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production and management of SMALL GRAINS FOR FORAGE

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Summary

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

Small grains may be planted for forage production from early September to late November. Early plantings result in earlier forage production while midseason plantings generally result in maximum forage production. Early planting increases the risks of insect and drouth damage but is necessary if early forage production is desired.

Seeding rates between 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 64-80 pounds per acre are suggested.

Small grains respond to fertilization. Application rates depend on soil type, rainfall and desired production level and should be based on soil test results. Studies have shown favorable responses to nitrogen up to 120 pounds per acre. A split application of nitrogen is definitely favored with part of the nitrogen applied at or prior to planting and part applied as a top dressing in midwinter.

Clipping management studies have shown that forage yields may be reduced 20-80 percent by early and frequent pasturing or clipping. Top growth is reduced, and crown and root development is retarded. Allowing the plant to become well established, 6-8 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 between growth and 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 during 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 often may be a limiting factor. Rainfall excessive for maximum growth may occur, especially in the coastal area.

Reduced sunlight energy during the winter months apparently limits growth of small grains. Planting rates and methods do not seem to alter this response significantly. Preliminary evaluation of crops and varieties shows no important differences in adaptation to limited light.

Nitrate accumulation is known to occur in small grains and to induce toxicity in grazing animals. Since many factors influence nitrate accumulation, seldom can it be attributed to any single factor. Research has shown that nitrate tends to be higher in basal parts of the plant, is favored by overcast weather and darkness and is favored to some extent by use of high rates of an oxidized form of nitrogen. Fertilization is usually necessary for small grain production, but the application of moderate amounts of fertilizer has not been associated with high nitrate accumulation.

Carrying capacity and total animal production of small grain pastures are dependent on forage production level. Small grain forage quality is excellent, and average daily gains of grazing animals are good.

Factors influencing choice of variety include disease reaction, cold hardiness and growth habit. Varieties change in disease susceptibility, and new, better adapted varieties are being developed constantly. Current adaptation should be determined when choosing a variety.

production and management of 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 acreage of small grains in Texas is estimated to exceed 8 million acres. Of this, more than 2 million 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, and then the livestock are removed in time for a grain crop to mature.

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 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 other winter growing crops. For these reasons, the acreage of small grains used for winter pasture exceeds that of any other winter crop. Because the costs of land preparation, fertilization, seed, seeding and other factors

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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.

DATE OF PLANTING

There is no fixed date for seeding small grains for forage production. Planting may be as early as late August or as late as late November. A 3-year study was conducted at College Station to determine the effect of planting date on forage production. Three varieties were seeded at 15-day intervals from September 1 to December 1.

The data in Table 1 show that date of planting has a significant effect on early forage production and also on total forage production. Plantings made after October 1 had little or no forage available by December 1. Peak harvested forage yields were obtained with an October 15 seeding. Seedings prior to October 1 or after November 1 generally produced less forage.

The number of clippings varied with the date of seeding. Clipping generally reduces the potential dry-matter production of small grains. Thus, the study also included plots which were harvested only at maturity to determine the influence of planting date in the absence of clipping effects. The varieties did respond differently. Gator rye showed peak production with November 1 seeding, Mustang oats with October 15 seeding, and Suregrain oats differed little from October 1 to November 1. Late seeding (after November 1) appeared to restrict potential yield more than early seeding.

TABLE 1. FORAGE YIELD OF SMALL GRAIN VARIETIES WITH VARIOUS DATES OF PLANTING, COLLEGE STATION (3-YEAR AVERAGE)

Date of planting	Variety	Harvestable Forage December 1	Total yield of 3 - 4 clippings	Total yield harvested only at maturity
Sept. 1[1]	Gator rye[2]	360	1840	
	Mustang oats	790	1460	
	Suregrain oats[3]	960	1710	
Sept. 15	Gator rye	700	2530	4260
	Mustang oats	710	2050	3350
	Suregrain oats	920	2210	3880
Oct. 1	Gator rye	590	2240	4100
	Mustang oats	690	2120	3600
	Suregrain oats	940	2160	4050
Oct. 15	Gator rye	230	2940	4680
	Mustang oats	210	2610	4630
	Suregrain oats	410	2900	4260
Nov. 1	Gator rye	0	2570	5370
	Mustang oats	0	2310	3500
	Suregrain oats	0	2180	4250
Nov. 15	Gator rye	0	2470	3840
	Mustang oats	0	1980	3240
	Suregrain oats	0	1830	2800
Dec. 1	Gator rye	0	1590	3490
	Mustang oats	0	1850	2960
	Suregrain oats	0	1330	2360

[1]Yields are based on only 1 year and adjusted for year effects.
[2]Cordova barley was used instead of Gator rye 1 year.
[3]Moregrain oats was used instead of Suregrain oats 1 year.

TABLE 2. FORAGE PRODUCTION WITH VARIOUS RATES OF SEEDING OATS AT CRYSTAL CITY

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

Certain problems may be encountered with early plantings which are less likely to occur at later dates. The three major problems are insects, drouth and weeds. These are reduced or eliminated with the advent of cool weather. Early seeding is necessary for early forage production. If the major need is for late fall and early winter forage, some sacrifice of total production may be desirable in order to obtain early forage. Similarly, the risks involved in early planting may not eliminate the desirability or necessity of early planting.

SEEDING RATES AND METHODS

Seeding rate studies have been limited, but in general they have shown that seeding rates between 48 and 112 pounds usually do not greatly influence total forage production. The results of a seeding-rate study with irrigation at Crystal City are given in Table 2. Early production was increased with the higher rates of seeding, but total production with 96 pounds of

TABLE 3. THE INFLUENCE OF SEEDING RATE AND METHOD ON EARLY FORAGE PRODUCTION, COLLEGE STATION

Seeding method	Pounds seed per acre	Pounds dry forage per acre, December 1 Oats	Rye	Wheat
Broadcast	50	1000	1260	920
	100	1260	1480	840
	Average	1130	1370	880
12-inch rows	50	870	1160	920
	100	920	1380	1000
	Average	1015	1320	960

TABLE 4. INFLUENCE OF RATE OF SEEDING ON THE FORAGE YIELD OF OATS AT KIRBYVILLE

Pounds seed per acre	Pounds dry forage per acre
48	6360
64	6020
80	6420
96	6710
112	6460

TABLE 5. FORAGE YIELDS OF OATS WITH VARIOUS ROW SPACINGS AND SEEDING RATES AT BEEVILLE (4-YEAR AVERAGE)

Treatment: Row spacing, inches	Treatment: Pounds of seed per acre	Pounds of air-dry forage per acre
12	32	1440
12	48	1680
12	64	1550
18	48	1540
36	24	1290
36	36	1430
36	48	1330

seed was only 500 pounds above that with 48 pounds. Available forage on December 1 in a study at College Station, Table 3, was increased by a maximum of 260 pounds due to a heavy seeding rate. Similar results were obtained at Kirbyville where yields varied less than 700 pounds with seed rates from 48 to 112 pounds per acre, Table 4. Because of the need for early production and the slight advantage of increased plant numbers both in producing early forage and assuring a satisfactory stand, it probably is advisable to use 64-80 pounds of seed per acre.

Most small grains are drill-seeded with the drills 7-8 inches apart. Experimental plantings in most instances were in 12-inch rows or drills for convenience in handling the small plots. In a study at College Station involving broadcast versus 12-inch row seedings, there were no significant differences in early forage production, Table 3.

Row-spacing and seeding-rate studies have been conducted at Beeville for 4 years. The results are presented in Table 5. It is apparent that neither row spacing nor seeding rate influences 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.

FERTILIZATION

The growth of winter-growing crops is limited by two main factors: temperature and light. Growth of small grains essentially stops at 40° F. While less work has been published on light effects, it is known that light energy during the winter months amounts to only a fraction of peak summer light levels. Probably anything that limits growth also limits responses to other factors. Thus, it would be expected that yield response to applied nutrients would be less than in warm-season grasses and that smaller amounts of nutrients would be necessary for maximum production. Fertilizer management might become quite important under such conditions.

Time and Rate of Nitrogen Application

Studies were conducted at College Station and Mt. Pleasant to determine the effect of time of nitrogen application as well as total amount of nitrogen application on forage yield of small grains. Studies involving rates of nitrogen have been conducted at Temple. The College Station and Mt. Pleasant studies were on fine sandy soil and the Temple studies on Houston black clay. In all cases the crops were fall planted, usually in mid-October, in rows 12 inches apart. Phosphorus and potassium were applied prior to planting. Fall nitrogen applications were made prior to planting; other dates of application are shown in Tables 6 and 7. The plots generally were clipped 3-5 times each year or when 12-15 inches of growth had occurred. Yields are presented as totals approximately to February 1, from February 1 to March 15 and after March 15.

The study at College Station indicates that seasonal production and total yield of both oats

TABLE 6. FORAGE YIELD OF OATS AND RYE AS INFLUENCED BY TIME AND AMOUNT OF NITROGEN, COLLEGE STATION (2-YEAR AVERAGE)

Fertilizer treatment			Date of nitrogen application				Pounds of dry forage per acre							
							Oats				Rye			
N	P	K	October	December	January	March	Early winter	Late winter	Spring	Total	Early winter	Late winter	Spring	Total
40	40	40	40				1130	580	1055	2765^{c}	1415	1090	425	2930^{d}
80	40	40	80				1210	570	990	2770^{c}	1660	1175	420	3255^{cd}
80	40	40	40		40		1060	970	1060	3090^{abc}	1380	1545	430	3355^{bcd}
80	80	80	40		40		1370	1040	1095	3505^{a}	1495	1660	445	3600^{abc}
120	40	40	120				1835	655	1135	3625^{a}	2095	1275	330	3700^{abc}
120	40	40	60	60			1450	850	1150	3450^{a}	1855	1515	505	3875^{ab}
120	40	40	60		60		1260	1060	1050	3370^{a}	1920	1730	400	4050^{a}
120	40	40	40	40	40		1210	1140	970	3320^{a}	1695	1595	440	3730^{abc}
120	80	80	40	40	40		1340	1170	1100	3610^{a}	1880	1730	460	4070^{a}
120	40	40	40	40		40	1280	860	1250	3390^{a}	1755	1435	550	3740^{abc}
120	40	40	40		40	40	1230	1100	1160	3490^{a}	1580	1555	535	3670^{abc}
120	40	40	30	30	30	30	1120	1045	1035	3200^{abc}	1620	1575	540	3735^{abc}

Total yields within a column with a common letter designation do not differ significantly.

TABLE 7. INFLUENCE OF APPLICATION TIME AND NITROGEN RATE ON FORAGE PRODUCTION OF OATS, MT. PLEASANT (4-YEAR AVERAGE)

Nitrogen applications Pounds per acre				Pounds of air-dry forage per acre			
October 1	February 15	March 15	Total	Early winter	Late winter	Spring	Total
0			0	348	100	573	1021^{h}
30			30	710	218	733	1661^{g}
60			60	1055	340	928	2323^{f}
90			90	1155	390	1093	2638^{d}
120			120	1130	458	1268	2856^{cd}
30	30		60	720	393	1515	2628de
45	45		90	898	573	1550	3021^{c}
60	60		120	1055	735	1740	3530^{a}
30	30	30	90	783	438	1930	3151^{bc}
45	45	45	120	885	595	1933	3413^{a}

Yields wih a common letter designation do not differ significantly.

and rye were affected by time and rate of application. The study did not include a 0 nitrogen level. The 80-pound nitrogen level increased yield over the 40-pound level, on the average, 165 and 375 pounds, respectively, for oats and rye. The 120-pound rate gave a further average increase of 480 pounds. Neither the level of production nor the response to fertilization above a minimum level was great. There was an increase of 300 to 400 pounds of forage with the 120-80-80 treatment with three nitrogen applications over the 120-40-40 applied in a similar manner. However, the yield was no greater than with 120-40-40 when the nitrogen was split into only two applications.

Early winter forage production was encouraged by a heavy pre-planting nitrogen application or a combination of pre-planting and December application. Late winter production was greater when some of the nitrogen was applied in January.

Yields generally were favored by splitting the nitrogen into a pre-plant and a post-plant application. There was no advantage to more than one top dressing. The post-plant application can be made in either December or January with little effect on total production.

The study at College Station was continued a third year with fertilizer rates up to 200-160-160. This treatment produced 400 pounds more forage than the 120-40-40 treatment. Intermediate treatment levels produced from 150 to 200 pounds more forage than 120-40-40. Thus, while some responses were obtained above 120 pounds of nitrogen, they were not of practical significance.

In the study at Mt. Pleasant, presented in Table 7, yield responses to nitrogen were greater than at College Station. It is apparent that 120 pounds of nitrogen produced 1200 to 1500 pounds more forage than 60 pounds of nitrogen. Fall and early winter growth increased as the pre-plant nitrogen increased from 30 to 120 pounds. Nitrogen applied in February increased late-winter growth slightly. A split application, especially of the high rate, increased yield over a single pre-plant (October) application. However, more than two applications (one preplant and one postplant) did not further increase yield but did alter distribution of growth to some extent.

Similar results have been obtained on ryegrass in the Coastal Prairie (unpublished data). Thus, it appears that 40-60 pounds of nitrogen at the time of or prior to planting and 40-60 pounds in December, January or February provide the best combination for small grains and winter annual grasses for forage production. Phosphorus and potash should be applied according to soil test indications — probably 40-60 pounds of each on light-textured soils in Central and East Texas.

Nitrogen and Phosphorus

A 5-year study of fertility practices for the production of oats for forage in the blacklands was conducted at Temple. The data in Table 8 indicate both a nitrogen and a phosphorus response. That more forage production resulted from nitrogen and phosphorus in combination than from the additive effects of the two applied independently indicated a favorable interaction. The maximum yield was produced with 90-60-0, but this was only 220 pounds higher than that produced with a 30-30-0. A 60-60-60 treatment was included in the test, but its production was no higher than that from a 60-60-0.

TABLE 8. THE INFLUENCE OF COMBINATIONS OF NITROGEN AND PHOSPHORUS ON FORAGE YIELDS OF OATS AT TEMPLE (5-YEAR AVERAGE)

Pounds P_2O_5 per acre	Pounds of air-dry forage per acre					
	Pounds N per acre					
	0	15	30	60	90	Average
0	2700	3040	3550	3520	3790	3320
30	2920	3515	3960	3910	4050	3670
60	3065	3630	3990	4040	4180	3780
Average	2895	3395	3830	3820	4010	

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 barley and oats were conducted at Crystal City to determine the importance of stage of growth at first clipping and the frequency of clipping on small grain forage yields. These results are presented in Table 9.

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 14-16 inches than when clipped as soon as they reached 3-4 inches or 8-10 inches in height. Clipping at 3-4 inches was more detrimental than clipping at 8-10 inches. Oat yields were reduced more than those of barley. Under field conditions, barley yields from 8 to 10-inch clippings were 10-percent less than from 14 to 16-inch clippings, while the yields for oats were reduced 59 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 effects because clipping removes all the forage at one time.

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

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

TABLE 9. EFFECT OF CLIPPING ON THE FORAGE PRODUCTION OF OATS AND BARLEY, CRYSTAL CITY

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

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

Studies carried out at College Station, Table 10, further emphasize the importance of proper management of small grains used for winter pasture. Oats, clipped each time the plants reached a height of 4-6 inches, produced only 1550 pounds of forage. When clipped each time the plants attained a height of 10-12 inches, yield amounted to 3170 pounds or twice as much. Figure 1 shows the growth of plants in this clipping study.

The plants in this study had reached a height of 4-6 inches on November 13 and did not reach a height of 10-12 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 reduced production by as much as 1500

TABLE 10. AVERAGE FORAGE YIELD, POUNDS PER ACRE, OF TWO OAT VARIETIES CLIPPED AT TWO STAGES OF GROWTH, COLLEGE STATION

Height of cutting, inches	Season of harvest[1] Early winter	Mid-winter	Early spring	Total
4- 6	485	450	615	1550
10-12	985	1005	1180	3170

[1]Dates of clipping: EARLY WINTER—(4-6 inches) November 18, December 1, December 17, January 3; (10 to 12 inches) January 3. MID-WINTER—(4-6 inches) January 20, February 9, February 24; (10-12 inches) February 24. EARLY SPRING—(4-6 inches) March 7, April 15; (10-12 inches) March 7, April 15; (10-12 inches) April 15.

Figure 2. Mid-winter growth at College Station of a winter-type variety (left) and a spring-type variety of small grain (right).

TABLE 11. FORAGE PRODUCTION OF OATS OF DIFFERENT GROWTH HABITS AND WITH VARIOUS CLIPPING FREQUENCIES, COLLEGE STATION

Early growth habit	Harvest frequency, days	Pounds of air-dry forage per acre				
		November 10 to December 20	December 20 to February 1	February 1 to March 14	March 14 to May 3	Total
Erect	10	220	350	290	100	960
	20	420	780	630	200	2030
	40	390	790	620	240	2040
	Maturity				2550	2550
	Average	340	640	510	770	1890
Prostrate	10	210	450	490	130	1280
	20	230	560	680	310	1780
	40	320	680	960	340	2300
	Maturity				2370	2370
	Average	250	560	710	770	1930

pounds per acre, the value of production at this level might be questionable.

The influence of clipping practices on root and crown development as well as on forage production has been studied at College Station. An erect and a prostrate variety of oats, Figure 2, 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 regularity of clipping. Air-dry forage produced with these treatments is shown in Table 11. 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 production of the erect variety 48 percent when compared with the 40-day clipping and 58 percent when compared with clipping only at maturity. The reduction in the prostrate variety yield due to frequent clipping was slightly less than for the erect variety.

Crown and root development was 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 12. Apparently, more frequent clipping reduced tillering and resulted in a smaller crown which

TABLE 12. TOP AND ROOT GROWTH OF OATS OF DIFFERENT GROWTH HABITS AND WITH VARIOUS CLIPPING FREQUENCIES, LUFKIN FINE SANDY LOAM SOIL, COLLEGE STATION

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

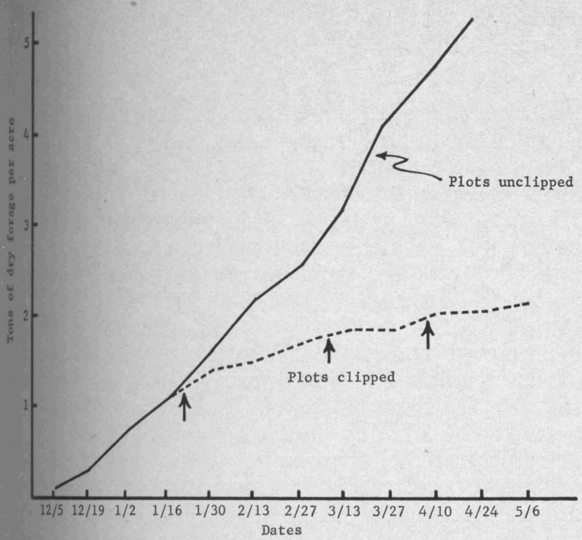

Figure 3. Average cumulative growth of three oat varieties on Lufkin fine sandy loam, College Station.

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. That root production was poor this particular season may account for the poor growth obtained in this study.

Cumulative growth of three oat varieties with and without the effects of clipping has been studied, Figure 3. Two sets of plots were established; one set of plots was unclipped and the other clipped at regular intervals. Due to inclement weather, clipping was delayed until late January when more than 2,000 pounds of forage had been produced. Total cumulative growth with the two treatments is shown in Figure 3. Recovery following clipping was extremely poor which indicates that utilization may be delayed too long, especially if all the top growth is to be removed and if regrowth is expected. Any degree of defoliation of small grains is somewhat detrimental to total development of the plant. In most of these studies, maximum total production was 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. Subsequent grazing or utilization should provide for either adequate residual leaf area or an adequate recovery period between grazings or utilization.

GROWTH BEHAVIOR

The growth of small grain varieties depends on light, soil and air temperatures and soil moisture and nutrients. Varieties may differ in their response to management practices and environmental factors. In establishing a forage program, it would be valuable to know the response to reduced light, 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, accumulated growth must be depended on for grazing during such periods.

Response to Management

The growth-behavior pattern of oat varieties has been studied at College Station and Iowa Park for 2 years. Three varieties differing in growth habit and cold-hardiness were used at each location. The varieties were seeded in 12-inch rows and sampled for above-ground growth at weekly intervals. Since the plants were removed at ground level, the data presented in the figures that follow include the weight of crowns and are higher than those normally 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 there being limiting factors in plant growth. A continuous record of air temperature was made.

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

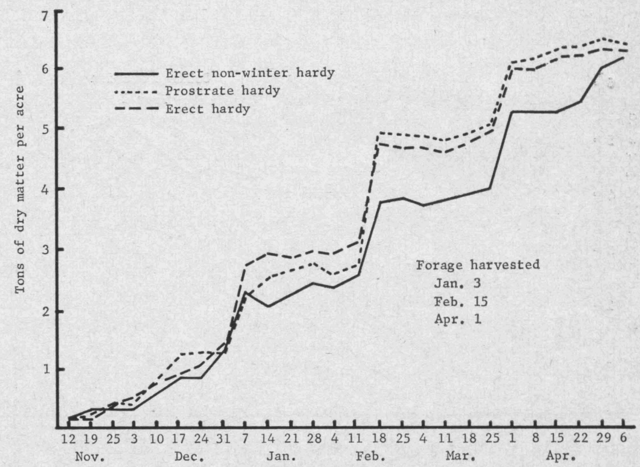

Figure 4. Cumulative growth of three oat varieties grown on Lufkin fine sandy loam.

was very similar. Their growth habits normally are different, and it would not be expected that the yields would be equal using normal harvesting procedures. However, when all above-ground growth was measured, the three varieties produced about the same until the first date of harvest. The erect nonwinter-hardy type failed to recover and produce as much after the first clipping. After the second clipping, its production dropped even further below that of the other two varieties.

All three varieties were slow in their recovery following each clipping. As much as 4-5 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 accumulation of above-ground dry weight. When the first clipping was delayed until late January, Figure 3, recovery was never satisfactory. These results indicate that clipping may be delayed too long as well as be too frequent, and the effects may be much the same. These results also show that a longer rest period than is usually provided between grazings would be desirable if rotation grazing is practiced.

Response to Temperature

To study the growth response of plants to temperature, plots were clipped throughout the season. Growth to each date was determined by sampling an unclipped 2-foot section of row. Average accumulative growth of the three varieties by weekly periods is shown in Figure 5. Growth was 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 the first year came in March. The temperature dropped below freezing for a short period, impairing growth and evidently producing some top kill since accumulated growth was reduced during this time. Growth was almost uniformly

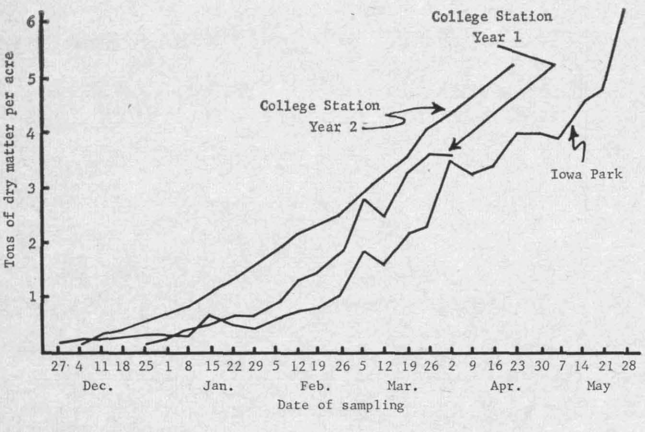

Figure 5. Average cumulative growth of small grain varieties at two locations in Texas.

continuous at College Station during the second year.

Growth was more irregular at Iowa Park, probably because conditions unfavorable to plant growth occurred 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 1 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 75-100 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. Although growth was produced at Iowa Park during the winter, 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 having colder winters.

Although growth behavior of the three varieties without clipping is not presented, some interactions at Iowa Park may be 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, the erect nonwinter hardy oat produced no growth for 2 weeks, the erect winter hardy variety made slight growth and the prostrate type made good growth. Evidently the stage of growth is a major factor in determining the influence of low temperature on growth. The erect types were in a critical stage of growth in early March while the prostrate, being later in maturity, did not reach this critical stage until early April.

The relationship of oat growth to mean temperature was calculated. Temperatures recorded every 3 hours were averaged in computing mean temperatures. The regression of growth on mean temperature, shown in Figure 6, was highly significant. The correlation coefficient was 0.650 with 37 degrees of freedom indicating a good relationship between the two variables. The regression of growth on temperature calculated as a straight line relationship gave a value of 64 and indicates little or no growth below an average daily temperature of 40° F. On the average with each 1° change in temperature, biweekly growth changed 64 pounds within the temperature limits of these studies. It is apparent from the regression figure, which is based on 3 years of data at College Station and 1 year at Iowa Park, that other factors also influenced

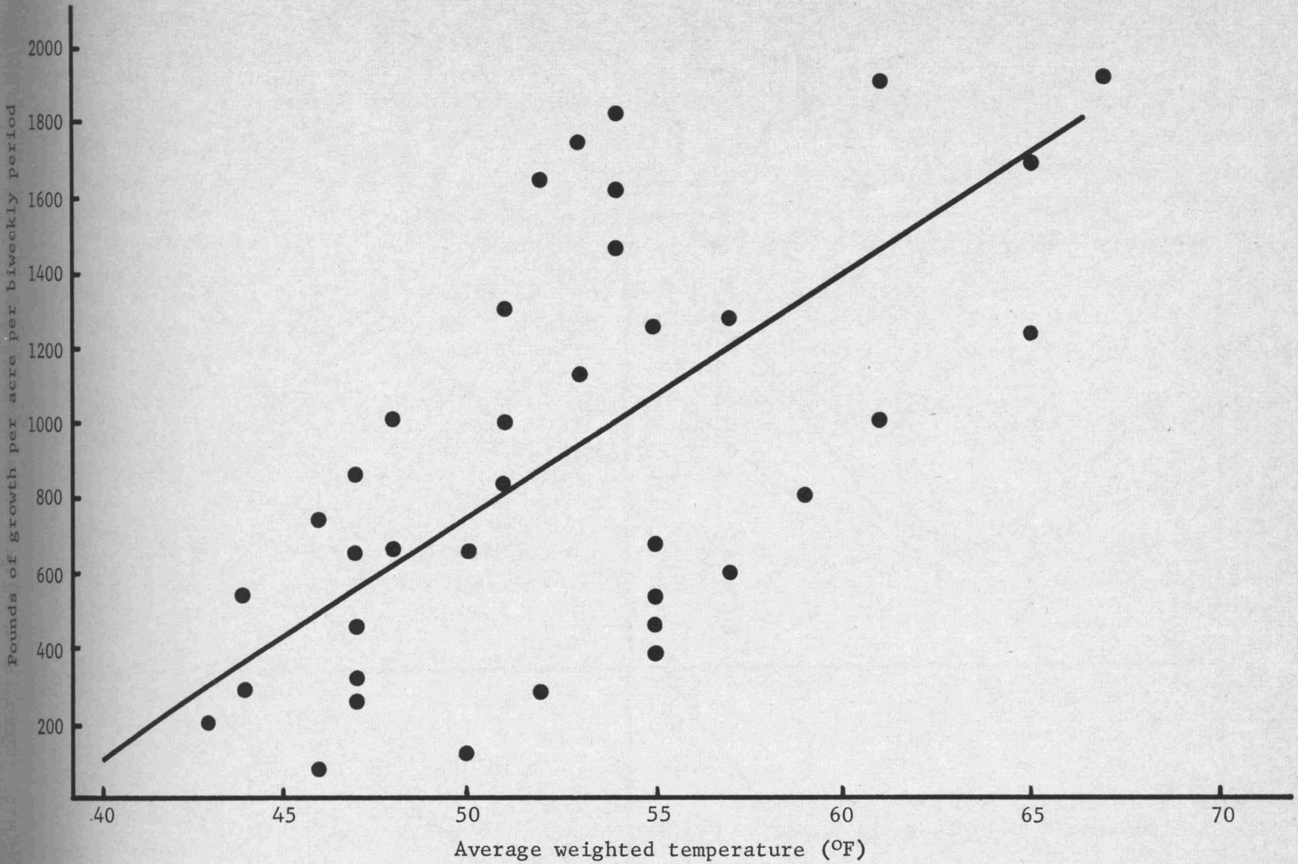

Figure 6. Regression of oat growth on weighted air temperature, College Station and Iowa Park.

growth. It is difficult to maintain moisture at an optimum level, and this was a contributing factor to variability in growth rate. Sunlight energy varied and may well have contributed to the variation in plant growth. 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 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.

These studies indicate that residual or surplus growth rather than continuous growth must be depended on for continuous grazing in areas in which average temperatures may be below 45° F. for periods of several days.

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 forage yield of all varieties grown at each location during the entire 6-year period also is shown.

Yield data are not available for all years at Angleton. The available data indicate a negative relationship between yield and total rainfall. The lowest rainfall 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 between 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

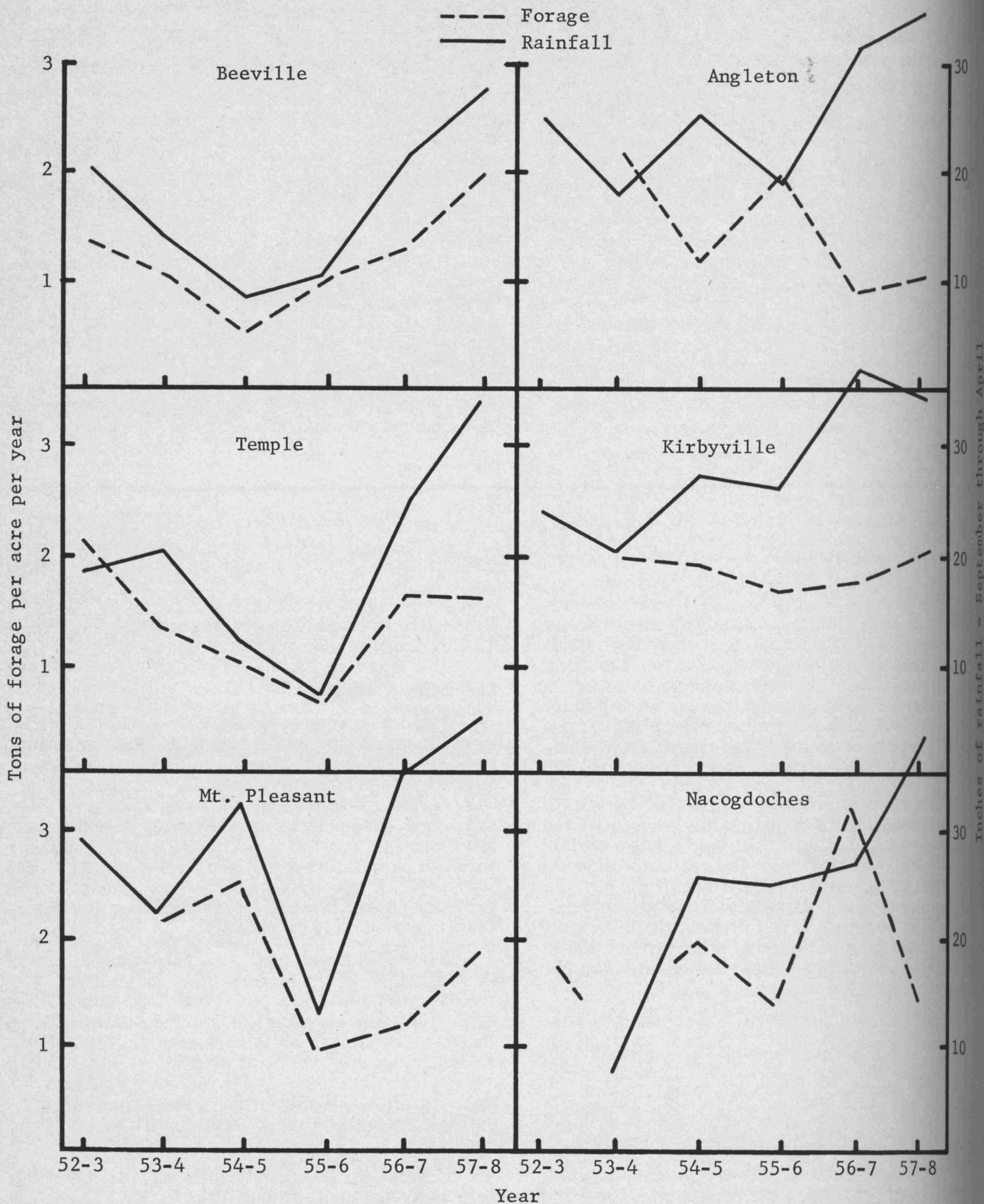

Figure 7. Average forage yield of small grain varieties and total seasonal rainfall, Beeville, Angleton, Temple, Kirbyville, Mount Pleasant and Nacogdoches.

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 was a mobile station, and the test area was moved during the period. It is possible that soil effects on yield were the more important since rainfall exceeded 25 inches except for 1 year.

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 experience a deficiency, but because of the flat topography and heavy soils, excessive moisture for optimum growth may be encountered. Failure to obtain better relationships between 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. Several outbreaks of disease would alter the yield-rainfall relationships.

Response to Cutting Height

Forage production and total above-ground cumulative growth of a prostrate oat variety, an erect rye variety and annual ryegrass were determined at three cutting (stubble) heights. The crops were planted in mid-October and harvested at 28-day intervals at stubble heights of 2, 4 and 6 inches beginning December 21. Total above-ground growth including harvested material was determined at weekly intervals beginning at the second cutting. Leaf area index also was determined weekly.

Total forage yield was not significantly influenced by height of clipping, Table 13. Winter harvested yields of oats and ryegrass were very limited at 4 and 6-inch stubble heights. Over 1,100 pounds of forage had been harvested from oats cut at 2 inches by the end of January while only 350 pounds had been harvested with the 6 inch-cutting height, Figure 8. The short heights produced as much total yield only because the final clipping was made at a uniform 2-inch height. Rye which was more upright in growth produced more winter forage with the 4-inch height.

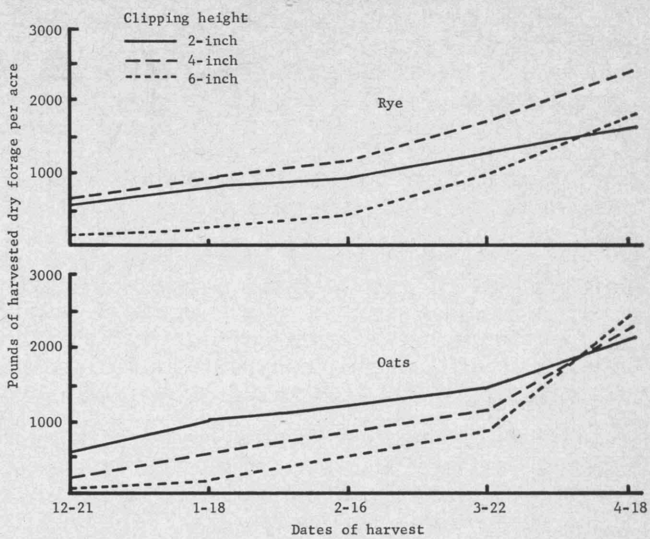

Figure 8. Cumulative yield of rye and oats clipped at 28-day intervals, College Station.

Total above-ground cumulative growth of oats and rye was favored by the 6-inch clipping height, Figure 9. Most of this growth was apparently below the 4 to 6-inch height. Since midwinter is a more critical period for available green forage than early spring, the improved growth of the plant with mild clipping during this period is of less significance than the utilization of the growth.

Since total cumulative growth is favored by mild defoliation, it might be assumed that growth was more uniform with the less severe defoliation. However, this was not found to be the

TABLE 13. TOTAL FORAGE YIELD OF OATS, RYE AND RYEGRASS CUT AT THREE HEIGHTS AND TWO FREQUENCIES, COLLEGE STATION

Height of cutting, inches	Pounds of dry forage per acre			
	Oats	Rye	Ryegrass	Average
2	2179	1764	3008	2317
4	2271	2460	2550	2427
6	2494	1848	2750	2364

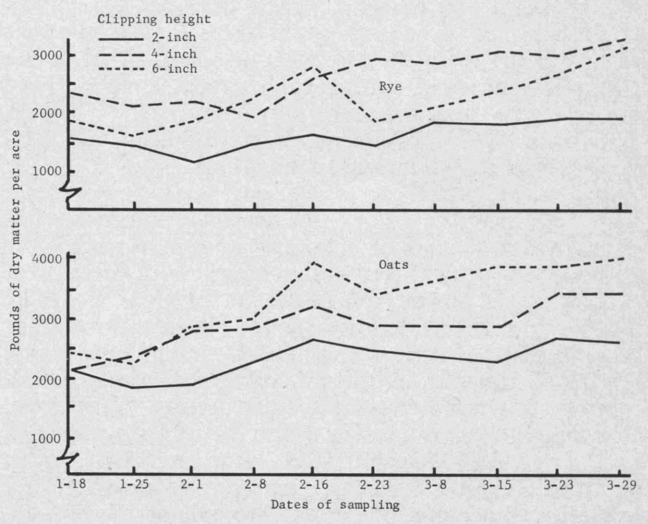

Figure 9. Cumulative growth of rye and oats clipped at 28-day intervals, College Station.

case. Clipping, regardless of the clipping height, resulted in a decrease during the following week or weeks in accumulated weight of the plants. These weight losses were more severe with greater stubble heights than with the lesser. Even though the weight losses were more severe, recovery was more rapid. These results suggest that initial regrowth is made at the expense of reserves stored in the crown. The less severe defoliation would favor a greater storage and more potential for weight change. Greater reserves would result in more rapid recovery. Frequent close utilization would restrict the building up of stored carbohydrates and thus the potential for weight loss would be limited.

Height of cutting resulted in significantly different leaf-area patterns. The relationship of leaf area to growth during the succeeding week had a correlation coefficient of 0.243 which is highly significant. Even though this relationship was significant, it was not high and suggests that many other factors than the amount of leaves influence regrowth of these plants.

The winter of 1959-60 had extended periods of overcast when limited light retarded growth. Under these conditions the effect of differences in leaf area might be reduced. The growth behavior of the plant suggests that initial regrowth following clipping is made from stored reserves rather than from new photosynthetic products. Since significant differences in leaf area existed, this growth behavior might suggest that the old or basal leaves are inefficient or ineffective and that new leaves produced from stored reserves are necessary for photosynthesis. Leaf area actually decreased further during the week following clipping with most treatments indicating that many of the basal leaves died and that this leaf loss exceeded new leaf growth.

If it is assumed that the old leaves are inefficient in photosynthesis, a better correlation of leaf area with growth might be obtained by omitting the week following clipping when only old leaves were present. The correlation coefficient for leaf area and growth using an average of the leaf area in the second and third week following harvest and total growth in the third and fourth weeks was significant, $r = 0.520$. This was based on the periods following the January 18 and February 16 harvests.

The results of these studies suggest that prostrate varieties of oats and ryegrass may have to be utilized at fairly short heights in midwinter if forage is to be available at critical periods. These practices do not favor maximum plant development, but a compromise seems necessary. Greater clipping heights favor total plant development but not necessarily uniformity of growth. Winter annual plants respond to clipping with a loss in total accumulated dry weight. With greater clipping heights, recovery is more rapid, probably because of more stored reserves and greater residual leaf area to promote recovery growth.

Response to Light Intensity

One of the major environmental factors probably limiting growth of winter crops is light. Relatively little information is available on the response of agronomic crops to light or whether available crops differ in their response to limited light. One method of increasing production of winter crops would be using or developing crops suited to growth under low light conditions. Several crops have been evaluated under both controlled environment and field conditions on the assumption that if reduced light does not alter growth, light is not a major factor in the production of that crop.

Five cool-season forage crops (ryegrass, rye, barley, oats and wheat) were planted in pots in Norwood fine sandy loam soil. Following emergence the plants were thinned to 25 plants per pot, trimmed to a uniform 2-inch height and uniformly watered with a liquid complete fertilizer. The pots were placed in two growth chambers operating at alternating day-night temperatures of 72 and 60° F. Maximum light intensity was maintained in one chamber, and light in the other chamber was reduced approximately 40 percent. The day and night periods were 12 hours each.

When the plants reached an approximate height of 6 inches, they were cut to a 2-inch stubble height, and the clippings were dried and weighed. The stubble from one-half the pots in each chamber was removed at the soil surface, dried and weighed, and the pots were discontinued. Pots of two of the five remaining blocks in each chamber were switched to balance previous light effects. The pots were again watered with a complete nutrient solution, and the plants were allowed to grow to a height of 6 inches followed by a second harvest.

Three winter annual crops (ryegrass, rye and oats) were seeded on Lufkin fine sandy loam soil October 24 in 12 and 24-inch rows at the rate of 75 pounds of seed per acre. Light was reduced 25 percent beginning December 13 for 28 days and again January 31 for 28 days. All treatments including shading were replicated six times.

In the field test, plant samples were collected at weekly intervals and separated into leaves and stems. Air temperature was recorded with a Dixon recording thermograph, and light was recorded with a Pyrheliometer.

Winter-annual Crops (Growth chamber): Rye and ryegrass showed the least effect of light level on yield in the growth chamber. In the regrowth, wheat showed the least effect of reduced light followed by ryegrass. However, these differences were not great, Table 14. Growth was definitely less with reduced light, and the reduction of stubble weight caused by reduced light in all cases indicated a lack of carbohydrate storage in the presence of limited light.

Previous light level also influenced regrowth following cutting. Maximum yields were ob-

TABLE 14. THE AVERAGE EFFECTS OF LIGHT LEVELS ON GROWTH AND REGROWTH OF ANNUAL CROPS IN A GROWTH CHAMBER

Light for both cuttings[1]	First cutting[2] Yield	First cutting[2] Stubble weight	Second cutting[2] Previous light	Second cutting[2] Yield
High	0.2420	0.1323	High	0.1840
			Low	0.1586
Low	0.2255	0.0911	High	0.1541
			Low	0.1252

[1]Light was reduced approximately 40 percent in the low light chamber.
[2]Values are grams of dry matter per pot.

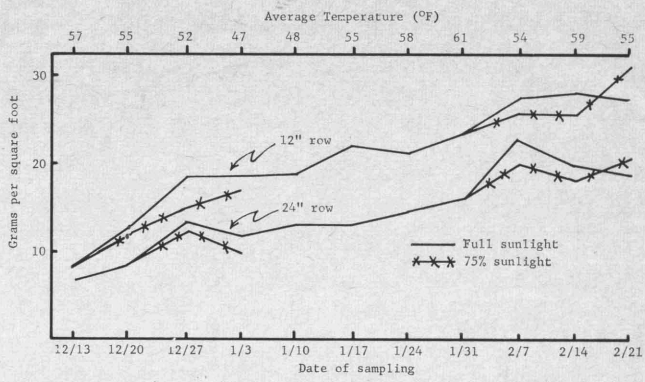

Figure 10. Cumulative growth of winter annual crops and response to reduced light.

tained from plants maintained throughout at high light. Reduced light had approximately the same effect on regrowth whether the reduced light was with the initial growth or the regrowth. Apparently the effect of reduced carbohydrate content of the stubble with reduced light was about as great as the direct effect of reduced light on regrowth. Regrowth from plants maintained at reduced light throughout was approximately 65 percent as great as from plants maintained throughout at high light.

These data do not suggest any major differences among the varieties in response to limited light. The barley and oat varieties may have been slightly more sensitive than wheat, rye and ryegrass. Ryegrass showed slightly fewer overall effects.

Winter-annual Crops (Field): Plant development, whether expressed as total plant weight or as plant components, was less on a unit-area basis in wide rows than in narrow rows; the reduction was from 30 to 50 percent, Table 15. This is not unexpected since plant growth at the time of these measurements was inadequate to cover the entire area between 24-inch rows.

Light reduction reduced growth approximately 12 percent in late December and early January. The trend started out the same in February, but the pattern was reversed the last week of measurement. In every instance shaded plants exceeded unshaded plants at the final sampling date.

The growth patterns are shown in Figure 10 along with average maximum temperature for each measurement period. That the two row spacings showed the same pattern of response to shading would suggest no major difference in light utilization efficiency due to row spacing. The reversal of the shading effect at the final sampling period is assumed to be associated with temperature and a generally very poor light situation. A below freezing temperature occurred on February 17, and there were only two days of sunshine during the period. Covered frames were used to reduce the light. Even though they were elevated at least 12 inches to allow air circulation, they no doubt offered some protection from the low temperature. The lack of light would have prevented recovery in the exposed plots, whereas the protected plots likely continued to make some growth (elongation) from stored reserves in the stubble.

These studies indicate that major winter annual crops do not differ greatly in sensitivity to limited light. The data also indicate that the crops are restricted in growth by limited light as well as by low temperatures.

TABLE 15. THE RESPONSE OF WINTER ANNUAL CROPS[1] TO REDUCED LIGHT UNDER FIELD CONDITIONS

Row spacing, inches	Light treatment	December 13	December 20	December 27	January 3	January 31	February 7	February 14	February 21
		Plant weight (grams per square foot)							
12	Full sunlight	8.3	12.7	18.6	18.7	23.6	27.7	28.2	27.3
	75 percent sunlight	8.3	12.8	15.0	17.0	23.6	25.8	25.8	31.1
24	Full sunlight	6.8	8.4	13.5	11.9	16.2	22.9	19.8	18.8
	75 percent sunlight	6.8	8.2	12.5	9.8	16.2	20.4	17.8	20.6
		Leaf weight (grams per square foot)							
12	Full sunlight	6.4	9.6	13.7	13.9	17.1	20.3	21.7	21.4
	75 percent sunlight	6.4	9.9	11.2	12.7	17.1	19.2	20.2	22.3
24	Full sunlight	5.3	8.3	10.8	8.8	11.4	16.8	17.8	14.4
	75 percent sunlight	5.3	5.9	9.7	7.1	11.4	15.0	13.3	14.9
Average maximum temperature (°F.)		57	55	52	47	61	54	59	55

[1]Average of ryegrass, rye and oats.

NITRATE ACCUMULATION

Nitrate accumulation sometimes occurs in small grains, and animal toxicity may result from grazing small grains high in nitrate. Many factors, both internal and external, influence nitrate accumulation. A few of these factors have been studied with oats grown under field conditions on fine sandy loam soil at College Station. These factors have included time and rate of nitrogen application, form of nitrogen, plant parts and day-night fluctuations in nitrate content of plant tissue.

A plot was seeded to oats in mid-October and fertilized with 40-40-40 at time of seeding. On February 1, two sources of nitrogen were applied at the rate of 100 pounds of N per acre on plots 5 by 10 feet in three replications. Beginning February 14, plant samples were collected from each plot at 3-hour intervals for a period of 48 hours. The plants were cut at the ground level and dried immediately at 180° F. Following drying, each sample was separated into leaves versus sheath and stem tissue. The samples were then ground to pass a 40-mesh screen and were analyzed for nitrate.

The data in Figure 11 indicate a source of nitrogen effect, a diurnal cycle in nitrate content and a morphological difference in nitrate accumulation. Obviously sheath and stem tissue was higher in nitrate than leaf tissue. With few exceptions this occurred with all treatments and times of collection. Source of nitrogen effect is most apparent in the stem tissue, the oxidized form resulting in the greatest accumulation. A level of approximately 1.0 is considered to be approaching or in the area of potential toxicity. This level was exceeded or even approached only in stem tissue with an oxidized form of nitrogen. Nitrate accumulation with nitrate fertilization was greater during dark periods than light periods, but no diurnal cycle is evident with ammonia fertilization. The sampling period was characterized largely by mild temperatures, complete cloud cover and periodic light rain except for some clearing during the final 3-6 hours.

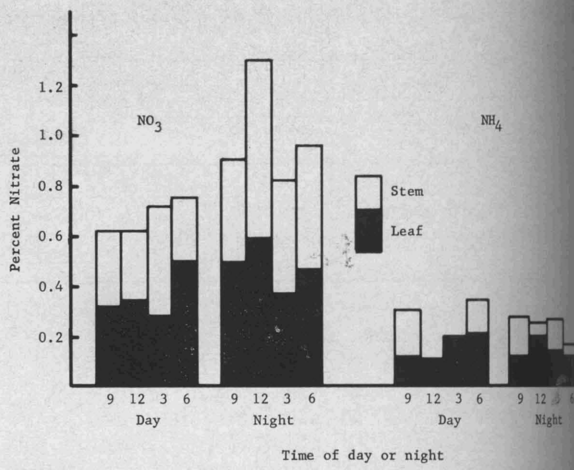

Figure 11. The influence of source of nitrogen, plant part and time of day on nitrate content of oat tissue.

Following the initial sampling, the plots were harvested, but no additional nitrogen was applied. A second set of samples was obtained 14 days after the initial sampling. No major trends in nitrate content were evident at the second sampling — two weeks had elapsed giving a greater time interval between fertilization and sampling, the period was characterized by clear rather than cloudy weather, and new growth was involved. Any or all of these factors could have caused the difference in results. The highest nitrate levels encountered were well below the suspected toxicity level. Obviously nitrate accumulation does not always occur even at night or in stem and vascular tissue or with nitrogen fertilization.

To determine whether either time or amount of nitrogen fertilization is important in nitrate accumulation in winter forage, oats were seeded in October and fertilized with phosphorus and

TABLE 16. NITRATE CONTENT (PERCENT NITRATE) OF OATS WITH VARIOUS FERTILIZATION TREATMENTS, COLLEGE STATION

Pounds of N and date of application[1]			Part of plant	Date of sample: December		January			February			Average[2]
October	December	January		22	29	5	13	26	1	9	18	
40			Leaves	.45	.32	.75	.96	.39	.32	.41	.16	.47
			Stems	.97	.88	.98	.92	.76	.79	.42	.10	.73
120			Leaves	.52	.55	.69	1.05	.44	.35	.43	.29	.54
			Stems	1.38	1.35	.95	.95	.57	.46	.36	.43	.81
60	60		Leaves	.69	.65	.78	.93	.51	.40	.54	.37	.61
			Stems	1.63	.77	.87	.60	.57	.76	.54	.62	.80
40	40	40	Leaves	.22	.36	.61	.46	.58	.29	.33	.56	.43
			Stems	.56	.88	.91	.97	.72	.50	.62	.37	.69
Date average[3]			Leaves	.47	.47	.71	.85	.48	.34	.43	.34	
			Stems	1.14	.97	.97	.86	.66	.63	.49	.38	

[1]All plots received 0-40-40 prior to planting.
[2]On the average, stems were significantly higher in nitrate than leaves.
[3]Dates differed significantly.

potash at planting. Nitrogen in the form of ammonium nitrate was applied at the times and the amounts shown in Table 16. Nitrate determinations were made on samples taken at intervals from December 22 to February 18. The samples were divided into those portions above and below mower cutting height and labeled as leaves and stems, respectively. Stem tissue or the basal part of the plant was higher in nitrate than leaf tissue. Stem tissue from plots receiving a single heavy nitrogen application in October was higher in nitrate in late December than stem tissue from plots receiving smaller increments. No consistent trends or differences seem to be associated with December or January applications of N up to 60 pounds per acre. These results indicate some effects of nitrogen fertilization, but none of these levels would be considered high from a toxicity standpoint.

Nitrate accumulation is influenced by many factors and may change greatly within a few hours. These samples were taken during late morning hours except as indicated in Table 15, and this is not necessarily the peak period. Thus, the levels found in these studies do not necessarily represent maximum or even average levels but should give a fairly good indication of treatment effects. The results suggest that an oxidized form of nitrogen may favor nitrate accumulation, especially in mid-winter. Heavy rates in a single application might influence nitrate accumulation under favorable conditions. There is little indication that nitrogen application in moderate amounts or increments is a major factor in nitrate accumulation in small grains.

GRAZING[1]

Oat grazing research was started at the Texas A&M University Research Center at McGregor in fall 1958. Experimental pastures, 10 acres in size, were located on gently sloping land, capability class II, medium depth Houston clay soil. During 1959-62, a fertilizer treatment of 32-40-0 per acre was applied at planting time with a topdressing of 20 pounds of nitrogen applied in January. During the 1963-65 period, the fertilizer rate was increased to 50-40-0 at planting time without topdressing in January.

Mustang variety of oats was used in 1959 and 1960. Suregrain oats were used in 1961. Moregrain, New Nortex and Bronco oats were used in 1962. Alamo-X, new Nortex and Bronco oat varieties were used during 1963-65. The oats were sown at the rate of 96 pounds of seed per acre, and planting dates varied from October 1 to October 20 during 1959-62. During 1963-65, the planting dates varied from September 15 to October 10.

Beef steers weighing about 400 pounds, ranging from 350 to 500 pounds, were purchased in the fall and used on the pastures. The animals were weighed at 28-day intervals except during rainy weather. Stocking rate adjustments were made on weigh day using the put-and-take system to adjust the animal numbers for the forage available. Stocking rate adjustments were made to maintain a visual surplus of forage on 25-30 percent of the pasture. Grazing was continuous. Animals were not taken off pastures during wet weather, and no supplemental feed was given livestock.

[1]Research reported in this section was taken from Texas Agricultural Experiment Station Progress Report 2473, prepared by M. J. Norris and W. E. Kruse, Texas A&M University Research Center at McGregor.

Summaries of animal performance on oat pastures for 1959-65 are shown in Table 17. The year column in this table designates the year the oat crop matured. The grazing period included the spring of the year listed and the fall of the previous year. The calendar grazing period varied from 141 days in 1964 to 219 days in 1960. Grazing was started as early as November 10 and as late as January 23 and ended as early as May 5 and as late as June 8.

Rainfall, temperatures and other forage crop growing factors during this 7-year period were erratic but provided a reasonable sample of conditions that are normally expected at this location.

Oat grazing results with beef cattle steers during a 7-year period furnished realistic estimates of stocking rates, animal grazing days

TABLE 17. SUMMARY OF OAT GRAZING WITH BEEF STEERS, McGREGOR, 1959-65

Year		Stocking rate, acres per animal	Animal days per acre	Livestock gains, pounds	
				Per acre	Daily, per head
1959	Winter grazing[1]	3.3	26.1	40.4	1.5
	Spring grazing[2]	2.6	39.9	100.7	2.5
	Season total	2.9	66.0	141.7	2.2
1960	Winter grazing	2.6	43.0	45.0	1.0
	Spring grazing	2.5	44.8	121.6	2.7
	Season total	2.5	87.8	166.6	1.9
1961	Winter grazing	2.0	49.0	97.5	2.0
	Spring grazing	1.1	85.8	214.2	2.5
	Season total	1.4	134.8	311.7	2.3
1962	Winter grazing	3.3	19.5	36.4	1.9
	Spring grazing[3]	2.3	44.9	96.5	2.4
	Season total	2.6	64.4	132.9	2.1
1963	Winter grazing	2.9	26.6	74.1	2.8
	Spring grazing	2.1	44.3	109.5	2.5
	Season total	2.4	70.9	183.6	2.6
1964	Winter grazing	2.3	16.6	14.6	0.9
	Spring grazing[3]	1.7	62.2	130.0	2.1
	Season total	1.8	78.8	144.6	1.8
1965	Winter grazing	2.2	37.6	62.2	1.7
	Spring grazing	0.8	98.1	193.1	2.0
	Season total	1.2	135.7	255.3	1.9
Average	Winter grazing	2.7	31.2	52.9	1.7
	Spring grazing	1.9	65.4	137.9	2.4
	Season total	2.1	96.6	190.8	2.1

[1]Winter grazing includes grazing to March 1.

[2]Spring grazing includes grazing from March 1 to end of season—about June 1-15.

[3]Stocking rates were not high enough to fully use forage available in the spring.

per acre, individual livestock gains and acre livestock gains. Under average weather conditions, 2.7 acres per steer were required for satisfactory gains during the winter and 1.9 acres from March 1 to about June. Livestock gains per acre averaged 190.8 pounds per season, with 96.6 animal grazing days per acre at an average daily gain of about 2 pounds per steer. During a more favorable growing season, such as 1961, the stocking rate was increased to 2 acres per animal during the winter and 1 acre per animal after March 1, with a production of 312 pounds animal gains per acre on 135 animal-grazing days per acre.

VARIETIES

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 are grown extensively are commercial grain varieties. Experimental lines that show promise for grain production are tested for forage production. Thus, 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 primarily with oat varieties. Descriptions of these varieties are available in other publications. 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 prostrate 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.

Because of the major disease problems on small grains, varieties change rapidly. Disease is less a problem in forage production than in grain production because disease seldom becomes serious until early spring when the major forage needs have been met. However, disease susceptibility would probably reduce forage production and certainly influences availability of seed. Since varieties do change relatively rapidly, specific variety performance data will not be reported in this publication. Currently, varieties which give the most consistent performance in various sections of the State are included in Table 18. Other varieties not named may be satisfactory, and new ones are in the process of being developed.

TABLE 18. LIST OF VARIETIES CURRENTLY ADAPTED FOR FORAGE PRODUCTION

Area	Oats	Wheat	Rye	Barley
North and Northeast Texas	Ora Nora Norwin Alamo-X Moregrain New Nortex	Knox 62 Riley 67 Caddo Sturdy	Bonel Elbon	Cordova Era Zora Rogers
Central and Southeast Texas	Coronado New Nortex Ora Alamo-X Florida 500 Suregrain	Caddo Sturdy Knox Milam Atlas 66	Bonel Elbon	Cordova Zora Rogers
Coast Prairie	Coronado Cortez Florida 500 Ora Suregrain	Milam Atlas 66	Bonel Elbon	Cordova Rogers
Rio Grande Plains	Florida 500 Coronado Cortez Ora Suregrain	Milam Atlas 66	Bonel Elbon	Cordova Rogers
West Texas	Cimarron Norwin Alamo-X New Nortex	Caddo Tascosa Concho Wichita Scout	Bonel Elbon	Cordova Rogers Will Era
Northwest Texas	Cimarron Norwin Wintok Arkwin	Caddo Sturdy Concho Tascosa Wichita Scout	Bonel Elbon	Will Rogers Cordova

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