THE EFFECT OF DATE OF PLANTING ON THE YIELD OF FORAGE AND OTHER CHARACTERISTICS OF MAIZE, SORGHUM AND SUDANGRASS

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FORAGE STUDIES

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Title: The effect of date of planting on the yield of forage and other characteristics of maize, sorghum, and Sudangrass.

Experiments were conducted in 1965 and 1966 at the Agricultural Research and Education Center of the American University of Beirut in the Beqa'a plain, Lebanon, to study the effect of five dates of planting on the yield of forage and other characteristics of maize, sorghum, and Sudangrass.

The highest total yields of dry matter were obtained from the second date of planting (mid-May); yields decreased with successively later plantings. Delayed sowings beyond mid-May caused a gradual increase in the moisture and protein contents of the forage; on the other hand, the plant height of the forage decreased with delayed plantings after mid-May. The number of days from planting to tasselling and heading was reduced with delayed planting up to mid-July; however, the crops planted in mid-August required almost as many days to head and tassel as those from the first date of planting (mid-April). The forage obtained from the crops from different dates of sowing did not show any consistant change in the leaf-stem ratio.

Maize gave higher yields of dry fodder than sorghum and Sudangrass in both years; whereas the forage of maize, at harvest, had lower moisture content than that of sorghum and Sudangrass. The dry forage of Sudangrass contained a higher amount of protein than that of maize and sorghum. Maize produced the tallest plants followed by sorghum and Sudangrass, respectively. The forage of maize had a higher leaf-stem ratio than that of either sorghum or Sudangrass.

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I. INTRODUCTION

A preëminent problem of our times is that of providing sufficient amounts of food for a population expanding at an ever-increasing rate. The challenge to world agriculture is two-fold, quantitative and qualitative; not only more plant food material is to be provided for this growing population but the production of protective foods such as meat and dairy products should also be intensified. This qualitative aspect of population diet is quite acute in the developing countries where the expansion of forage production can do much to reduce malnutrition and threat of famine.

Intensified grazing and centuries of mismanagement have caused the continued deterioration of ranges and pastures in the Middle East countries. This coupled with higher demands for livestock products emphasizes the need for research on forages to find ways of increasing production and improving the quality of these crops. An adequate supply of reserve forages, in the form of silage and hay, is essential for successful livestock production. According to Hughes et al. (24, p. 17) a forage reserve of 30 to 50 percent of annual normal needs will bridge such emergencies as a severe winter, a late spring, or a partial crop failure.

The long growing season of the Beqa'a plain offers great possibility in growing and increasing the supply of forages in Lebanon. Of particular value are the forage crop species which are able to grow vigorously during the hot summer period prevailing in the Beqa'a plain; in this regard few species can surpass maize (Zea mays L.), sorghum (Sorghum vulgare Pers.), and Sudangrass (Sorghum vulgare var. Sudanense (Piper) Hitchc).

Maize and sorghums (including Sudangrass) are important forage crops in many areas of the world. Statistical data are not available for the production of forage sorghum and Sudangrass in Lebanon. However, a comparison of the area under cultivation and the production of maize and grain sorghum for the United States and Lebanon for the period of 1964-65 is as follows (6, pp. 48-53).

Country	Crop	Area under cultivation in hectares	Yield in metric tons
United States	Maize	23,185,000	91,032,000
	Grain sorghum	4,847,000	12,494,000
Lebanon	Maize	6,000	11,000
	Grain sorghum	6,000	11,000

Although a considerable amount of experimental work has been done on the various aspects of forage production in the more developed regions of the world, lack of knowledge in the production and preservation of forage crops is, in part, responsible for the restricted growth of livestock enterprise in the Middle East. A comparison of net imports of meat (fresh, chilled, or frozen) for Lebanon for the years 1959 and 1964 is as follows (7, p. 14).

Year	Amount in metric tons	Value in Dollars
1959	600	610,000
1964	1080	1,240,000

With the prospects of contributing to the growth of livestock production, the present experiments were conducted to study the effect of different dates of planting on the forage yield and other characteristics of maize, sorghum, and Sudangrass when grown under irrigated conditions at the Agricultural Research and Education Center of the American University of Beirut in the Beqa'a plain, Lebanon.

II. REVIEW OF LITERATURE

Maize, sorghum, and Sudangrass are able to grow and yield well under a wide range of climatic and soil conditions in the warmer areas of the world. They are warm-weather crops that require high temperatures both day and night during the growing season.

General Environmental Factors

Maize

Finch and Baker (8, pp. 310-11) stated that practically no maize is grown where the mean summer temperature is less than 66°F, or where the average night temperature during the three months of the summer falls below 55°F. Shaw (42, pp. 315-316) reported that the region of greatest production of maize in the United States has a mean night temperature exceeding 58°F, and a frostless season of more than 140 days. Maize flowers and ripens much faster when grown at 80°F than at 70°F, and temperatures as low as 60°F greatly retard its development and maturity (8, p. 315). Few strains of maize germinate satisfactorily below 50°F. At 55°F and below, the germinating seedlings of most strains are highly susceptible to seedling diseases.

Ahlgren (2, pp. 294-96) observed that time of planting for maximum production of maize varies with season and locality. He tabulated the general planting dates of maize in the United States as follows:

Region	Beginning	General	Ending	Planting period (days)
Gulf States	March 15	April 5	May 10	55
Central latitudes	April 15	May 1	May 25	40
Northern latitudes	May 10	May 20	June 1	20

Although the response of maize to changes in day length is not so pronounced as that of some other crop species, the time of tasselling and ripening is modified by a change in length of the daylight period. The length from emergence to tasselling of maize will be reduced by short days while the period will increase by exposure of plants to longer days.

Maize production in northern latitudes is limited not so much by the day length and length of growing period as by low temperatures. Torsell _et al._ (48) reviewed the findings of Klages and Seeley who stated that the number of heat units required for the growth of maize from emergence to tasselling varies from 1232 to 1919. Harper (20) suggested that, since most maize varieties do not germinate at temperatures below 50°F, the growing season for maize should be re-defined as "the time between the soil reaching a temperature of more than 50°F (or the last killing frost if this occurs later) and the first killing frost in the fall".

Sorghum and Sudangrass

According to Ahlgren (2, pp. 259-269) sorghum and Sudangrass require a warm soil for planting and may be planted about the same time as maize or one to two weeks later. Seedlings are most successful when made in April or early May in southern latitudes, May to early June in central latitudes, and late May to early June in more northern latitudes in the United States. Best yields are seldom obtained where the mean July temperature is less than 75°F (8, pp. 347-48). Dyas (5) stated that, since the average daily air temperature is nearly the same as the average daily soil temperature at one- to two-inch depths, the air temperature can be used as a guide in planting sorghums.

Rhykerd *et al*. (38) reported that, though sorghum and Sudangrass seedlings grow well at 70°F, temperatures of 80° to 90°F are needed for maximum growth. They observed very little top growth at 60°F and 14 times as much growth when temperature was increased to 70°F. With further increase in temperature to 80°F and 90°F the growth doubled as compared with that at 70°F.

McCloud (4, pp. 123-24) observed a reduction in growth rate as well as in tillering ability of forage crops with temperature drops from 30° to 20°C. Furthermore, there was a drastic reduction in growth when the night temperature was reduced from 20° to 10°C. He attributed the yellowing of leaves in plants exposed to 10°C to chlorophyll destruction and/or a lack of chlorophyll formation, either of which would lead to reduced growth rates.

Relation of Planting Date of Plant Diseases and Insect Pests

Maize

Early planting of maize is helpful in extending the growing season. However, establishment of a satisfactory stand from early plantings is difficult because seeds and seedlings are vulnerable to the attack of soil inhabiting pathogens.

In a date of planting experiment with maize Dickson (16) observed that the seedlings which emerged from the earlier planting date (April 20) were severely damaged by seedling blights but from the last date of planting (May 20) only the very susceptible strains were affected. Sabet (41) reported that the susceptibility of maize plants to seedling rot caused by *Erwinia carotovora* f. sp. *Zeae* increased with higher soil temperatures up to 35°C beyond which the susceptibility decreased rapidly.

Langford *et al*. (26) studied the relation of planting date of maize to Japanese beetle injury in Maryland. They found the heaviest damage in early-planted maize which silked before August 10, and reported that damage can be reduced by delayed planting. In another date of planting experiment with maize Chela (13) found the highest percent of infestation by the corn borer (Chilo zonellus) in the early sown maize (July 5) and least infestation in the last planting date (August 4). Grogan et al. (19, pp. 12-20) also related the damage caused by the European corn borer to date of planting. In their studies, from 1955 to 1957 in Missouri, they found that the number of borer larvae increased as planting was delayed from April 1 to June 20. Rolston (39, pp. 36-38), in a study of the life cycle and control of the south-western corn borer (Diatraea grandiosella), observed that the over-wintering population of the insect was significantly reduced by the low survival of the third generation larvae on early planted maize. He reported that in a test conducted at Fayetteville, Arkansas, maize planted in mid-April, mid-May, and mid-June had damage by "dead heart" of 1, 8, and 40 percent, respectively. He concluded that losses from "dead heart" and stunting can be reduced by early planting and loss from girdling of plants may be lowered by early harvesting of maize. Chiang et al. (14, pp. 58-60) reported that in Missouri and Nebraska, the earlier planted maize had the highest first generation infestation, while the maize planted later in the season received higher second generation infestation and the late-planted maize had heavier third generation infestation of the larvae. Johns and Brown (25) reported that rust disease (*Puccinia sorghi*) was more serious on maize planted in July than that on earlier planted maize.

Sorghum and Sudangrass

Seed rot occurs frequently when sorghums are planted in cold, wet soils, since many seeds fail to germinate and are attacked by various seed-borne and soil inhabiting fungi. The effect of soil temperature on the emergence and development of sorghum seedlings was studied in the green house by Martin *et al.* (31). They reported that the per-cent and the rapidity of germination were reduced by soil temperatures below 25°C. According to Leukel *et al.* (28, pp. 2-3) low temperatures not only retard seed germination but expose seeds to the attack of rotting fungi which have low optimum temperatures. They stated that the species of *Fusarium*, *Aspergillus*, *Rhizopus*, *Rhizoctonia*, *Penicillium*, and *Helminthosporium* invade and destroy the endosperm of seeds and hence deplete them of the food necessary to produce strong seedlings.

Tarr (47, p. 251) reviewed the work of Thadani who reported that in Sind (India) late maturing sorghums were severely attacked by long smut (*Tolyposporium ehrenbergii*) when planted on June 30, but were hardly affected when sown in early June. He further observed that varieties which flowered before the end of August appeared to be unaffected by the disease.

According to Arnon (9) early planted sorghum can escape heavy damage by the sorghum fly (Artherigona exigua) for which no chemical control is yet available. Tarr (47, p. 83) reviewed the findings of Karper *et al.* on charcoal rot (*Macrophomina phaseoli*) which causes seedling blight and hollow stem of sorghum at maturity in warm weather. He concluded that delayed planting or cultivation of late maturing varieties to bring the crop to maturity in cool weather, may minimize charcoal stalk rot. In Georgia, Luttrell (29) noted that sorghum head molds often appeared to be associated with early planting, whereas late sown crops were not seriously affected. He considered, however, that head molds might become serious in seasons when the climatic conditions favor their development before harvesting, regardless of sowing date. El-Helaly and Ibrahim (18) reported that in Egypt sorghum planted in April and May had the greatest amount of infection by covered smut (*Sphacelotheca sorghi*); however, the severity of infection decreased with later plantings and almost disappeared with sowings made during the hot months of July and August.

Ciccarone (15) made periodical plantings of sorghum throughout the year in Venezuela to study the effect on the development of zonate leaf spot caused by *Gloeocercospora sorghi*. He observed that the infection was quite severe on the spring sown crops, and with summer plantings the disease disappeared completely.

Effect of Dates of Sowing on Plant Development and Yield

Maize

Early planting may be necessary where forage production of maize is limited by the length of the growing season. However, late planting of crops under a two crop program often is necessary to increase the forage production. Brandolini (11) reported that maize can be grown successfully after wheat as a catch crop for forage production in northern Italy. Bunting *et al*. (12), in a varietal and date of planting study with maize in England, observed an increase in final emergence with delayed plantings. They also noted that northern flint varieties were superior to southern dent varieties. The lower final emergence of the southern dent varieties was most marked at the early sowing dates. They attributed these differences to the genetic constitution of the different varieties and suggested the breeding of hybrid varieties as a possible solution to the problem of extending maize cultivation in England.

Grogan *et al*. (19) studied the effect of planting dates on the development of hybrid maize of different maturity groups. It was concluded that date of sowing is more influential than the different hybrids in changing the time required from planting to tasselling and silking. Alberts (3) reported that the varieties required different numbers of days to reach the silking stage but that the varieties silked in the order of planting. The period required from silking stage to the time of denting was approximately 40 days for both early and late plantings.

York et al. (50, pp. 11-14), in Arkansas, observed that delayed planting from April 15 to late May and early June increased the lodging of plants significantly. Grogan et al. (19) in Missouri found approximately a 15 percent increase in root lodging with every month delay in planting from April 20 to June 20. Stalk lodging was also increased with delayed planting. Rounds (40) in Michigan observed that late season frosts may not be severe enough to kill early planted maize even though the above-ground seedling leaves may have been killed. Also, he observed increased lodging in maize with delays in planting.

Stanley (46), in Indiana, reported that the total weight of the above ground portion of the maize plant did not vary much with delayed planting. However, later planted maize had a smaller percentage of grain and a greater weight of stalk than that of the earlier planted crop. Hoffmann (21) reported that each 10 day delay in planting maize after the beginning of May results in a 1.3 percent reduction in dry matter content and is equivalent to growing maize at an altitude 100 meters higher.

Sorghum and Sudangrass

Pauli (36) reviewed the works of Karper et al. and of

Martin and Sieglinger who found that medium to late planting of sorghum generally results in a shorter growth period than early plantings. Paulson (36) studied four varieties of sorghum that were planted at two-week intervals. He observed that the varieties required progressively shorter periods to reach 50 percent bloom as date of planting was delayed from May 1 to July 10. In further experiments with 12 varieties of sorghum he reported that the interval between planting and floral initiation ranged from 32 to 44 days when varieties were planted the same date. When they were planted on different dates, the interval between planting and floral initiation ranged from 52 days for the late varieties planted on May 1 to 23 days for the early varieties planted on May 28. Singh (44, pp. 17-22) conducted a date of planting experiment with sorghum in Indore (India) before the onset of monsoon rains. He reported that early drilling of sorghum seeds in dry soil is a sound practice to get higher yields by taking advantage of early light showers.

According to Arnon (9) early planting of sorghums in spring insures their early development during a period of moderate temperatures in Mediterranean areas. Early planted sorghums also take the greatest possible advantage of moisture stored in the soil prior to planting. He stated that with the improved method of seedling protection sorghum seeds may be sown when soil temperature is only

15-16°C, which is about 10 to 14 days earlier than formerly.

Nevens and Kendall (34, pp. 28-32) studied the effect of delayed planting from May to June with a large number of Sorgho and Kafir varieties over a five-year period (1943 to 1947). The results obtained indicate that late planting of sorghums (early June) does not cause any appreciable decrease in forage yields under central Illinois conditions. Bartel and Martin (10) observed that sorghum varieties planted on July 22 had a more rapid increase in early growth and a lower total weight at maturity than those planted on June 18. The growth curve of plants in both sowing dates indicated a slow increase in growth in early stages of development and a more rapid increase at later stages. Owen and Webster (35) reported that advancing maturity of sorghums from the bloom to the hard-seed stage resulted in significant decreases in moisture, crude protein, and crude fiber in sorghum silage. Furthermore, they observed that silage made from hybrid sorghums had a higher percent of crude protein and crude fiber than that obtained from the standard varieties.

Martin and Stephens (30, pp. 3-4) reported that sorghum is rapidly replacing maize for silage in Kansas, Nebraska, Texas, Oklahoma and western Missouri where drought frequently injures the maize crops. They stated that adapted varieties of forage sorghum frequently yield one-third to two-thirds more silage than maize in good seasons, whereas, under conditions of severe drought or grass hopper injury when maize is nearly a failure, sorghum may still produce a reasonable amount of silage. Zucchini (51) reported that in experimental trials near Rome and other regions in central Italy, sorghum hybrids introduced from the United States gave higher yields of forage and were more resistant to drought than the local varieties of maize.

III. MATERIALS AND METHODS

The present investigation was carried out at the Agricultural Research and Education Center of the American University of Beirut during the 1965 and 1966 growing seasons. Adapted hybrids Indiana 620 and Beefbuilder were used for maize and sorghum, respectively. The variety Sweet Sudan was used for Sudangrass plantings. The sowings were made in the middle of April, May, June, July, and August of each year.

The experimental design employed was a split-plot in a randomized complete block design, each main treatment being replicated four times. Dates of planting were the main plots and the three crops were the sub-plots. In 1965 the sub-plots consisted of six rows, each five meters long. To minimize the shading effect caused by earlier sown plots, eight rows were planted for each crop in the 1966 studies.

Maize was planted with a hand planter whereas sorghum and Sudangrass were sown by means of a V-belt planter. The rows were 50 cm apart. Maize seeds were planted 30 to 35 cm apart within the rows. Sorghum and Sudangrass rows were planted thickly and, 10 days after emergence, the stands were thinned to 4 to 6 cm for sorghum and 2 to 4 cm for Sudangrass. The final plant populations were 6,000, 40,000 and 67,000 plants per dunum for maize, sorghum and Sudangrass, respectively.

Treatment of the experimental plots, prior to seeding, consisted of a uniform application of 12 kg nitrogen in the form of granulated ammonium sulfo-nitrate (26% N), and 20 kg P_2O_5 in the form of superphosphate (18 to 21% P_2O_5) per dunum, disked into the soil before planting.

Three side-dressings of nitrogen, at the rate of 4 kg of nitrogen per dunum each, were applied at the following stages of development of maize, sorghum, and Sudangrass:

Crops	First side-dressing	Second side-dressing	Third side-dressing
Maize	Plants 70 cm tall	Plants 150 cm tall	Two weeks after tasselling
Sorghum	Plants 100 cm tall	After first cutting	Plants 100 cm tall
Sudangrass	After first cutting	After second cutting	After third cutting

The plots of the first planting date were irrigated up to 4 weeks by sprinklers in order to get uniform seed germination and seedling establishment. Thereafter, furrow irrigation was maintained at weekly intervals throughout the growing season. The plots were weeded with hand hoes. Leafhoppers were controlled by the application of Dipterex and Metasystox, and aphids were controlled by Metasystox. To control the cutworms the soil was uniformly treated with heptachlor prior to planting.

Dates of tasselling for maize were recorded at the 80 percent tasselling stage and dates of heading for sorghum and Sudangrass were recorded at the 90 percent heading stages. Maize plots were harvested when ears reached the late dough stage. Sorghum and Sudangrass were harvested 5 to 10 days after full heading. The middle two rows of each plot were harvested to obtain yield data. To minimize the border effects, 50 cm on each end of every row was discarded. Plant height was calculated by averaging the heights of three representative plants in every treatment. For calculation of dry matter content of the forage a representative sample of one kg was taken from each replication (a total of 4 kg for each treatment). The leaf-stem ratios of different treatments were determined from a representative sample of four plants per sub-plot.

For analysis of protein content, a 25-gm sub-sample from each moisture sample was oven-dried at 70°C for 72 hours. It was ground to pass through a 40-mesh screen in a Wiley grinding mill. Chemical analysis for nitrogen was made on each sample using the modified Kjeldahl method, as detailed in the Official Methods of Analysis of the Association of Official Agricultural Chemists (23, pp. 12-13). The amount of nitrogen obtained was multiplied by the factor 6.25 and the results were expressed as percentage of crude protein.

Though it was indicated in the review of literature that the occurrence of many diseases was influenced by changing the dates of planting away from the optimum dates, there was no incidence of disease observed in the crops under study in either year of this investigation.

The daily degree-hours were calculated from the weekly thermograph sheets recorded by means of a planimeter at the Weather Station of the Agricultural Research and Education Center. Total degree-hours are the summation of all daily degree-hours to which the different crops were exposed from the time of sowing until harvest.

Data were analysed by using statistical methods appropriate to the split-plot design. The analysis of variance, F-test, and L.S.D. were used to find out the statistical significance of the results. The crop maize and the planting made in mid-April were considered as the controls.

IV. RESULTS AND DISCUSSION

The present two-year study was performed to evaluate the effect of different dates of planting on forage yield and quality of adapted varieties of maize, sorghum, and Sudangrass. The forage characteristics evaluated are total dry matter yield, protein content of dry forage, total protein yield of dry forage, moisture content of fresh forage, plant height, number of days to tasselling or heading, and leaf-stem ratio of dry forage. The results are presented, together with the analysis of variance, in Tables 1 through 14. The L.S.D. values at the five percent and one percent levels of significance are reported under each table for those treatments and interactions found to be statistically significant.

Yield of Dry Matter

The total dry matter yields of maize, sorghum, and Sudangrass as affected by different planting dates are reported in Tables 1 and 2. The data for total yields represent the summations of all individual cuttings obtained from each individual treatment. Only one harvest was obtained from the maize plots per season. The number of cuttings obtained from sorghum plots varied from one to

Table 1. Average yield of dry matter of maize, sorghum, and Sudangrass in kg per dunum as affected by different dates of planting in 1965.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	1622	2230	1828	1301	576	1511
Sorghum	1799	2144	1360	1327	341	1394
Sudangrass	1535	1581	1143	756	255	1054**
Mean	1652	1985	1444	1128*	391**	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	49923	N.S.		
Dates	4	4403810	43.19**	425	705
Error (a)	12	101972			
Species	2	1127744	18.11**	262	425
Dates x Species	8	114193	N.S.		
Error (b)	30	62247			
Total	59				

** Indicates F values significant at 1% level.

Table 2. Average yield of dry matter of maize, sorghum, and Sudangrass in kg per dunum as affected by different dates of planting in 1966.

Variety	Date of planting					
	April	May	June	July	August	Mean
Maize	2718	3184	2274	1728**	736**	2128
Sorghum	2472	2905	1554**	890**	532**	1671**
Sudangrass	2250	1936**	1743**	805**	447**	1436**
Mean	2480	2675	1857**	1141**	572**	

** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	224124	3.86*		
Dates	4	9224170	158.91**	321	585
Error (a)	12	58046			
Species	2	2523798	46.45**	245	397
Dates x Species	8	249672	4.59**	529	739
Error (b)	30	54338			
Total	59				

* Indicates F values significant at 1% level.
** Indicates F values significant at 5% level.

two, while Sudangrass produced from one to four harvests depending on the time of planting and season. The data for individual cuttings appear in Tables 15 and 16 (Appendix) for 1965 and 1966, respectively.

Wide differences in mean yields of dry matter were obtained from the various planting dates. Maize, with only one cutting, gave consistantly higher yields of dry fodder than sorghum and Sudangrass in both years; however, the difference between the yields of maize and sorghum was not statistically significant in 1965. Watkins et al. (49, pp. 13-16) in Illinois, Abdul Moquit (1) and Maun (32) at the Agricultural Research and Education Center reported that forage sorghum hybrid RS 301F gave higher yields of dry fodder than the maize varieties tested. Quinby and Marion (37, p. 12) compared sorgo varieties with one maize variety at six locations in Texas for yield of fodder during 1956-1957. They concluded that maize in Texas is less productive of fodder than forage sorghum.

Great differences were found in the mean forage yields of different crops as a result of various planting dates. The data show a trend for higher forage yield as planting was postponed from mid-April to mid-May; however, with further delays in planting the mean forage yields of the three crops decreased significantly. This is in agreement with the results on maize obtained by Hoque (22) and Mufti (33) at the Agricultural Research and Education

Center. The high yields obtained from the mid-May plantings, with the possible exception of Sudangrass in 1966, indicate that the crops appear to have been able to utilize the growing season most effectively when planted in mid-May. The over-all forage yields were much higher in 1966 than in 1965, probably because of beneficial effects of alfalfa that was grown on the site several years prior to the present experimental studies.

Comparisons of total yields of the crops at various dates of planting with cumulative temperatures, in degree-hours, to which they were exposed during the growing season, are reported in Table 3. The significant coefficients of correlation of +0.70 and +0.68 for the 1965 and 1966 seasons, respectively, indicate a high relationship between total yields and temperatures for crops planted at different periods during the growing season. Two main causes may account for the reduction in yield for the crops planted after mid-May. First of all later plantings result in a shorter growing season which does not permit the plants to mature fully. Also, as is shown in Table 3, crops from delayed plantings were exposed to lower temperatures, or fewer degree-hours from planting to the time of harvest, which reduced the rate of plant growth and development. For example, maize planted in mid-August (2-year average) produced only 33 percent of the yield of that obtained from the mid-April plantings; the corresponding percentages for

Table 3. Average yields of dry matter in kg per dunum of the crops at different planting dates and cumulative temperatures, in degree-hours, in 1965 and 1966.

Year	Variety	Date of planting: April		May		June		July		August	
		Yield	Temperature	Yield	Temperature	Yield	Temperature	Yield	Temperature	Yield	Temperature
1965*:											
	Maize	1622	49680	2230	56490	1828	52710	1301	50310	576	32400
	Sorghum	1799	81660	2144	80310	1360	46710	1327	43530	341	32520
	Sudangrass	1535	84540	1581	79710	1143	60810	756	50760	255	33420
1966**:											
	Maize	2718	54660	3184	58860	2274	61530	1728	53370	736	36390
	Sorghum	2472	77430	2905	83820	1554	71250	890	38070	532	36390
	Sudangrass	2250	87060	1936	83820	1743	68580	805	56940	447	36390

* Correlation coefficient was r = +0.70 for 1965 comparison. The value differs significantly from zero.

** Correlation coefficient was r = +0.68 for 1966 comparison. The value differs significantly from zero.

sorghum and Sudangrass were 21 and 19, respectively. However, later planting of crops under a two crop program often is necessary to increase the forage production in the rotation. The harvesting of early maturing winter crops in June and July in the Beqa'a plain often provides land for a second crop. Under these conditions maize ,being more adapted to the area than sorghum and Sudangrass, is recommended as a suitable forage crop. Because of the low yields that were obtained in the trials, August plantings are not recommendable under the conditions found in the Beqa'a plain.

Protein Percentage

Mean protein percentages of the different crops grown at the various planting dates in 1965 and 1966 studies are presented in Tables 4 and 5. Since the plots of sorghum and Sudangrass produced from one to four harvests, the protein percentages for these crops are reported on the basis of weighted average. Percentages of protein for individual cuttings of sorghum and Sudangrass treatments are presented in Tables 17 and 18 (Appendix) for 1965 and 1966, respectively.

The forage of the crops varied in protein content with Sudangrass having the highest percent of protein for each date of planting except mid-August planting in 1966 when sorghum had higher percent of protein than Sudangrass.

Table 4. Average percentage of protein in maize, sorghum, and Sudangrass as affected by different dates of planting in 1965.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	7.30	7.30	7.05	7.69	10.64	8.00
Sorghum	6.48	6.24	7.09	7.38	11.16	7.67
Sudangrass	7.80	7.80	7.90	9.05	12.53	9.02
Mean	7.19	7.11	7.35	8.04	11.44**	

** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	1.06	N.S.		
Dates	4	40.41	18.45**	1.97	3.27
Error (a)	12	2.19			
Species	2	9.88	9.5**	1.07	1.74
Dates x Species	8	0.59	N.S.		
Error (b)	30	1.04			
Total	59				

** Indicates F values significant at 1% level.

Table 5. Average percentage of protein in maize, sorghum, and Sudangrass as affected by different dates of planting in 1966.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	8.10	8.00	6.00	6.87	6.93	7.18
Sorghum	8.70	7.62	8.34	9.83	11.80	9.26*
Sudangrass	9.22	8.84	9.59	10.55	11.53	9.95**
Mean	8.67	8.15	7.98	9.08	10.09	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D. 5%	L.S.D. 1%
Blocks	3	7.96	N.S.		
Dates	4	8.61	N.S.		
Error (a)	12	4.82			
Species	2	41.71	17.98**	1.59	2.59
Dates x Species	8	4.96	N.S.		
Error (b)	30	2.32			
Total	59				

** Indicates F values significant at 1% level.

The mean values for protein percentages of Sudangrass were higher than those of maize and sorghum in 1965 and 1966 (9.02 and 9.95 percent, respectively); however, the difference was not statistically significant for 1965. The percent of protein in the forage of maize and sorghum was not consistant in either year. Abdul Moquit (1) and Maun (32) reported that the maize hybrid Indiana 620 gave a higher percent protein than the sorghum hybrid RS 301F. Nevens and Kendall (34, pp. 17-19) indicated that at Urbana, Illinois, the mean protein content of the dry forage of seven varieties of sorgo was 6.9 percent as compared to 7.4 percent obtained from the maize hybrid U.S. 13.

Mean values (two year) of protein content of the three crops for the various dates of planting show a slight decrease from mid-May and mid-June plantings as compared to those of mid-April. However, with further delays the protein content of the forages gradually increased. The mean protein percentage of the crops obtained from the mid-August planting in 1965 (11.44) was significantly higher than the corresponding values for the check (mid-April planting).

The high percentages of protein in the forage obtained from the mid-August date of planting may be attributed to the immaturity of crops brought about by curtailment of the growing season.

Protein Yield

Dates of planting greatly influenced the yield and percentage of protein in the forage and significantly affected total protein yields of the different crops as shown in Tables 6 and 7. The mean protein yield of maize was higher than that for sorghum and Sudangrass for both years. However, the differences were not statistically significant in the 1966 tests. This is in agreement with the findings of Abdul Moquit (1) who reported that maize gave higher total yield of protein than sorghum. On the other hand, Maun (32) reported that sorghum produced more total protein than maize. Nevens and Kendall (34, p. 19) observed that the mean acre yield of protein for seven sorgo and three kafir varieties was slightly higher than that of hybrid maize U.S. 13.

Different dates of planting had significant effects on total protein yields of the three crops. In 1965 mid-May sowings gave the highest total yield of protein (140 kg per dunum) in the forage, closely followed by the first planting date (119 kg per dunum). In 1966 the first two planting dates produced the greatest amount of total protein as compared with that obtained from later sowings. A gradual decrease in protein yield was obtained with further delays in planting, the last date (mid-August) gave significantly lower yields of protein in both years.

Table 6. Average yield of protein in maize, sorghum, and Sudangrass in kg per dunum as affected by different dates of planting in 1965.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	118	163**	129	98*	63**	114
Sorghum	119	133*	97**	100*	38**	98**
Sudangrass	120	124	91**	69**	32**	87**
Mean	119	140	106	. 89	44**	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D. 5%	L.S.D. 1%
Blocks	3	691	N.S.		
Dates	4	15536	14.22**	44.0	73.0
Error (a)	12	1092			
Species	2	3730	88.81**	6.8	11.1
Dates x Species	8	467	11.12**	14.8	20.6
Error (b)	30	42			
Total	59				

** Indicates F values significant at 1% level.

Table 7. Average yield of protein of maize, sorghum, and Sudangrass in kg per dunum as affected by different dates of planting in 1966.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	220	255	135	117	51	156
Sorghum	217	210	134	87	63	142
Sudangrass	207	171	168	84	50	136
Mean	215	212	146**	96**	55**	

** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	1587	N.S.		
Dates	4	59862	41.74**	15.9	26.5
Error (a)	12	1434			
Species	2	2093	N.S.		
Dates x Species	8	2092	N.S.		
Error (b)	30	1271			
Total	59				

** Indicates F values significant at 1% level.

If the objective is production of the greatest amount of protein, then planting maize in mid-May is the recommended practice for the Beqa'a plain. With an acute shortage of feed in the spring, mid-April plantings of either maize, sorghum or Sudangrass will provide an answer to the problem.

Moisture Content

Mean moisture contents of the various crops planted at different dates are reported in Tables 8 and 9. Since sorghum and Sudangrass plots were harvested from one to four times, the moisture contents are reported on the basis of the weighted average. Moisture contents of individual cuttings of sorghum and Sudangrass treatments are reported in Tables 19 and 20 (Appendix) for 1965 and 1966, respectively.

The data presented show that the forage of maize, at the time of harvest, had significantly lower moisture content than that of sorghum and Sudangrass. According to Nevens and Kendall (34, pp. 28-32) the higher moisture content of sorghum and Sudangrass is not a problem if the crops are harvested for hay. To produce satisfactory silage that contains about 70 percent moisture, sorghum and Sudangrass should be harvested two weeks after full heading. The mean moisture contents of the forage increased consistantly with a delay in planting after mid-May. This indicates that

Table 8. Average moisture content of maize, sorghum, and Sudangrass as affected by different dates of planting in 1965.

Variety	Date of planting					
	April	May	June	July	August	Mean
Maize	77.7	70.5*	74.2	79.1	87.3**	77.8
Sorghum	80.4	77.7	80.3	79.2	85.0*	80.5*
Sudangrass	79.7	78.3	81.6	79.8	83.3	80.5*
Mean	79.3	75.5*	78.7	79.4	85.2**	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	3.7	N.S.		
Dates	4	146.8	25.75**	3.2	5.3
Error (a)	12	5.7			
Species	2	49.5	7.39**	2.7	4.4
Dates x Species	8	27.8	4.15**	5.9	8.2
Error (b)	30	6.7			
Total	59				

** Indicates F values significant at 1% level.

Table 9. Average moisture content of maize, sorghum, and Sudangrass as affected by different dates of planting in 1966.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	63.3	65.4	64.5	75.0**	82.1**	70.1
Sorghum	83.2**	80.3**	83.8**	86.5**	83.0**	83.4**
Sudangrass	81.3**	81.2**	82.0**	84.1**	82.1**	82.1**
Mean	75.9	75.6	76.8	81.9*	82.4**	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	6.3	N.S.		
Dates	4	132.7	17.0**	3.7	6.1
Error (a)	12	7.8			
Species	2	1080.7	174.3**	2.6	4.3
Dates x Species	8	79.7	12.9**	5.7	7.9
Error (b)	30	6.2			
Total	59				

** Indicates F values significant at 1% level.

shortening of the growing season does not permit normal plant development and full maturity of the crop.

Plant Height

The data for plant heights of maize and for the first cuts of sorghum and Sudangrass grown at different planting dates appear in Tables 10 and 11. The plant heights of the subsequent harvests of sorghum and Sudangrass are reported in Tables 21 and 22 (Appendix).

The mean heights of the three crops show that sowings made until mid-July did not noticeably affect the size of the plants; however, the last date of planting decreased significantly the height of the plants of all crops studied. This is probably due to curtailment of the growing season by such a late planting. The results are in agreement with the findings of Chela (13) in India. He reported that any delay in planting of maize after July 15 will produce progressively shorter plants.

The mean heights of the five dates of planting show that maize was taller than sorghum and significantly taller than Sudangrass in both years. However, Maun (32) reported that hybrid sorghum produced slightly taller plants than maize.

Table 10. Average plant height, in cm, of maize, sorghum, and Sudangrass as affected by different dates of planting in 1965.

Variety	Date of planting					
	April	May	June	July	August	Mean
Maize	204	215	222	219	159*	204
Sorghum	201	204	223	221	105**	191
Sudangrass	159*	182	158*	161*	97**	151**
Mean	188	200	201	200	120**	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	264.7	N.S.		
Dates	4	14563.8	47.9**	23.1	39.2
Error (a)	12	304.3			
Varieties	2	14786.0	50.1**	18.0	29.1
Dates x Variety	8	884.6	3.0*	39.2	54.3
Error (b)	30	295.1			
Total	59				

* Indicates F values significant at 5% level.
** Indicates F values significant at 1% level.

Table 11. Average plant height, in cm, of maize, sorghum, and Sudangrass as affected by different dates of planting in 1966.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	273	269	240**	266	223**	254
Sorghum	228**	269	275	196**	164**	226*
Sudangrass	180**	207**	200**	194**	154**	187**
Mean	227	248	238	219	180*	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	1403	N.S.		
Dates	4	8163	16.49**	29.6	49.1
Error (a)	12	495			
Varieties	2	22785	132.47**	17.8	28.9
Dates x Varieties	8	2226	12.94**	17.2	24.0
Error (b)	30	172			
Total	59				

** Indicates F values significant at 1% level.

Number of Days to Tasselling and Heading

Data in Tables 12 and 13 show the number of days required for maize to reach the 80 percent tasseling stage and for sorghum and Sudangrass to attain the 90 percent heading stage. The average number of days from sowing to tasselling and heading was found to be influenced greatly by dates of planting of the different crops.

A consistant reduction in the number of days to tasselling and heading was observed with successively later dates of planting up to mid-July. Crops planted on the last date of sowing in mid-August required almost as many days to head and tassel as those from the first planting, with a two-year average of 75.3 and 77.6 days for mid-August and mid-April plantings, respectively. In this connection Grogan _et_ _al_. (19), in Missouri, and Mufti (33) also reported that maize planted in June required three to five weeks less time to reach the tasselling stage than the earlier planted maize.

The crops planted in mid-April apparently were slow in their earlier development because of the low temperatures prevailing in the early parts of the growing season. Also, the mid-August planting subjected the growing plants to the lower temperatures encountered during the latter period of the summer which increased the period from planting to heading or tasselling.

Table 12. Average number of days from planting to tasselling and heading of maize, sorghum, and Sudangrass as affected by date of planting in 1965.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	70.8	65.8**	62.8**	61.8**	79.0**	68.0
Sorghum	101.5**	84.0**	84.0**	78.8**	78.0**	85.3**
Sudangrass	61.5**	60.8**	59.5**	54.5**	72.5**	61.8**
Mean	77.9	70.2**	68.8**	65.0**	76.5**	

** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D. 5%	L.S.D. 1%
Blocks	3	0.68	N.S.		
Dates	4	352.70	608.10**	1.01	1.68
Error (a)	12	0.58			
Varieties	2	2963.00	8978.00**	0.60	0.97
Dates x Varieties	8	191.80	581.20**	1.32	1.84
Error (b)	30	0.33			
Total	59				

** Indicates F values significant at 1% level.

Table 13. Average number of days from planting to tasselling and heading of maize, sorghum, and Sudangrass as affected by date of planting in 1966.

Variety	Date of planting					Mean
	April	May	June	July	August	
Maize	74.8	66.8**	63.5**	58.0**	70.3**	66.7
Sorghum	88.0**	80.3**	79.5**	70.0**	77.8**	79.1**
Sudangrass	68.8**	58.3**	56.8**	53.8**	74.5	62.4**
Mean	77.2	68.4**	66.6**	60.6**	74.2**	

** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	0.33	N.S.		
Dates	4	509.00	1018.00**	0.95	1.57
Error (a)	12	0.50			
Varieties	2	1506.50	2248.50**	0.86	1.40
Dates x Varieties	8	65.12	97.19**	1.86	2.60
Error (b)	30	0.67			
Total	59				

** Indicates F values significant at 1% level.

Ratio of Leaf to Stem

To determine the leaf-stem ratio of the dry forage, the ears were included with the leaf portions of the maize plants. Similarly, the heads of the sorghum and of the Sudangrass were also included with the leaf portions of these plants. The average leaf-stem ratios of dry forage in the crops for the different dates of planting appear in Table 14. Values reported for sorghum and Sudangrass treatments are the weighted averages obtained from all harvests of each treatment. The leaf-stem ratios for individual harvests are reported in Table 23 (Appendix).

The forage from maize had a higher leaf-stem ratio at each date of planting as compared with that of sorghum and Sudangrass. Maize planted in mid-April gave a significantly higher leaf-stem ratio (3.06) than any other treatment. This may be due to the heavier weight of ears produced by maize planted early in the season. Hoque (22) and Mufti (33) reported that the early-planted maize had more yield of grain than that planted later in the season. Nevens and Kendall (34, pp. 17-20) showed that the ear of maize hybrid U.S. 13 represented 57 percent of the dry matter of the whole plant. Eik and Hanway (17) found that the number, area, rate of emergence, and longevity of maize leaves varied for different hybrids, but were only slightly affected by four sowing dates. However, they observed a

Table 14. Average ratio of leaf to stem of dry forage in plants of maize, sorghum, and Sudangrass as affected by various planting dates in 1966.

Variety	Date of planting					
	April	May	June	July	August	Mean
Maize	3.06	1.62*	0.68**	1.32**	0.82**	1.50
Sorghum	0.71**	0.41**	0.58**	0.94**	0.75**	0.68**
Sudangrass	0.92**	0.74**	0.68**	0.61**	0.75**	0.74*
Mean	1.56	0.92	0.65*	0.96	0.77*	

* Indicates significant differences at 5% level.
** Indicates significant differences at 1% level.

Analysis of variance

Source	d.f.	M.S.S.	F	L.S.D.	
				5%	1%
Blocks	3	0.17	N.S.		
Dates	4	1.45	4.83*	0.75	1.24
Error (a)	12	0.30			
Varieties	2	4.10	18.64**	0.50	0.81
Dates x Varieties	8	1.19	5.41**	1.07	1.49
Error (b)	30	0.22			
Total	59				

* Indicates F values significant at 5% level.
** Indicates F values significant at 1% level.

slight increase in the number of leaves with delayed planting. Sieglinger (43) stated that though the number of leaves of mature stalks of sorghum varieties is regarded as a varietal characteristic, it varies with date of planting, locality and season. In the present experiment the forage obtained from different dates of planting did not show any consistant change in the leaf-stem ratio.

V. SUMMARY AND CONCLUSIONS

The experiments were conducted during the 1965 and 1966 growing seasons at the Agricultural Research and Education Center of the American University of Beirut, in the Beqa'a plain, Lebanon. Hybrids Indiana 620 and Beef-builder were used for maize and sorghum, respectively. The variety Sweet Sudan was used for Sudangrass trials. Plantings were made in the middle of April, May, June, July, and August. The forage characteristics evaluated were total dry matter yield, protein content of dry forage, total protein yield of fodder, moisture content of fresh forage, plant height, number of days to tasselling or heading, and leaf-stem ratio of dry forage.

Maize gave consistantly higher yields of dry fodder than sorghum and Sudangrass in both 1965 and 1966 studies. A trend for higher forage yield was observed in the three crops as planting was delayed from mid-April to mid-May; however, with further delays in planting the yields of all three crops decreased significantly. Late plantings shorten the growing season and expose the crops to low temperatures during the late summer and autumn resulting in a reduction in forage yield. Significant correlation coefficients of +0.70 and +0.68 for 1965 and 1966, respectively, were obtained between yields and temperatures (degree-hours) for crops planted at different periods during the growing season. Maize was found to be more adapted to the environmental conditions found in the Beqa'a plain than sorghum and Sudangrass, and is recommended for forage production for this area.

The forage of Sudangrass contained a higher protein percentage than that of maize or sorghum at all dates of planting. The percent of protein in the forage of maize and sorghum was not consistant in either year. The high protein percentage in the forage of the mid-August planted crops was the result of immaturity of the crops which was brought about by the shortening of the growing season.

Maize produced greater yields of protein than did sorghum and Sudangrass for both years (1965 and 1966). However, the differences were not statistically significant for the 1966 tests. The mid-April and mid-May plantings produced the greatest amount of total protein as compared with that obtained from later plantings. If the objective is production of the greatest amount of protein, then planting maize in mid-May is the recommended practice. With an acute shortage of feed in the spring, April plantings of either maize, sorghum or Sudangrass will provide large amounts of protein.

The forage of maize, at harvest, had a significantly lower moisture content than that of sorghum and Sudangrass.

The moisture content of the forage increased consistantly with a delay in planting after mid-May. This suggests that shortening of growing season does not permit normal plant development and full maturity of the crop.

Earlier planted sorghum grew almost as tall as maize. However, the adverse conditions to which the crops were exposed as a result of planting in mid-August retarded the height of sorghum more than that of maize. Sudangrass produced shorter plants than maize and sorghum at all dates of planting studied.

A consistant reduction in the number of days to tasselling and heading was observed in the crops with successively later dates of planting. The crops planted in mid-April and in mid-August required the greatest number of days to reach the tasselling or heading stage. The crops planted in mid-April were slow in their early development because of cool weather prevailing early in the growing season, while those planted in mid-August were exposed to lower temperatures during late summer and early fall.

The forage obtained from the crops from different dates of planting did not show any consistant change in the leaf-stem ratio. Maize planted in mid-April gave a significantly greater leaf-stem ratio than any other treatment. This was probably due to the heavier ears produced by the early-planted maize.

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A P P E N D I X

Table 15. Average yield of dry matter, in kg per dunum, of individual cuttings of sorghum and Sudangrass as affected by dates of planting in 1965.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	913	1089	1360	1327	341
	2nd	886	1055			
Sudangrass						
	1st	562	642	611	632	255
	2nd	302	566	533	124	
	3rd	378	374			
	4th	294				

Table 16. Average yield of dry matter, in kg per dunum, of individual cuttings of sorghum and Sudangrass as affected by dates of planting in 1966.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	1241	1602	1317	890	532
	2nd	1231	1164	237		
Sudangrass						
	1st	770	831	869	568	447
	2nd	783	873	874	237	
	3rd	696	232			

Table 17. Average percent of protein in dry forage of individual cuttings of sorghum and Sudangrass planted at different dates in 1965.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	6.55	5.83	7.09	7.36	11.16
	2nd	6.42	6.69			
Sudangrass						
	1st	8.15	8.63	8.33	8.51	12.53
	2nd	8.81	5.39	7.38	11.63	
	3rd	6.52	9.99			
	4th	7.81				

Table 18. Average percent of protein in dry forage of individual cuttings of sorghum and Sudangrass planted at different dates in 1966.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	9.78	7.27	7.53	9.83	11.81
	2nd	7.54	8.17	15.30		
Sudangrass						
	1st	10.19	10.59	10.68	10.57	11.53
	2nd	8.10	6.62	8.37	10.15	
	3rd	9.48	11.02			

Table 21. Average plant height, in cm, of individual cuttings of sorghum and Sudangrass planted at different dates in 1965.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	201	204	223	221	105
	2nd	200	202			
Sudangrass						
	1st	159	183	158	161	97
	2nd	135	159	148	68	
	3rd	137	105			
	4th	122				

Table 22. Average plant height, in cm, of individual cuttings of sorghum and Sudangrass planted at different dates in 1966.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	228	269	275	196	164
	2nd	263	221	76		
Sudangrass						
	1st	180	207	200	194	154
	2nd	193	203	189	74	
	3rd	201	85			

Table 23. Average leaf-stem ratio of dry forage of individual cuttings of sorghum and Sudangrass planted at different dates in 1966.

Variety	Cutting	Date of planting				
		April	May	June	July	August
Sorghum						
	1st	0.91	0.48	0.41	0.94	0.75
	2nd	0.51	0.30	1.69		
Sudangrass						
	1st	0.64	0.83	0.73	0.44	0.77
	2nd	0.59	0.39	0.60	1.21	
	3rd	1.66	1.78			

Table 24. Average protein percent in the leaf and stem of maize and individual cuttings of sorghum and Sudangrass planted at different dates in 1966.

Variety	Cutting	Date of planting									
		April		May		June		July		August	
		Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem
Maize		9.88	2.85	10.27	4.52	8.47	4.27	11.77	2.77	13.61	3.07
Sorghum											
	1st	14.70	5.36	12.99	4.44	14.27	5.00	15.08	4.86	17.24	7.96
	2nd	12.77	4.85	13.10	4.35	17.13	11.27	-	-	-	-
Sudangrass											
	1st	16.52	6.55	16.39	5.80	18.00	5.28	16.74	7.88	17.19	7.63
	2nd	15.94	3.25	12.44	4.50	15.35	5.19	16.91	9.27	-	-
	3rd	12.11	5.19	14.28	6.75	-	-	-	-	-	-