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SMALL GRAINS for FORAGE

TEXAS AGRICULTURAL EXPERIMENT STATION

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SUMMARY

Small grains produce good yields of high quality forage at a season of the year when green grazing is limited. Forage production generally is more dependable and yields higher than for any other crop grown for winter pasture. Acreages of small grains grown for forage exceed that of any other winter grazing crop.

Clipping management studies have shown that forage yields may be reduced 20 to 80 percent by early and frequent pasturing or clipping. Top growth is reduced and crown and root development are retarded. Allowing the plant to become well established, 6 to 8 inches high, before grazing begins is particularly important if maximum yields are to be obtained. However, some sacrifice of total production may be necessary or desirable to utilize some forage during critical fall and early winter periods.

Growth studies with oats have shown a direct relationship of growth to temperature. Winter temperatures generally are mild enough south of College Station for continuous growth, but north of this area, growth stoppages are likely to occur with cold periods. Thus, the management program should allow for residual or accumulated growth for use during such periods. Otherwise, overgrazing may result in damage to the stands. Growth also is related to rainfall or available moisture during the growing season. Apparently about 20 inches of rainfall from September through April is adequate in most areas. Seasons with less than 20 inches of rainfall occur frequently in most of the areas; therefore, moisture frequently may be a limiting factor. Excessive rainfall for maximum growth may occur, especially in the coastal area.

A number of varieties, especially of oats, are adapted for forage production. These include Mustang, New Nortex, Alamo and Victorgrain oats and Cordova barley in North and Central Texas; and Goliad barley and Camellia oats along with Mustang, New Nortex, Alamo and Victorgrain oats in the Gulf Coast area and South Texas. Abruzzi rye is adapted in the Norteast Texas area, and Bronco oats is adapted for late production for hay or silage. Several new varieties, including Gator and Elbon rye and Mid-South oats, show promise for both early and sustained production. Further testing of these varieties is underway. Other varieties may be used satisfactorily, but the ones named have given the most consistent performance.

Small grain varieties differ in growth habit, some producing maximum forage in the fall and others during the spring. Mixtures of early and late types have been studied, both as seed mixtures and cross-seedings. Mixtures of spring and winter-type oats have not produced more than either type in pure stands. With proper management, production with these variety mixtures may be improved slightly over pure stands, but the results have not been consistently better. Cross-seedings also have shown no yield advantage, but they might improve footing for grazing animals under wet conditions.

Legumes interplanted with small grains are used to some extent. This practice has improved yields only slightly, but it may increase the protein content of the forage. These studies have not included possible soil benefits resulting from the use of legumes in mixtures with small grains.

Seeding rates from 48 and 112 pounds per acre appear to have little influence on total forage production. Early production is favored to some extent by the heavier seeding rates; for this reason, seeding rates of 64 to 80 pounds per acre are suggested.

ACKNOWLEDGMENTS

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Small Grains for Forage

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SMALL GRAINS are suited to many uses, one of the main ones being forage for livestock. The average annual seeded acreage of small grains in Texas is estimated to exceed 6,000,000. Of this acreage, more than 1,200,000 are sown for livestock pasture and are grazed during the winter and spring until the forage is exhausted and the crop killed out. A considerable portion of the remaining acreage is grazed during the winter, then the livestock are removed in time to mature a grain crop.

In addition to grazing, some acreages, particularly of oats, are used for hay, silage or as soiling crops. A larger percentage of the acreage in East Texas and on the Coast Prairie is seeded exclusively for grazing than in the other Texas areas. Oats and rye are the principal small grain crops in East Texas, oats and barley on the Coast Prairie and Rio Grande Plain and wheat and oats in Central and West Texas.

The small grains produce high quality forage at a season when green forage is limited. The small grains generally are more reliable for forage production and produce a larger volume of forage than most winter growing crops. For these reasons, the acreage of small grains used for winter pasture exceeds that of any other winter crop. Because the cost of land preparation, fertilization, seed, seeding and other factors make winter forage from small grains expensive, it is important to use adapted varieties and follow good cultural and management practices to obtain high yields and efficient production.

The results of studies of a number of factors influencing forage production are reported in this bulletin.

MANAGEMENT

Grazing, clipping or other harvest of small grains used for forage should strive for maximum sustained forage production without damage to stands of the crop. The management system should be economical and practical, taking into consideration total production and the time and distribution of the forage produced, whether for pasture or silage.

Greenhouse and field clipping studies on Goliad barley and Mustang oats were carried out at Crystal City to determine the importance of stage of growth at first clipping and frequency of clipping on small grain forage yields. These results are presented in Table 1.

Under both field and greenhouse conditions, it was found that oats produced more than twice as much total forage for the season when allowed to grow to a height of 14 to 16 inches than when clipped as soon as they reached 3 to 4 inches or 8 to 10 inches in height. Clipping at 3 to 4 inches was more detrimental than clipping at 8 to 10 inches. Oat yields were reduced more than those of barley. Under field conditions, barley yields with 8 to 10-inch clippings were 10 percent less than when clipped at 14 to 16 inches high, while the yields for Mustang oats were reduced 59

TABLE 1. EFFECT OF CLIPPING ON THE FORAGE PRODUCTION OF MUSTANG OATS AND GOLIAD BARLEY, CRYSTAL CITY, 1956-57

Location	Height at which clipped, inches	Number of clippings	Yield in oven-dry grams of forage	Percent reduction in yield due to clipping
		MUSTANG OATS		
Greenhouse	3 to 4	8	7	83
	8 to 10	5	15	63
	14 to 16	2	40	
Field	3 to 4	9	414	75
	8 to 10	5	669	59
	14 to 16	3	1637	
		GOLIAD BARLEY		
Greenhouse	3 to 4	8	6	76
	8 to 10	5	15	40
	14 to 16	3	25	
Field	3 to 4	11	518	51
	8 to 10	6	958	10
	14 to 16	4	1061	

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percent with the same treatment. The effects of clipping were more severe in the greenhouse than under field conditions. Clipping effects probably are more severe than normal livestock grazing because clipping removes all the forage at one time.

TABLE 2. FORAGE YIELD, POUNDS PER ACRE, OF ALAMO AND MUSTANG OATS CLIPPED AT TWO STAGES OF GROWTH, COLLEGE STATION, 1954-55

Variety	Height of cutting, inches	Season of harvest[1]			Total
		Early winter	Mid-winter	Early spring	
Alamo	4-6	540	350	430	1320
	10-12	1200	850	910	2960
Mustang	4-6	430	550	800	1780
	10-12	770	1160	1450	3380

[1]Dates of clipping: EARLY WINTER—4 to 6 inches—Nov. 18, Dec. 1, Dec. 17, Jan. 3; 10 to 12 inches—Jan. 3. MID-WINTER—4 to 6 inches—Jan. 20, Feb. 9, Feb. 24; 10 to 12 inches—Feb. 24. EARLY SPRING—4 to 6 inches—Mar. 7, April 15; 10 to 12 inches—Mar. 7, April 15; 10 to 12 inches—April 15.

Figure 1. Growth of oat varieties in clipping management study. College Station, February 1957.

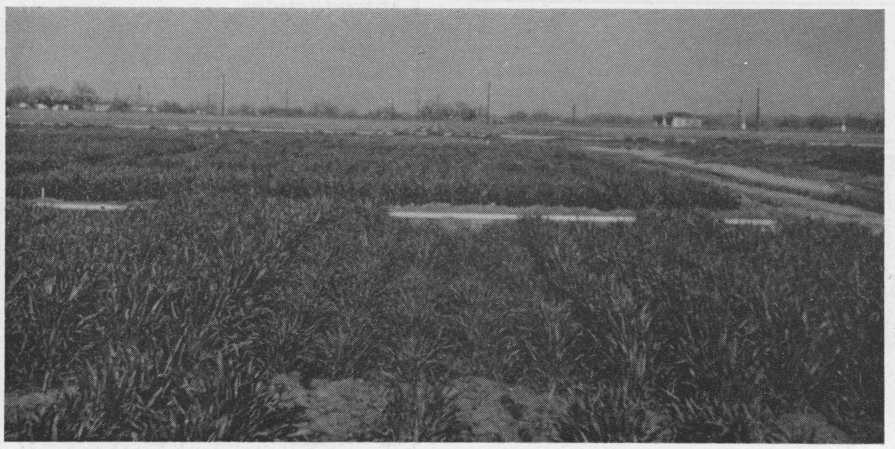

Figure 2. Mid-winter growth at College Station of Mustang oats (center), a winter-type variety, and Alamo oats (left), a spring-type variety.

A previous greenhouse study at the same location had shown that the yield of Arkwin oats was reduced 83 percent when the plants were clipped each time they reached a height of 3 to 4 inches. Clipping the plants one time at 3 to 4 inches high followed by regular clipping at 10 to 12 inches reduced growth 20 percent, as compared with regular clipping at 10 to 12 inches.

In these studies, the best root development on oats and barley occurred when they attained a height of 14 to 16 inches before clipping. Plants clipped at 3 to 4 inches showed poor root development and those at 8 to 10 inches showed moderate development. This points out the importance of allowing small grains to become well established before turning livestock on them for pasture.

Studies carried out at College Station, Table 2, further emphasize the importance of proper management of small grains used for winter pasture. Alamo and Mustang oats, clipped each time the forage reached a height of 4 to 6 inches, produced only 1,320 and 1,780 pounds of forage, respectively. These two varieties produced 2,960 and 3,380 pounds of forage respectively, or twice as much when clipped each time the plants attained a height of 10 to 12 inches. Figure 1 shows the growth of plants in this clipping study.

The plants in this study had reached a height of 4 to 6 inches on November 13 and did not reach a height of 10 to 12 inches until January 3, or 6 weeks later. The grower must decide whether the production during this period is more important than greater total production for the season. However, the value of allowing oat plants to become well established before grazing starts is evident and if frequent close utilization reduces production by as much as 1,500 pounds per acre, the value of production at this level may be questionable.

The comparative performance of the two varieties in the early part of the season is important. Alamo is an erect-growing oat which usually produces early forage, while Mustang is a winter-type which grows prostrate in the early part of the season and produces relatively little forage during this period, Figure 2. When clipping was delayed until the plants attained a height of 10 to 12 inches, the early winter production of Alamo was obtained. When clipping was started at 4 to 6 inches height, Alamo produced little more early forage than Mustang. Thus, early frequent clipping or grazing of a spring-type variety could eliminate its early yield advantage.

Studies were initiated at College Station in 1955-56 to determine the influence of clipping practices on root and crown development as well as forage production. Alamo and Mustang oats were clipped at 10, 20 and 40-day intervals and at maturity. Supplemental irrigation was used to prevent growth stoppage from drouth and to permit a regular frequency of clipping. Air-dry forage produced with these treatments is shown in Table 3. By December 20, a greater tonnage of dry matter was produced on plants unclipped to that time (40-day interval) than on plots that had been clipped two or four times. Clipping at a 10-day interval reduced Alamo production 48 percent when compared with the 40-day clipping, and 58 percent when compared with clipping only at maturity. The reduction in Mustang yield due to frequent clipping was slightly less than for Alamo.

Crown and root development were measured frequently and followed the same pattern as top production. Average root and crown weights at the end of the growing season are given in Table 4. Apparently, more frequent clipping reduced tillering and resulted in a smaller crown which would be expected to reduce top growth. Crowns from the most frequently clipped plots weighed only 37 percent as much as those from plots clipped at 40-day intervals. Approximately half of the above-ground development was in the crowns so that it was below the mower blade cutting height.

Root production in the top foot of soil was reduced by frequent clipping, but to a lesser extent than top and crown development. Roots from frequently clipped plots weighed 30 percent less than roots from 40-day clipping. Root production was poor this particular season, which may account for the poor growth obtained in this study.

A study in 1956-57 using Mustang oats demonstrates the value of delaying the first clipping or grazing, Table 5. The study was designed to be sampled at 10, 20, 30 and 40-day intervals. Owing to inclement weather, the first clipping was delayed until January 4. Because the plants had become well established, the reduction in yield due to frequent clipping was less than in previous years. Plots clipper at 10-day intervals produced only 77 percent as much forage as those clipped at 40-day intervals. The highest production was obtained with the 20-day clipping interval.

Two sets of plots were established in 1957, one of which was to be unclipped and the other clipped at

TABLE 3. FORAGE PRODUCTION OF ALAMO AND MUSTANG OATS WITH VARIOUS CLIPPING FREQUENCIES, COLLEGE STATION, 1955-56

Variety	Harvest frequency, days	Pounds of air-dry forage per acre				
		Nov. 10 to Dec. 20	Dec. 20 to Feb. 1	Feb. 1 to Mar. 14	Mar. 14 to May 3	Total
Alamo	10	220	350	290	100	960
	20	420	780	630	200	2030
	40	390	790	620	240	2040
	Maturity				2550	2550
	Variety average	340	640	510	770	1890
Mustang	10	210	450	490	130	1280
	20	230	560	680	310	1780
	40	320	680	960	340	2300
	Maturity				2370	2370
	Variety average	250	560	710	770	1930

TABLE 4. TOP AND ROOT GROWTH OF ALAMO AND MUSTANG OATS WITH VARIOUS CLIPPING FREQUENCIES, LUFKIN FINE SANDY LOAM SOIL, COLLEGE STATION, 1955-56

Variety	Harvest frequency, days	Pounds of air-dry forage per acre		
		Forage	Crowns	Roots
Alamo	10	1060	490	390
	20	2030	810	465
	40	2040	1140	540
	Maturity	2550	2720	640
Mustang	10	1280	760	500
	20	1780	1600	595
	40	2300	2190	710
	Maturity	2370	3170	810

TABLE 5. FORAGE YIELD OF MUSTANG OATS CLIPPED AT FOUR FREQUENCIES, COLLEGE STATION, 1956-57

Clipping frequency, days	Pounds of air-dry forage per acre			
	Nov. 1 to Jan. 4[1]	Jan. 4 to Feb. 25	Feb. 25 to Apr. 18	Total
10	920	890	850	2660
20	870	1290	1600	3760
30	910	920	1270	3100
40	740	1960	760	3460

[1]First clipping on all plots.

regular intervals. Due to inclement weather, clipping was delayed until late in January when more than 2,000 pounds of forage had been produced. Total cumulative growth with the two treatments is shown in Figure 3. These results indicate that utilization may be delayed too long, especially if all the top growth is to be removed and if regrowth is expected. As indicated in most of these studies, maximum total production is obtained with a single harvest at the end of the growing season.

Reduction in root development from frequent clipping could result in reduced ability of the plant to take up moisture and nutrients. This would cause it to suffer from drouth earlier than it would with extensive root development. Reduced crown development reduces the area from which growth takes place and leaves more of the soil exposed to evaporation and water loss from run-off. All of these factors and others are important in developing a grazing management program. The available data indicate the desirability of delaying the first grazing until the plants are well established and practicing rotation grazing with at least 3 to 4 weeks between grazing periods.

GROWTH BEHAVIOR

The growth of small grain varieties depends on soil and air temperatures and soil moisture and nutrients. Varieties may differ in their response to temperature, management practices and other environmental factors. In establishing a forage program, it would be valuable to know the minimum and maximum temperatures at which small grains stop growth and whether varieties respond alike to these conditions. Should growth stop below certain minimum temperatures, then accumulated growth must be depended on for grazing during such periods.

Response to Management

The growth behavior pattern of three oat varieties was studied at College Station and Iowa Park for 2 years. The varieties, Alamo, Mustang and an experimental line 119-50-8, (Tennex x Victoria-Hajira-Banner, C-I-6944), differ in growth habit and cold-hardiness. Alamo is an upright non-winter hardy variety; Mustang has a prostrate growth habit in early season and is winter-hardy; 119-50-8 is upright in growth habit and moderately winter-hardy. The varieties were seeded in 12-inch rows and sampled for above-ground growth at weekly intervals. Since the plants were removed at the ground level, the data presented in the figures that follow include the weight of crowns and are higher than normally are obtained in clipping studies. Forage harvesting was imposed on one set of plots at College Station. Water and fertilizer were applied at levels to prevent them from being limiting factors in plant growth. A continuous record of air temperature was made. The soil temperature recorder used in 1956-57 failed to function properly and soil temperature records were not obtained.

Accumulated growth on plots harvested three times during the growing season is presented in Figure 4. With all above-ground parts harvested, the rate of growth of the three varieties is very similar. Their growth habit normally is different, Mustang being prostrate in early season, and it would not be expected that the yields would be equal using normal harvesting procedures. However, when all above-ground growth is measured, the three varieties produce about the same until the first date of harvest. Alamo failed to recover and produce as much after the first clipping. After the second clipping, it dropped even further below the other two varieties.

All three varieties were slow in their recovery following each clipping. As much as 4 to 5 weeks were required for recovery and any appreciable growth. During this period, there was some shoot growth, but little change in total plant weight. Apparently food reserves in the crown were being transferred to develop new shoot growth, resulting in little change in the ac-

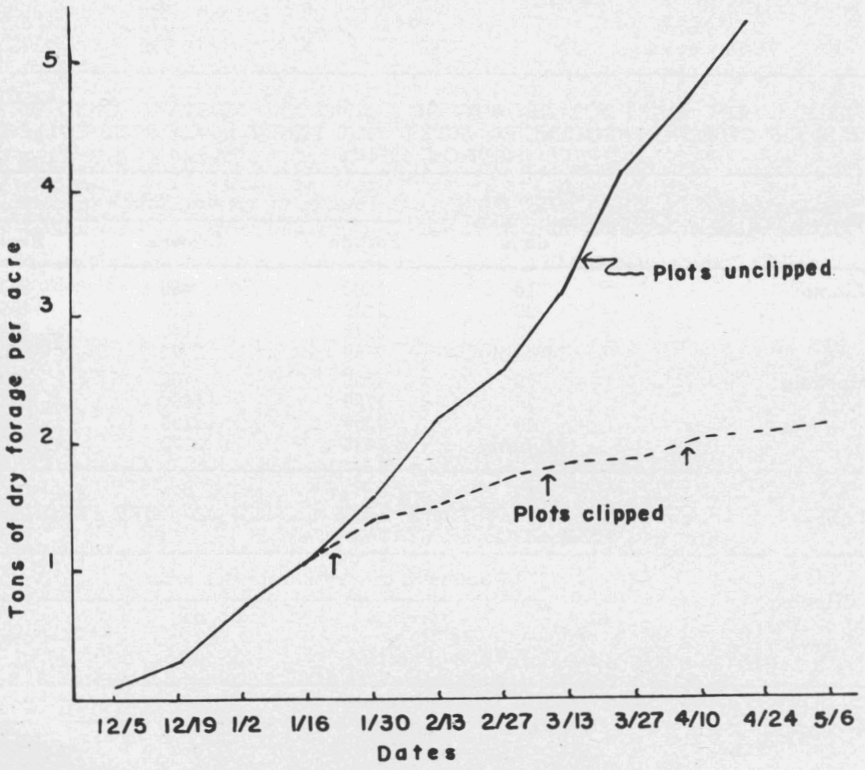

Figure 3. Average cumulative growth of Alamo, Mustang and 119-50-8 oats on Lufkin fine sandy loam, College Station, 1957-58.

cumulation of above-ground dry weight. The first clipping in 1957-58, Figure 3, was delayed until January 27 and recovery was never satisfactory following that date. These results indicate that clipping may be delayed too long as well as being too frequent, and the effects may be much the same. These results also show that a longer rest period than is normally provided between grazings would be desirable.

Response to Temperature

To study the growth response of plants to temperature, plots were used which were unclipped throughout the season. Growth to each date was determined by sampling an unclipped 2-foot section of row. Average accumulative growth of the three varietiees by weekly or biweekly periods is shown in Figure 5. It is apparent from these data that growth is more uniform at College Station than at Iowa Park. This is to be expected since winter temperatures at College Station are more suitable for continuous growth. The only major break in growth at College Station during 1956-57 came in March. The temperature dropped below freezing for a short period, imparing growth and evidently producing some top kill since accumulated growth was reduced during this time. Growth was almost uniformly continuous at College Station during 1957-58.

Growth was more irregular at Iowa Park, probably because conditions unfavorable to plant growth were encountered more frequently. The major breaks in growth occurred in mid-January, early March and early April. During the last 15 days of January, the temperature dropped below 20° F. on several occasions and the average temperature for the entire period was only 36.3°F. In early March and early April when temperatures probably would be more critical because of the more advanced stages of growth of the plants, the temperature dropped to freezing on one or more days. Growth stoppage and actual loss of dry matter during those periods are apparent in Figure 5. Less than 50 percent of the total growth at Iowa Park had been produced by March 26, whereas 75 to 100 percent of the growth had been produced at College Station by this date. One to 2 tons more forage had been produced at College Station than at Iowa Park by March 26. Growth was produced at Iowa Park during the winter, but production was less reliable from the grazing standpoint than at College Station. These results point up the need for more critical grazing management in the Texas areas with colder winters.

Although growth behavior of the three varieties without clipping is not presented, some interactions at Iowa Park are pointed out. In the early part of the season, all three varieties behaved about alike. Even during the severe cold period in January, there was no difference in the growth of the three varieties even though they differed in winter-hardiness. During a freezing period in early March, Alamo produced no growth for 2 weeks, 119-50-8 made slight growth and Mustang made good growth. In early April, Mustang was more severely affected by low temperature than the other two varieties. Evidently the stage of growth is a major factor in determining the influence of low temperature on growth. Alamo and 119-50-8 apparently were in a critical stage of growth in early March while Mustang, being later

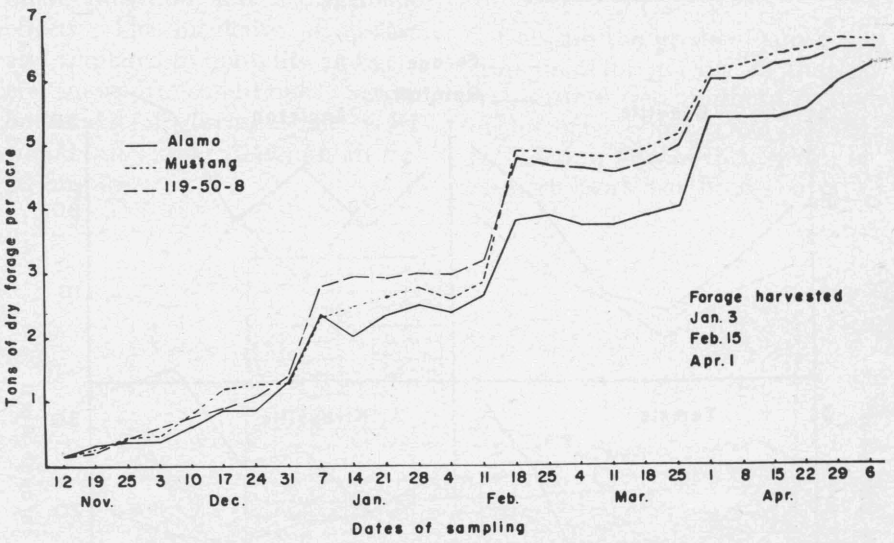

Figure 4. Cumulative growth of three oat varieties grown on Lufkin fine sandy loam, College Station, 1956-57.

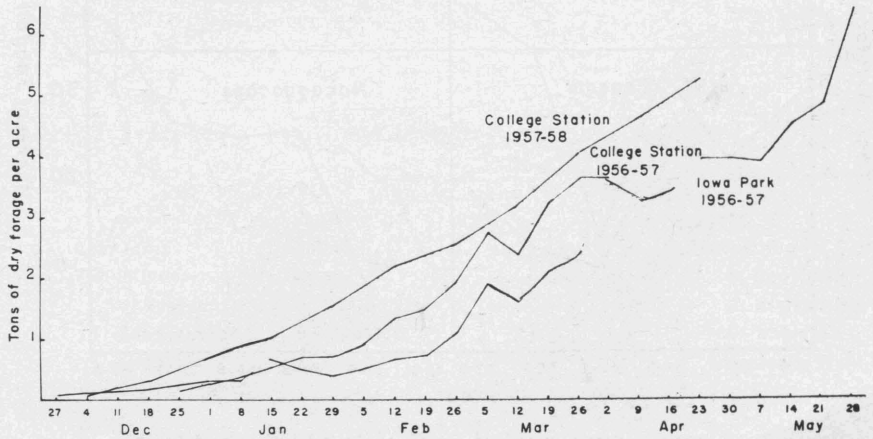

Figure 5. Average cumulative growth of Alamo, Mustang and 119-50-8 oats grown at College Station and Iowa Park.

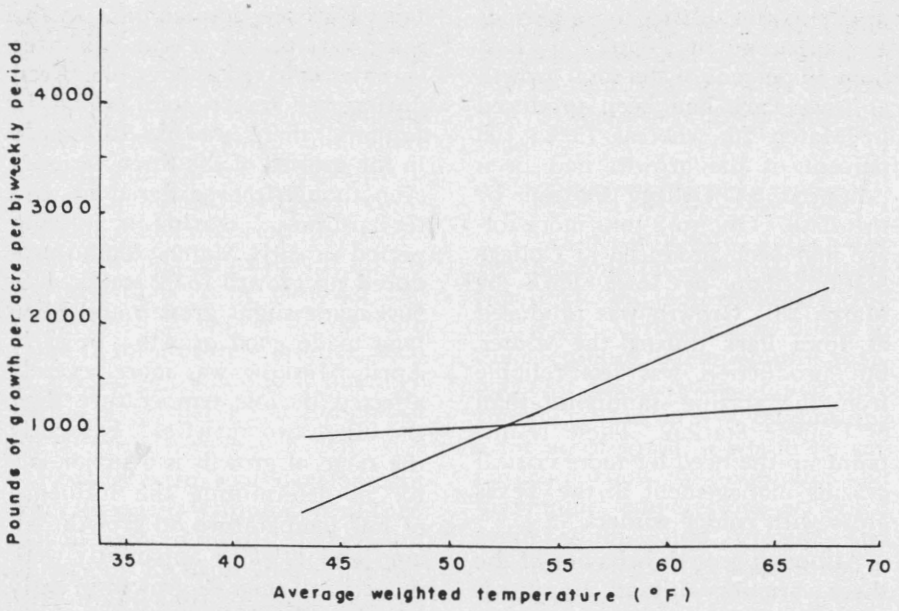

Figure 6. Regression of oat growth on weighted air temperature, College Station and Iowa Park, 1956-57.

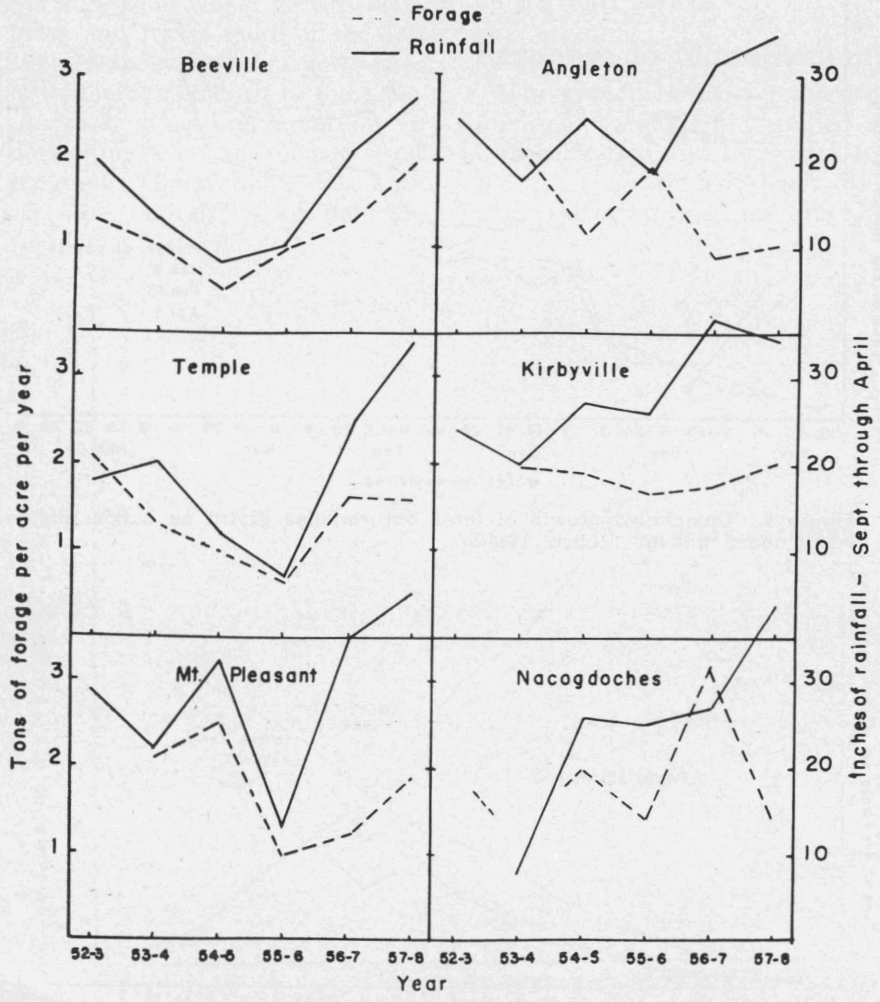

Figure 7. Average forage yield of small grain varieties and total seasonal rainfall, Beeville, Angleton, Temple, Kirbyville, Mount Pleasant and Nacogdoches, 1953-58.

in maturity, did not reach this critical stage until early April.

The relationship of oat growth to mean temperature was calculated. Temperature recorded every 3 hours was averaged in computing mean temperatures. The regression of growth on mean temperature, shown in Figure 6, was highly significant. The correlation coefficient was .658 with 17 degrees of freedom indicating a good relationship between the two variables. It is apparent from the regression figure, which is based on both locations in 1956-57, that other factors also influenced growth. It is difficult to maintain moisture at an optimum level and this was a contributing factor to variability in growth rate. Some of the variability could have been due to sampling error since only a 2-foot sample was taken from each plot and the stands were not completely uniform.

The regression line shown is based on a linear equation. Growth probably would not be linear, especially at the lower and upper limits. The regression line would indicate no growth below an average temperature of 40 to 42° F. Some growth was measured at Iowa Park at temperatures below this level, indicating that the curve is not linear. The data do indicate that when the temperature drops below a mean of 45° F, little growth may be expected.

Since high temperatures under field conditions are encountered only at or near the end of the normal growth cycle of oats, it was not possible to determine at what point or level high temperatures could become a limiting factor in plant growth. It is evident, however, that high temperatures seldom limit oats grown for forage in Texas.

Response to Moisture

Yield in response to moisture was not studied under controlled conditions, but some information can be gained from the data obtained at several locations over a

period of years. Rainfall varied by location and from season to season at a given location. Figure 7 shows the total rainfall for the growing season, September through April, for a 6-year period at six locations in Texas. Average yield of all varieties grown at each location during the entire 6-year period also is shown in the figure.

Yield data are not available for all years at Angleotn. The available data indicate a negative relationship of yield and total rainfall. The lowest rainfall obtained during the growing season was about 17 inches, which apparently is adequate for good production. This is an area where drainage is a problem in periods of high rainfall. Apparently, poorer performance in high rainfall years is related to the drainage problem.

Results at Temple indicate a good relationship of yield and rainfall below 20 inches. Above this amount of rainfall, the yield levels off at about 1½ tons of air-dry forage per acre.

Rainfall apparently was adequate during all years of the test at Kirbyville. The studies were located on a deep sandy soil which apparently had no drainage problems in years of high rainfall. Thus, the yield level remained about the same through the test period.

Rainfall at Gilmer, which was the nearest location to Mount Pleasant, varied from 13 inches to more than 40 inches. Yield was related to rainfall only in the years of lower rainfall. The relatively low yields in 1956-57 and 1957-58 are not fully understood. The test plots were located on a deep sand which should have been well drained. It is possible that rainfall in excess of 30 inches resulted in some leaching of nutrients, thus reducing yields.

Both rainfall and yield varied considerably at Nacogdoches, but the relationship between the two variables was not close. This is a mobile station and the test area was moved during the period. It is possible that soil effects on yield were more important since rainfall exceeded 25 inches except for one year.

Information presented in this section shows that rainfall is important in determining expected yields of small grains grown for forage. Rainfall may be insufficient for maximum production in many areas of Texas. The Coast Prairie is less likely to encounter a deficiency, but because of the flat topography and heavy soils, excessive moisture for optimum growth may be encountered. Failure to obtain better relationships of growth and moisture in some cases may have been due in part to rainfall distribution patterns, inadequate nutrition and management effects. The incidence of disease also is related to humidity and general moisture conditions. Severe outbreaks of disease some years would alter the yield-rainfall relationships.

VARIETY PERFORMANCE

Small grains are the most important crops grown for late fall, winter and early spring grazing in Texas. Many varieties which give satisfactory performance are available. Over much of the State the crop is grown primarily for grain, but is grazed during a part of its growing season. Therefore, one of the factors influencing choice of variety is its grain production. Practically all of the varieties that have been tested extensively are commercial grain varieties. Experimental lines that show promise for grain production also are tested for forage production. In this way, information on the forage producing ability is available when the variety is released for commercial production.

Oats are the predominant cereal crop used for grazing in the central, eastern and southern sections of the State. Other cereal crops are included in tests in these areas, but research work has been concerned

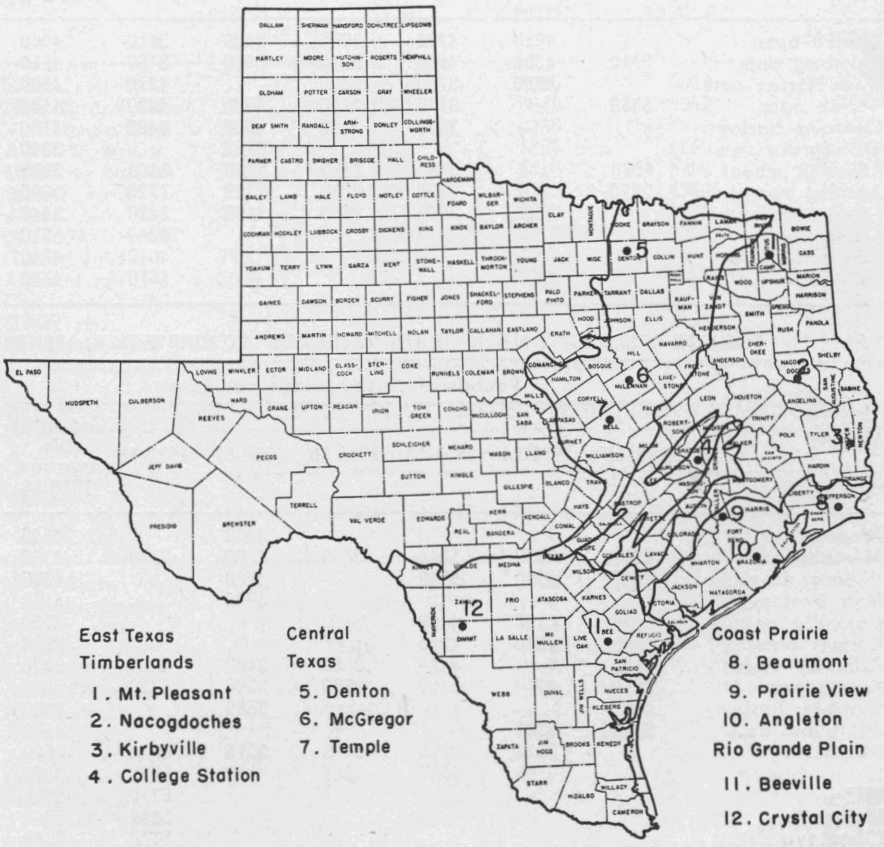

Figure 8. Areas and locations of small grain variety tests.

primarily with oat varieties. Descriptions of these varieties are available in other publications. The discussions here will be with reference to growth habit, production of forage and cold tolerance. Varieties differ in total production and in the distribution of production during the growing season. Oats are classified as spring, winter and intermediate types. The so-called "spring types" are not true spring types, such as are grown in the Corn Belt, but are erect growing winter oats of low hardiness which produce early forage when fall-seeded. Winter-type oats have a decumbent growth habit in the fall and winter and are late in forage production, but are cold-hardy. The intermediate types are intermediate between spring and winter types in these characteristics. Wheat, barley and rye varieties also differ in cold-tolerance and type of early growth.

TABLE 6. FORAGE YIELD OF SMALL GRAIN VARIETIES AT MOUNT PLEASANT, 1953-58

Variety	Pounds of air-dry forage per acre					
	1953-54	1954-55	1955-56	1956-57	1957-58	Comparable average
New Nortex oats	3400	4500	3190		4380	3600
Mustang oats	3900	4870	2460	2290	4160	3540
Bronco oats	4030	4900	1790	2670	3850	3450
Abruzzi rye	4650	5180	1530	2300	3250	3380
Atlas 66 wheat		4600	1770	1870	4590	3300
Alamo oats	2700	4460	3860	2090	3330	3290
Cordova barley		4390	1880		1870	2490
Quanah wheat	2710	3350				2110
Goliad barley	1940	3810				1950
Gator rye					4680	4450
Elbon rye					4630	4400

TABLE 7. FORAGE YIELD OF SMALL GRAIN VARIETIES AT NACOGDOCHES, 1952-58

Variety	Pounds of air-dry forage per acre						
	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	Comparable average, 1954-58
Bronco oats		4810	4770	3760	7420	3510	4860
Mustang oats	3310	4080	4500	4040	6590	3460	4650
New Nortex oats		4600	3700	3420		4210	4500
Alamo oats	3460		3170	3440	5920	4230	4190
Cordova barley			3970	3140	6030	3480	4160
Victorgrain oats					6130		3990
Atlas 66 wheat	4060		3590	2260	5440	3460	3690
Abruzzi rye	2870		3870	2050	7120	1720	3690
Goliad barley		3000	3060	2150	5120	3420	3440
Elbon rye						4240	5010
Suregrain oats						4010	4780
Gator rye						4010	4780

TABLE 8. FORAGE YIELD OF SMALL GRAIN VARIETIES AT KIRBYVILLE, 1951-58

Variety	Pounds of air-dry forage per acre						
	1951-52	1953-54	1954-55	1955-56	1956-57	1957-58	Comparable average, 1953-58
Bronco oats					4640		4840
Mustang oats	2960	4550	5040	3410	4300	4520	4360
Victorgrain oats	3570	3900	5040		3730		4200
New Nortex oats					3980		4180
Camellia oats	3670	4160	4430				4160
Ranger oats		3980	4200				3960
Atlas 66 wheat			4470	3180	3400	4430	3920
Alamo oats	2760	4210	4400	3670	3380	3730	3880
Cordova barley					3680		3880
Southland oats	2740	3740					3540
Abruzzi rye		3820	3230	3120	3275	4070	3500
Goliad barley		3160	2510	3160	3180	3930	3190
Midsouth oats						6210	5880
Gator rye						5870	5540
Elbon rye						5670	5340
Suregrain oats						5130	4800

Yield results are presented for several areas of the State. Four areas in which rather extensive testing has been conducted are shown in Figure 8. These areas have been designated as East Texas Timberlands, Coast Prairie, Rio Grande Plain and Central Texas which includes the Blackland and Grand Prairies. Small grains are used west of these areas, but experimental yield data are not available.

The results presented in the following tables represent total production for the growing season. Where a small grain is grown primarily for grain production, forage harvesting or grazing would have to be stopped earlier and forage yields would be less. Yields are presented in some cases by dates of harvest or periods. Forage production could be determined up to the time that cattle would have to be removed for grain production.

East Texas Timberlands

Results of performance tests at three locations in East Texas, Tables 6, 7 and 8, show that several varieties produce good total yields. At the central and northern stations, Mustang, Bronco and New Nortex oats and Abruzzi rye appear to be satisfactory. For the central and southern parts, Mustang, Alamo, Victorgrain, New Nortex and Camellia oats, Goliad barley and Atlass 66 wheat are satisfactory. Mustang, New Nortex and Bronco are winter-type oats, Victorgrain is an intermediate type and Alamo and Camellia are erect growing, non-hardy types. Goliad is not winter-hardy north of Cen-

tral East Texas, but makes early growth in the more southern locations. Abruzzi rye produces good total yields in much of the State, but is very late before making any appreciable growth. Atlas 66 wheat has been grown primarily for its early forage production, as shown in Table 9.

A number of new cereal varieties show promise for both early and sustained forage production. These include Mid-South and Suregrain oats and Elbon and Gator rye. These varieties are in the second year of testing. If they continue to show satisfactory disease resistance, they will find a place in the winter forage production program in the State.

Production varies from one year to another, as may be observed in Tables 6, 7 and 8. Forage yields are determined by variety, moisture, date of planting, soil type, fertilization and temperature. Rainfall during the small grain growing season for a number of locations is shown in Figure 7. These results indicate that soil moisture is a major factor in small grain production in East Texas.

The season of production as well as total production is important in a grazing program. Yields at Mount Pleasant in 1957-58 are shown by periods of the year (Table 9). Alamo oats and the two new rye varieties, Gator and Elbon, produced the most early forage. New Nortex oats, which produced good early forage yields in this test, is normally a later forage producer. It is apparent from the percentage of the forage produced by February 20, that varieties differ widely in their growth pattern. Cordova barley and Abruzzi rye were low in production and made very little growth before early spring. This again is somewhat abnormal for Cordova barley.

Central Texas

Variety forage yield tests were conducted at four locations in the Central Texas area (Tables 10, 11, 12 and 13). These locations were College Station, Temple, McGregor and Denton. Mustang and New Nortex oats and Cordova barley have been outstanding in total forage production and in its distribution. Alamo oats and Goliad barley produce more early forage in the southern part of this area, but may be damaged by low temperatures in the northern part. Goliad barley is very tender and should not be fall-sown north of Temple. Alamo oats produces slightly more early forage than Mustang and New Nortex in the northern part of the area, but may be more severely damaged by close grazing or clipping. Bronco oats produces high total forage production but its maximum production is not until late winter. For this reason, it

TABLE 9. FORAGE YIELD OF SMALL GRAIN VARIETIES AT MOUNT PLEASANT, 1957-58

Variety	Pounds of air-dry forage per acre				
	Late fall	Mid-winter	Late winter-early spring	Total	% produced by Feb. 20
Gator rye	800	1420	2460	4680	47
Elbon rye	940	1460	2230	4630	52
Atlas 66 wheat	660	1420	2510	4590	50
New Nortex oats	700	770	2910	4380	34
Mustang oats	340	880	2940	4160	29
Bronco oats	220	790	2840	3850	26
Alamo oats	950	580	1800	3330	46
Abruzzi rye	190	700	2360	3250	27
Cordova barley	50	170	1650	1870	12

TABLE 10. FORAGE YIELD OF SMALL GRAIN VARIETIES AT COLLEGE STATION, 1954-58

Variety	Pounds of air-dry forage per acre				
	1954-55	1955-56	1956-57	1957-58	Comparable average
Elbon rye			6360	5050	4730
New Nortex oats	3680	3230	6640	5050	4650
Victorgrain oats	3300		6360		4520
Atlas 66 wheat	3360	3780	5590	5130	4460
Mustang oats	3300	3140	5410	5250	4280
Bronco oats		2530	6280	4780	4210
Alamo oats	2750	3550	6270	4250	4200
Cordova barley		3150	5650	3930	3920
Goliad barley	2860	3820	4710	4260	3910
Abruzzi rye	3070	1360	5460	3060	3240
Mid-South oats				5870	5500
Gator rye				4990	4620
Suregrain oats				4870	4500

TABLE 11. FORAGE YIELD OF SMALL GRAIN VARIETIES AT TEMPLE, 1952-58

Variety	Pounds of air-dry forage per acre						
	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	Comparable average
New Nortex oats	4690		2205	1790	3970	4155	3040
Cordova barley			2595	1795	3445	4175	3020
Bronco oats	4175	3260	2035	1715	3630	3375	2800
Mustang oats	4430	2520	2265	1505	2985	3710	2600
Atlas 66 wheat			2385	950	2805	3705	2470
Goliad barley		2170	1965	675	2580	3915	2260
Alamo oats		2185	2440	1035	2075	3525	2250
Abruzzi rye	3975	1995	1620	655	3040	2460	1950
Texan barley	5325						
Quanah wheat		3205					
Mid-South oats						4110	4090
Suregrain oats						4345	3320
Elbon rye						3600	2580
Gator rye						3060	2030

is less desirable in most farm forage programs, but, because of its high tonnage, may be considered for hay or silage.

The newer varieties, especially Elbon and Gator rye, appear promising for the production of early winter grazing on the basis of recent tests, but may need further testing. These two varieties exceeded the yield of Goliad barley on February 15, 1958 at McGregor by more than 500 pounds and Alamo by more than 1,000 pounds per acre.

Rio Grande Plain

Small grain variety forage evaluation tests have been grown at Beeville each year since 1952, Table 14. Yields are relatively low most years at this location because of limited moisture. Seasonal rainfall exerts a great influence on small grain forage yields, as is evident from the maximum yield produced by Alamo oats in 1954-55, a dry season, and 1957-58, a good season. The highest yield in 1954-55 was 1,180 pounds per acre produced by Alamo oats, while the same variety produced 4,040 pounds in a good rainfall year. For this 6-year period, varieties ranged in average yield from 1,530 to 2,450 pounds per acre, or a range of less than 1,000 poupnds, whereas at other locations the range often is 1,500 pounds or more.

Mustang, Alamo, Victorgrain, Camellia and New Nortex oats give satisfactory performance. Alamo and Camellia oats and Goliad barley are upright varieties and tend to give more early production. A mixture of Alamo and Mustang oats has given satisfactory results and is being used in the Beeville station pasture program. As pointed out in the section on mixtures, this combination has about the same average production as the individual varieties, but, under some conditions may show some advantage over either grown alone.

Irrigated small grains are grown for grazing in some parts of the Rio Grande Plain. The yield performance of selected varieties under irrigation at Crystal City is given in Table 15. High yields can be obtained with irrigation and management. A number of varieties, including Victorgrain, Arkwin, New Nortex, Mustang and Alamo, produce good yields. The upright varieties, such as Goliad and Alamo, will give more early production but somewhat less total production.

Coast Prairie

Forage yield data for three locations are given in Tables 16, 17 and 18. Yields are not as high in this area as might be expected on the basis of a long growing season and more adequate moisture. In fact, it would appear that excessive rainfall on the Coast Prairie may

TABLE 12. FORAGE YIELD OF SMALL GRAIN VARIETIES AT McGREGOR, 1952-58

Variety	Pounds of air-dry forage per acre						Average % of forage on 1st clipping[1]
	1952-53	1953-54	1954-55	1956-57	1957-58	Comparable average	
Goliad barley					6950	5280	37
Cordova barley		5020	4295	4100	7570	5130	22
Mustang oats	4260	4500	4945	4930	6895	5110	20
Mustang-Alamo	4090	3870		5220		5000	20
Bronco oats	4665		4915	4150	6290	4960	16
Quanah wheat		5050	3805	4110	6430	4730	14
Suregrain oats					6295	4630	34
Atlas 66 wheat					6210	4545	30
New Nortex oats	4180	3680	4340	4150	6215	4510	19
Arkwin oats	4225				5810	4420	21
Alamo oats	4020	3780	3770	3945	5760	4250	29
Mid-South oats					5690	4020	14
Elbon rye					5690	4020	63
Gator rye					5395	3730	61
Abruzzi rye	3560			1770	3100	2510	5

[1]First clipping date varied from Feb. 4 to Mar. 3, average Feb. 15.

TABLE 13. FORAGE YIELD OF SMALL GRAIN VARIETIES AT DENTON, 1955-58

Variety	Pounds of air-dry forage per acre			
	1955-56	1956-57	1957-58	Comparable average
Bronco oats		3820	3550	3530
Mustang oats	3010	4090	3230	3440
New Nortex oats	2790	3440	3680	3300
Alamo oats	2470			2770
Quanah wheat	2420	2565	3060	2690
Knox wheat		2640	2690	2510
Cordova barley	2450	2210	2730	2460

TABLE 14. FORAGE YIELD OF SMALL GRAIN VARIETIES AT BEEVILLE, 1952-58

Variety	Pounds of air-dry forage per acre						
	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	Comparable average
Alamo 60%, Mustang 40%	2630	2120	1160	1840	2960	3985	2450
Alamo oats	2210	2010	1180	2170	2810	4040	2400
Camellia oats	2070	2100	790	2050	2400	4690	2350
Victorgrain oats	2510	2040	960	2040	2010	4290	2310
Mustang oats	2550	1860	850	1700	2750	3680	2230
New Nortex oats	1710		760	1850	2510	3960	2100
Cordova barley			710	1340	3000	3480	2070
Bronco oats	2070	1930	740	1440	2230		2020
Goliad barley	1890	1930	1030	1860	2180	3160	2010
Arivat barley			730	1940	2420	3210	2010
Abruzzi rye				670	3070	2400	1530

reduce yields. Rainfall in the 1957-58 growing season for small grains exceeded 38 inches. The yields at Angleton in 1957-58 were not as good as in 1955-56 when the rainfall was about 20 inches.

Goliad barley and Mustang oats have been the most consistent in performance in this area. Goliad and Alamo oats are early varieties, but are likely to produce less total forage than Mustang and are more sensitive to management practices. The newer varieties, Elbon and Gator rye and Mid-South oats, show promise provided they have adequate disease resistance. Disease is a major factor in this area and may account for poor yield performance in some years.

VARIETY MIXTURES

Since small grain varieties differ in growth habit and the season in which maximum growth is produced, some advantage might be gained through combinations of varieties. Work was started in 1954-55 at College Station to evaluate various combinations of a winter and a spring-type oat. The results of the study are presented in Table 19. No significant difference is shown in total yield among the various combinations. The mixtures produced about the same yield at the first clipping as Alamo and the same total yield as Mustang. The cross-seeding produced slightly less than any of the seed mixtures.

The mixture study was expanded in 1955 to include several types of small grains and ryegrass. This study has been conducted for 3 years and the results are presented in Table 20. All of the mixed seed were made up of equal parts by weight of each variety since the earlier study had indicated no difference with the various proportions of Mustang and Alamo. The seed mixtures gave slightly better early and total production than the cross-seedings. The seed mixtures produced somewhat less early forage than pure stands of Alamo and Goliad, but more than Mustang. The exception to this was Mustang-Abruzzi rye which is a mixture of two late types. This mixture performed about the same as a pure stand of Mustang. A cross-seeding of Goliad and ryegrass performed about the same as Goliad, with slightly more late production than with Goliad alone. In this mixture, ryegrass contributed significantly to the yield, but apparently the yield of Goliad was reduced accordingly after the early harvest since the total yield was no greater. This combination might be more reliable for late production than pure Goliad since Goliad frequently is damaged by disease during the spring.

TABLE 15. FORAGE YIELD OF SMALL GRAIN VARIETIES AT CRYSTAL CITY WITH IRRIGATION, 1952-57

Variety	Pounds of air-dry forage per acre				
	1952-53	1953-54	1954-55	1956-57	Comparable average
Victorgrain oats	10490	6800	9020	7060	8340
Arkwin oats	9250	7810	9100		8310
New Nortex oats	10140	7350	9600	5000	8070
Alamo oats		7170	8980	7030	8030
Abruzzi rye	10050	7450		5280	8020
Mustang oats	7510	7200	10120	6110	7740
Atlas 66 wheat			8000	7060	7510
Goliad barley	6970	6110	7800	8380	7320

TABLE 16. FORAGE YIELD OF SMALL GRAIN VARIETIES AT PRAIRIE VIEW, 1954-57

Variety	Pounds of air-dry forage per acre			
	1954-55	1955-56	1956-57[1]	Comparable average
Atlas 66 wheat		3270	4840[2]	4300
Bronco oats	4780	2930	4900[2]	4200
Victorgrain oats	4600		4160	3940
Abruzzi rye	4420	2100	5290[2]	3940
Mustang oats	4230	3310	4200	3910
Alamo oats	3640	3590	3650	3630
New Nortex oats	4870	2580	3430	3630
Cordova barley		2750	3440[2]	3340
Goliad barley	3600	2470	3520	3200

[1]Harvested the first time on March 14, resulting in no regrowth for most varieties.
[2]Includes some regrowth.

TABLE 17. FORAGE YIELD OF SMALL GRAIN VARIETIES AT BEAUMONT, 1953-58

Variety	Pounds of air-dry forage per acre				
	1953-54	1955-56	1956-57	1957-58	Comparable average
Elbon rye			5270	4710	5370
Mid-South oats				5295	5300
Mustang oats	4850	5660	3330	5340	4790
Floriland oats		5470			4710
Atlas 66 wheat		3750	5620	4610	4660
New Nortex oats		4535	3910	5280	4580
Camellia oats		5340			4580
Victorgrain oats	5280		2950		4500
Bronco oats	5560	4100	3550	4610	4450
Gator rye				4310	4310
Suregrain oats				4290	4290
Alber oats		5040			4280
Alamo oats	4240	5440	3340	3670	4170
Cordova barley	3360	5160	3790	4260	4140
Southland oats	4170	4490			3950
Goliad barley	3250	4730	3860	3840	3920
Abruzzi rye		4030	3840	1090	2990

A mixture of 60 percent Alamo and 40 percent Mustang has been seeded at Beeville each year since 1952. The results of this study in comparison with Alamo and Mustang are presented in Table 21. Forage production of this mixture has not been greatly different from pure stands of Alamo. The mixture produces about the same early forage as Alamo and does not hold up in late spring as well as Mustang. It is possible that the mixture might be more uniform in production year after year because the varieties do not respond the same to environmental variations and diseases. This should give a more stable response. Results at Denton with various combinations of small grains have been similar to those at Beeville.

These results do not indicate any yield advantage to cross-seedings of two small grain types, and it is doubtful that the additional seeding cost could be justified. It is possible that cross-seedings could give better footing for cattle where this is likely to be a problem.

The use of mixtures of two small grain types produced forage equal in all cases to pure stands of varieties. If properly managed, the benefits of the two types might be derived from a mixture. However, this practice would introduce certain problems. Seed of varietal mixtures would be difficult to identify accurately, and unless the buyer was certain of the mixture offered for sale, purchase of pure seed of the two varieties with mixing at planting time might be more desirable. Grazing management would be more exacting if the benefits of the mixture were to be realized. As discussed earlier, frequent grazing of an early upright type may damage it in early stages of growth. This would hold true in the mixture. Late harvesting or grazing of an early type in a mixture may result in the winter type being retarded and the mixture behaving as an early type. In addition to these factors, differences in palatability could introduce differential grazing especially where different species were involved, such as barley and oats or rye and oats.

TABLE 18. FORAGE YIELD OF SMALL GRAIN VARIETIES AT ANGLETON 1954-58

Variety	Pounds of air-dry forage per acre				
	1953-54	1954-55	1955-56	1957-58	Comparable average
Mid-South oats				3000	4070
Camellia oats	5520				4040
Suregrain oats				2720	3790
Victorgrain oats	4910				3730
Mississippi Red oats				2630	3700
Texas Red oats				2580	3650
Mustang oats	4910	2670	4390	2400	3590
Alamo oats	4110	2260	5560	2430	3590
Ranger oats	4660				3480
Southland oats				2290	3360
Elbon rye				2000	3070
New Nortex oats		2800	2870	2310	3050
Goliad barley	4090	2880	2700	2190	2960
Atlas 66 wheat		3150	2440	1910	2890
Bronco oats		2980	2050	2320	2840
Cordova barley		3340	1470		2460
Abruzzi rye			1790		1090
Domestic ryegrass	4120	1510	2670	1210	2380
Gulf ryegrass				2800	3870
Texas Rescue 46		3350			4150

TABLE 19. FORAGE YIELD OF OATS SEEDED IN PURE STANDS AND VARIETY MIXTURES, LUFKIN FINE SANDY LOAM SOIL, COLLEGE STATION, 1954-55

Variety or mixture	Pounds of air-dry forage per acre			
	Jan. 3	Feb. 24	Apr. 15	Total
Mustang 50%, Alamo 50%	1100	940	1290	3330
Mustang 60%, Alamo 40%	1170	1040	1220	3430
Mustang 70%, Alamo 30%	1220	1110	1030	3360
Mustang 50%, Alamo 50%[1]	900	810	1190	2900
Mustang	770	1160	1450	3380
Alamo	1200	850	910	2960

[1]Cross-seeded.

TABLE 20. FORAGE YIELD OF WINTER CROPS SEEDED ALONE AND IN PURE STANDS, LUFKIN FINE SANDY LOAM SOIL, COLLEGE STATION, 1955-58

Variety or mixture	Pounds of air-dry forage per acre				
	Jan. 15	Mar. 1	Apr. 1	May 1	Total
SEED MIXED[1]					
Mustang-Alamo	1440	1470	1310	550	4770
Mustang-Goliad	1790	1510	990	660	4950
Mustang-Atlas 66	1660	1610	650	760	4680
Mustang-Abruzzi	800	1430	1320	550	4100
CROSS-SEEDED					
Mustang-Alamo[2]	1160	1420	1250	580	4410
Mustang-Goliad[2]	1480	1620	790	630	4520
Mustang-Goliad[3]	1270	1620	1020	670	4580
Goliad-ryegrass[4]	2080	1000	790	710	4580
PURE STANDS[1]					
Mustang	1050	1590	1100	490	4230
Alamo	1830	950	1190	610	4580
Goliad	2010	1040	880	450	4380

[1]80 pounds of seed per acre.
[2]80 pounds of seed per acre of each.
[3]40 pounds of seed per acre of each.
[4]80 pounds of seed of Goliad and 15 pounds of ryegrass per acre.

SMALL GRAIN-LEGUME MIXTURES

Annual winter legumes have been used with small grains, es-

pecially oats, to increase production and improve quality. Studies of this practice have been conducted on two soil types at College Station and at Nacogdoches. The results are summarized in Table 22.

Vetch probably is the most common legume seeded with small grains for forage. Table 22 shows a slightly higher yield of oats and vetch as compared with oat alone at Nacogdoches and on Miller Clay soil at College Station. Crimson clover was the only legume which failed to show some increase in yield over oats alone at Nacogdoches, while oat yields on Lufkin soil at College Station were better with no legume. The percentage of legume in the forage shows that the legumes grew better in the Brazos bottom than on upland soil at College Station. While the forage was not separated into grass and legume components at Nacogdoches, fair legume growth was obtained.

In addition to influencing yields, legumes also may influence forage quality. Crude protein analyses from these studies are shown in Table 23. The legume increased the percentage of crude protein in the total forage, and it increased the crude protein in the grass component of the mixture. This occurred even when the legume constituted as little as 4 percent of the mixture. Increases in protein content of the total forage varied from 2 to 9 percent, depending on the amount of legume present. Oats grown alone averaged 14 to 18 percent crude protein in the forage. The value of increases in crude protein above this level may be questionable unless a system of grazing and feeding management is practiced whereby a part of the energy requirements of the animal is supplied from other sources.

These studies indicate that relatively little is gained from planting the annual legumes used in these studies with an oat variety for forage production. Where it is adapted, the use of vetch may be an exception. These results are considered from the standpoint of forage production only. The possible soil-improving benefits of annual winter legumes in combination with small grains are not considered.

SEEDING RATES AND METHODS

Seeding rate studies have been limited, but in general have shown that seeding rates between 48 and 96 pounds usually do not greatly

TABLE 21. FORAGE YIELD OF MUSTANG, ALAMO AND A MIXTURE OF MUSTANG AND ALAMO OATS AT BEEVILLE, 1952-57

Year and date	Pounds of air-dry forage per acre		
	Alamo	Mustang	Alamo 60% Mustang 40%
1952-53			
April 8	2040	2130	2360
May 23	170	420	270
Total	2210	2550	2630
1953-54			
Feb. 7	1080	730	1020
April 7	660	610	730
May 20	270	530	370
Total	2010	1860	2120
1954-55			
March 31	1180	850	1160
1955-56			
Feb. 13	1330	820	1040
April 8	850	880	800
Total	2170	1700	1840
1956-57			
Feb. 4	1800	1380	1920
April 12	1010	1370	1040
Total	2810	2750	2960
Comparable average	2080	1940	2140

TABLE 22. FORAGE YIELD OF OATS GROWN ALONE AND WITH LEGUMES AT COLLEGE STATION ON LUFKIN FINE SANDY LOAM AND MILLER CLAY SOIL, AND AT NACOGDOCHES

Oats with	Pounds of air-dry forage per acre				
	College Station				Nacogdoches, 1953-55
	Lufkin fine sandy loam,		Miller clay		
	1953-56	% legume	1954-55	% legume	
No legume	4850		2630		4370
Vetch	4380	14	3430	44	4510
Winter peas	4030	24	3000	50	
Crimson clover	4170	3	2580	14	4270
California burclover	4010	4	2530	19	4550
Red clover	4210		2560	5	4690

TABLE 23. PROTEIN CONTENT OF OAT FORAGE AS INFLUENCED BY A LEGUME IN THE MIXTURE, COLLEGE STATION, 1955

Mixture	Percentage crude protein								
	Lufkin fine sandy loam soil						Miller clay soil		
	Mar. 25			Apr. 26			Mar. 11		
	Grass	Legume	Mixture	Grass	Legume	Mixture	Grass	Legume	Mixture
Oats alone	14.2		14.2	18.3		18.3	14.0		14.0
Oats-winter peas	19.4	33.1	25.1	23.0	36.5	23.5	16.9	33.9	27.0
Oats-bur clover	16.0		16.0	20.3		20.3	16.1	30.3	21.4

influence total forage production. The results of a seeding rate study at Crystal City with irrigation in 1952-53 are given in Table 24. Early production was increased with the higher rates of seeding, but total production with 96 pounds of seed was only 500 pounds above that with 48 pounds. Similar results were obtained at Kirbyville in 1957-58. Yields varied less than 700 pounds with seed rates from 48 to 112 pounds per acre, Table 25. Because of the need for early production and the slight advantage of increased plant numbers in producing early production, it probably is advisable to use 64 to 80 pounds of seed per acre.

TABLE 24. FORAGE PRODUCTION WITH VARIOUS RATES OF SEEDING MUSTANG OATS AT CRYSTAL CITY, 1952-53

Pounds of seed per acre	Pounds of air-dry forage per acre			
	Jan. 3	Feb. 10	Mar. 18	Total
48	3110	2380	4050	9540
64	3060	2790	3480	9330
80	3380	1740	3480	8600
96	4400	2010	3680	10090

TABLE 25. INFLUENCE OF RATE OF SEEDING AND CLIPPING FREQUENCY ON THE FORAGE YIELD OF ALAMO AND MUSTANG OATS, KIRBYVILLE, 1957-58

Variety	Pounds of air-dry forage per acre					
	Pounds of seed per acre					Average
	48	64	80	96	112	
Alamo	6690	6350	6830	6920	6050	6570
Mustang	6020	5680	6000	6500	6860	6210
Average	6360	6020	6420	6710	6460	

TABLE 26. FORAGE YIELDS OF VARIOUS OATS WITH VARIOUS ROW SPACINGS AND SEEDING RATES AT BEEVILLE, 1953-56

Treatment		Pounds of air-dry forage per acre				
Row spacing, inches	Pounds of seed per acre	1954	1955	1956	1957	Average
12	32	2140	1040	1690	880	1440
12	48	2030	1060	1870	1780	1680
12	64	1950	1100	1750	1410	1550
18	48	1880	1140	1800	1350	1540
36	24	1360	1220	1400	1170	1290
36	36	1960	1360	1490	910	1430
36	48	1680	1160	1540	950	1330

Most small grains are drill-seeded with the drills 7 to 8 inches apart. Experimental plantings in most instances were in 12-inch rows or drills for convenience in handling the small plots. Row spacing and seeding rate studies have been conducted at Beeville for 4 years. The results are presented in Table 26. It is apparent that neither row spacing nor seeding rate influence forage production significantly. Yields with 36-inch row plantings tended to be slightly less than with 12 and 18-inch rows. These studies were conducted in a dry area. Where moisture is adequate, there might be a greater reduction in yield from wide rows. However, these results do indicate that the tillering characteristic of small grains tends to compensate for lower plant populations whether from lower seeding rates or wider row spacings.