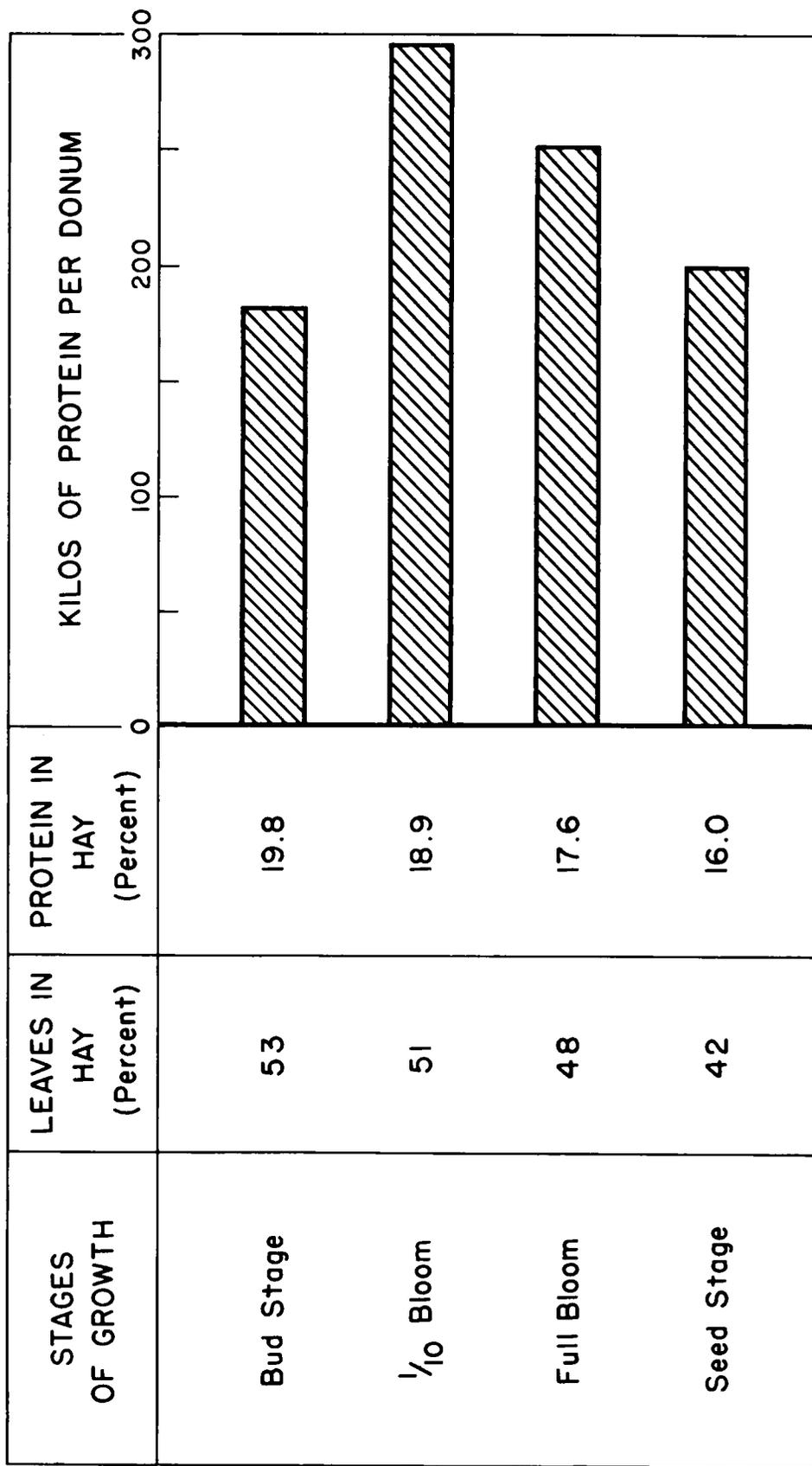


Figure 16 - Protein yield per donum and the percentage of protein in the leaves and hay of alfalfa cut at various stages of growth.

Table 6. Species that are apparently well adapted for temporary or permanent pasture under irrigation in Central Iraq.

P a s t u r e S p e c i e s		A d a p t a b i l i t y	
Scientific Name	Common Name	Permanent Pasture	Temporary Pasture
<u>GRASSES</u>			
Agropyron elongatum	Tall wheatgrass	x	-
Bromus catharticus	Rescue grass	-	x
B. inermis	Smooth brome	x	-
Cynodon dactylon	Bermuda grass	x	-
Dactylis glomerata	Orchard grass	x	-
Festuca elatior	Meadow fescue	x	-
F. arundinacea	Tall fescue	x	-
Eragrostis chloromelas	Boer lovegrass	x	-
E. curvula	Weeping lovegrass	x	-
E. lehmanniana	Lehmann's lovegrass	x	-
Lolium multiflorum	Common ryegrass	-	x
L. perenne	Perennial ryegrass	x	-
Panicum antidotale	Blue panic	x	-
Paspalum dilatatum	Dallis grass	x	-
Phalaris tuberosa	Large canary grass	x	-
P. tuberosa stenoptera	Harding grass	x	-
<u>LEGUMES</u>			
Hedysarum coronarium	Sulla	-	x
Lotus corniculatus	Birdsfoot trefoil	x	-
Medicago hispida	Bur clover	x	x
M. sativa	Alfalfa	x	-
Melilotus alba	White sweetclover	-	x
M. indica	Sourclover	-	x
Trifolium pratense	Red clover	-	x
T. repens	White clover	x	-
R. repens Ladino	Ladino clover	x	-
T. hybridum	Alsike clover	x	-
Vicia sativa	Common vetch	-	x
<u>OTHER</u>			
Sanguisorba minor	Burnet	x	-

permanent pasture. Ladino clover has also developed good stands in mixtures with tall fescue. The place of red clover, and of alsike clover, in Iraq's agriculture needs further study.

Based on results obtained at the Abu Ghraib Experiment Station the following mixtures of grasses and legumes are recommended for non-saline, well drained irrigated lands in Central Iraq.

Rate of Seeding per Donum  
(by species)

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Mixture Number	Birdsfoot t refoil	Ladino	Alfalfa	Tall fescue	Orchard grass	Dallis grass	Perennial rye grass	Harding grass
	kg.	kg.	kg.	kg.	kg.	kg.	kg.	kg.
1	2	-	2	2	2	4	2	2
2	3	-	-	4	4	2	2	1
3	-	2	2	4	2	4	2	1
4	-	-	3	4	4	4	2	-
5	2	2	-	4	2	4	2	2



