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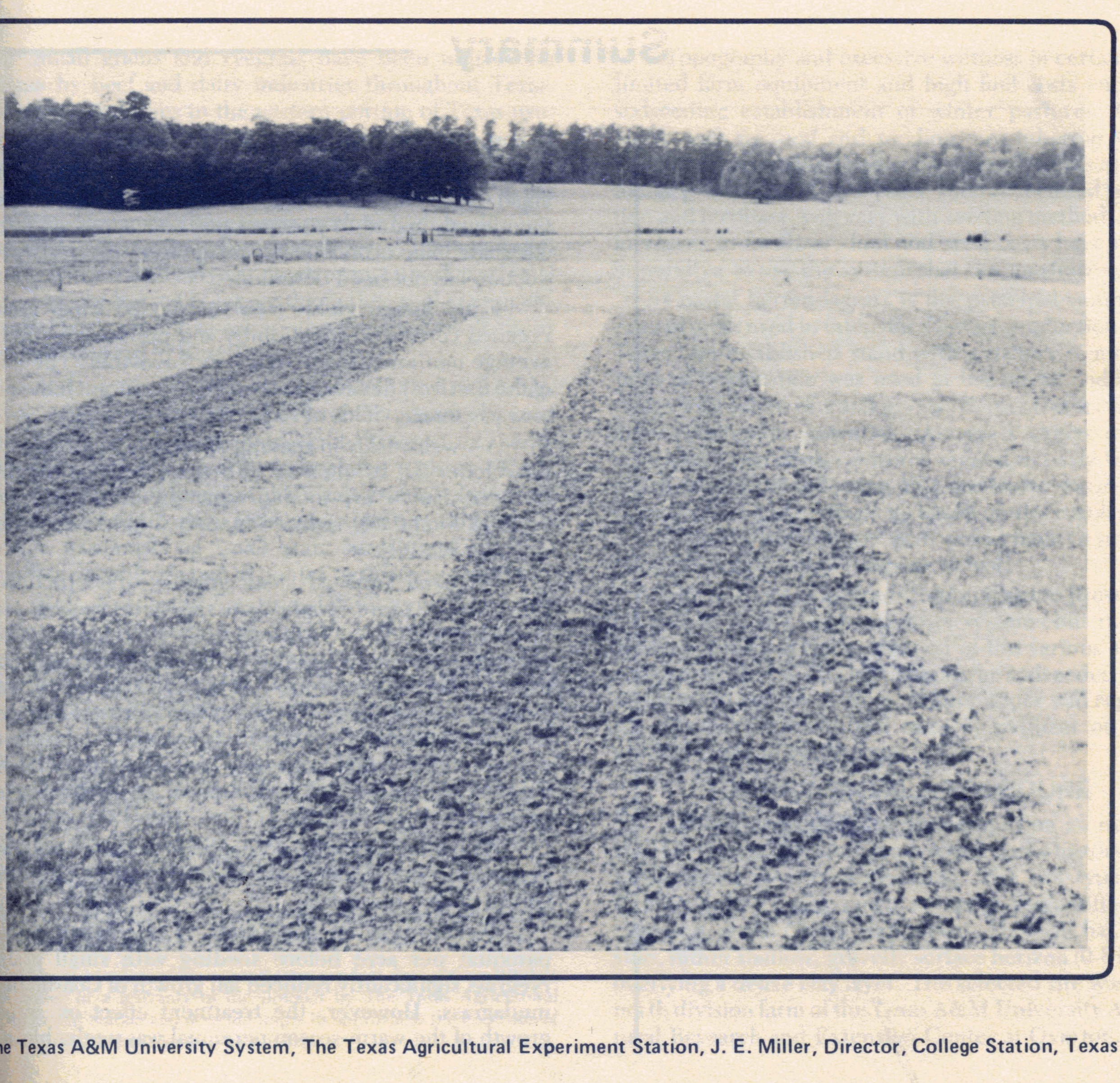
No-till and Seedbed Production of Small Grains-Ryegrass Mixture for Forage in East Texas



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Summary

In 2 out of the 3 years from 1971 to 1974, desiccation of Coastal bermudagrass gave significant increases in small grain-ryegrass forage yields early in the season. One-fourth pound of paraquat per acre appeared to be adequate. The economic advantage from the early production has not been determined.

Early forage yields from sodseeded small grain-ryegrass correlated significantly and positively with the average minimum temperature in November. The time of the first frost desiccation also had a significant influence on early forage yields of sodseeded winter forage.

A 4-week delay in seeding date (from September 24 to October 23) resulted in an 8-week delay in the first harvest. However, total production of small grain-ryegrass forage was reduced by only 5 to 10 percent by the later seeding.

Prepared seedbed small grain-ryegrass produced substantially more forage than the same species sodseeded into Coastal bermudagrass. Production differences were generally greatest in the fall when production from sodseeded forage was only 20 to 30 percent of that produced on seedbeds. These growth differences, caused by systems narrowed in the spring and total production of winter forage, varied from 46 to 66 percent and 63 to 82 percent for the low and high rates of applied nitrogen, respectively.

Production ratios of sodseeded to prepared seedbed systems generally increased with early fall, winter and spring rainfall quantities.

Disking plus an application of one-fourth pound paraquat per acre before seeding with small grain-ryegrass significantly reduced fall growth of Coastal bermudagrass. However, the treatment effect on spring growth of the warm-season perennial was negligible.

No-till and Seedbed Production of Small Grains-Ryegrass Mixture for Forage in East Texas

*J. E. Matocha**

Small grains and ryegrass have been utilized for forage by beef and dairy industries throughout Texas. Climatic conditions in the eastern portion of Texas usually are conducive to good production; however, year to year variation in forage yields can be rather extreme.

Forage production from cool-season annuals is expensive. However, these crops produce high quality forage during the season when green forage is limited. Small grains will normally give as much or more early and total seasonal production of forage than other cool-season annuals. Oats, rye and wheat are the principal small grains used for grazing in East Texas.

At least three systems of producing winter forage have been tried. These include (1) good prepared seedbed (one-way plow or several diskings), (2) semi-tilled (disked once) and (3) overseeded with no tillage. Recently, interest in use of chemicals exclusively (no-till) or with limited tillage to reduce competition from warm-season perennials on small grain seedlings has led to another possible system of winter pasture production.

Holt, Norris and Lancaster (1969) reported on several years of research in production and management of small grains for forage in the State and in East Texas. The research largely included only the prepared seedbed system of small grains production. Nitrogen fertilization as a factor affecting early forage production from small grains-ryegrass in East Texas has been studied and results reported by Holt et al. (1969), Matocha (1972) and Matocha, McCartor and Ott (1971). A majority of the studies reported have been conducted on prepared seedbed systems of pasture production.

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Topography and excessive wetness in certain areas, limited farm equipment and high fuel costs encourage sodseeding establishment of winter pastures. Certain costs, such as seed and seeding, are inherent to both the prepared seedbed and sodseeding systems of winter forage production. Other costs, such as seedbed preparation and fertilizer, will vary with seeding method. Recent increases in fertilizer, fuel and seed costs have made it imperative to use the system that can maximize profits.

Coastal bermudagrass is the principal summer perennial grass used in intensified forage production in East Texas. An established stand with a history of moderate rates of fertilization was used in the no-till and limited tillage evaluation of small grains. Because of its tremendous production potential, this grass exerts extreme competition on winter pasture seeded in early fall. The rationale used in selecting this particular warm-season perennial for sodseeding was based on the corollary that maximization of profit per acre would have to involve a strong summer forage program as well.

The purpose of this publication is not to present cost economics of the winter pasture systems but rather to present results of the evaluation of the various systems and the effect of factors influencing the sodseeded system of winter forage production. A later paper will report on the effects of sources and rates of fertilizer on forage production from small grain.

EXPERIMENTAL PROCEDURE

The experimental site was located on an excellent stand of Coastal bermudagrass which had a history of low to moderate rates of fertilization. The soil type was a Reklaw sandy loam more recently reclassified as a Cuthbert series (Typic Hapludult). This soil has a variable, rather shallow, gravelly surface horizon (0-8 inches) overlying a dense clay layer. The selected site was at the north division farm of the Texas A&M University Agricultural Research and Extension Center at Overton.

The study involved three separate date-of-seeding experiments which evaluated rates and carriers of paraquat used in chemical desiccation of Coastal bermudagrass. Major studies were conducted in the 1971-72, 1972-73 and 1973-74 growing seasons following a preliminary study initiated in the 1970-71 season. Early date-of-seeding studies were started on September 19 and 24 in 1972 and 1973, respectively. A mid seeding date in all years of the experiment ranged from October 4 to October 8. A late seeding date of October 23 was evaluated in 1972.

Paraquat (1,1'-dimethyl-4, 4'-bipyridinum dichloride) was used as the chemical desiccant with two types of carriers, fertilizer nitrogen solution (Uran) or water plus a surfactant, Ortho X-77 Spreader. All treatments were sprayed with 60-pound-per-square-inch pressure to obtain a fine mist. The aqueous solution of paraquat was applied at a rate of 30 gallons per acre while the fertilizer solution-paraquat mixture was applied at a constant rate of 120 pounds of nitrogen (N) per acre both with and without paraquat. This equaled 375 pounds per acre (35 gallons) of solution, since the Uran contains 32 percent nitrogen.

Paraquat rates were 1/8, 1/4 and 1/2 pound active ingredient per acre mixed with water and 1/8 and 1/4 pound mixed with fertilizer solution. In all years the Coastal bermudagrass was clipped to approximately 2 inches of the surface and allowed a few days of regrowth before it was sprayed. In the 1971 and 1972 seasons, the small grain was drilled into the sod 2-3 days before chemical desiccation of the sod. This was intended to prolong the desiccative effect and to further reduce the competition of the warm-season perennial. Spraying was performed immediately before seeding to start the 1973-74 season.

The treatments were applied to 8- by 12-foot plots with treatment allocations arranged in a randomized, complete block design with four replications. Adequate soil fertility was maintained by split applications of fertilizer totaling 240 pounds of nitrogen per acre, 120 pounds of phosphate (P_2O_5) per acre and 180 pounds of potassium oxide (K_2O) per acre. All plots except the fertilizer check received the same rate of fertilizer. Ammonium nitrate (NH_4NO_3) was the source of nitrogen in all plots not treated with Uran. Triple superphosphate (0-46-0) and muriate of potash (0-0-60) were sources of phosphorus and potassium. The nitrogen was split into three applications, half at seeding, one-fourth in December and one-fourth about February 1. Phosphorus was supplied in a single application at seeding, while potassium was split into two applications.

Riley 67 wheat at 90 pounds per acre and tetraploid ryegrass at 10 pounds per acre were seeded in 1971, while Bonel rye at 75 pounds per acre and common ryegrass at 10 pounds per acre were used in the last two seasons. The center 3 feet of each plot was clipped at a height of 2½ inches for yield determinations. Clippings were usually scheduled on a monthly basis starting in November and excluding December. A lower frequency of clippings was used in the last season (1973-74).

In order to obtain data on actual production, small grain-ryegrass forage produced in the early fall and late spring was hand-separated from bermudagrass forage. This enabled evaluation of paraquat in altering vegetative competition of the two grass systems.

RESULTS AND DISCUSSION

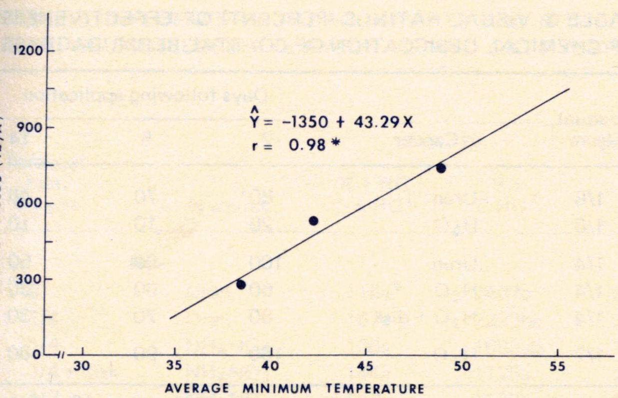
Effect of Bermudagrass Desiccation and Temperature on Small Grain

Sodseeding a mixture of small grains and ryegrass has been reported to furnish good grazing in East Texas (McCartor and Taylor, 1971). Chemical desiccation as a means of reducing competition from Coastal bermudagrass was intensely investigated by this author in research plots over a period of years. Data are reported for individual years since total dry matter production varied considerably with year.

Comparative data are presented in Table 1 for desiccated treatments at a constant rate of one-fourth pound of paraquat per acre and for nondesiccated treatments over the 3 years (1971-74). Early seasonal as well as total seasonal production was variable in all years. Data for the 1971-72 fall season show a significant increase in dry matter yields of wheat-ryegrass as a result of desiccation of the Coastal bermudagrass at seeding. The enhancement of wheat growth occurred early in the fall and continued with ryegrass contributing to the mixed winter forage. Significant differences were observed until the sixth harvest on March 21. Cumulative yields for the season showed almost a 500-pound-per-acre dry matter increase due to chemical desiccation. Similar data for 1972-73 showed no significant treatment effects. However, early season data (harvest 1) for 1973-74 at the low and medium nitrogen application rates showed at least a 50-percent increase in forage yields due to desiccation of the bermudagrass.

Growth obtained from the small grain-ryegrass by January 20 was not always a good indicator of total production for the season. For example, dry matter collected by January in 1971-72 was almost twice that for the corresponding period the following season; however, cumulative production for 1972-73 was twice that of 1971-72. The third season, 1973-74, produced the highest initial yields as well as the highest cumulative totals. Production in the third season ranged up to 50 percent more than in the previous season.

Forage production through January 15 was 656, 296 and 862 pounds per acre which represented 32, 8 and 16 percent of total seasonal production for 1971-72, 1972-73 and 1973-74 seasons, respectively (Table 2). Early forage yields correlated positively with lateness of first frost and average minimum temperature in November for the three seasons (Figures 1 and 2). However, relative production (percent of total yield produced by January 15) was not positively related to average November temperatures and frost dates because of substantial differences in spring rainfall (Appendix Table 1) during the time when the bulk of the forage was produced. This suggests that fall production and spring production are independent and that both are related to temperature, assuming that moisture is adequate.



igure 1. Relationship between average minimum temperature in lovember and yields of small grain-ryegrass by January 15 (1971-73). ields are averaged over desiccated and undesiccated plots (Seeded October 8).

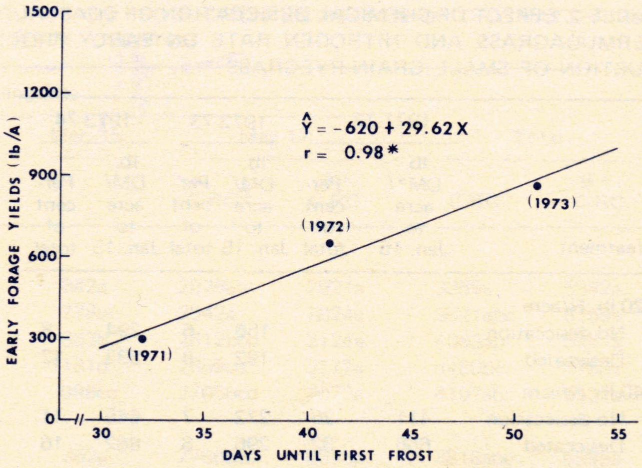


Figure 2. Relationship between days until first freeze and yields of small grain-ryegrass by January 15. Yields are for plots receiving chemical desiccation at seeding (Seeded October 8).

ffect of Paraquat Rate and Seeding Date

The effectiveness of the paraquat in immediate des-ccation and in longevity of the knockdown varied with he rate of application and the carrier as shown in Table 3. lant response data to rate of paraquat and seeding dates re shown in Tables 4 and 5. Early seeding dates in 1972 nd 1973 were September 18 and 24, respectively. The ate seeding date of October 23 was evaluated only in 972.

In the 1972-73 early seeding date, only a slight and nonsignificant increase in production of rye-ryegrass occurred when paraquat rates were increased (Table 4). However, as would be expected, increasing the paraquat rate from 1/8 to 1/2 pound per acre decreased dry matter production of the Coastal bermudagrass and rye-ryegrass mixture at the first harvest. The activity of paraquat was

ABLE 1. EFFECT OF DESICCATING COASTAL BERMUDAGRASS ON PRODUCTION OF SODSEEDED SMALL GRAIN AND RYE-RASS (SEEDED IN EARLY OCTOBER), AS INFLUENCED BY NITROGEN RATES, OVERTON

1971-72 — Production to clipping date (lb. DM[1]/acre)

	Nov. 29	Dec. 20	Jan. 10	Feb. 14	Mar. 10	Mar. 21	Apr. 7	May 2	Total
40 lb. N/acre									
Sodseeded—no desiccation	148a[2]	129a	134a	79a	128a	294a	373a	298a	1583a
Sodseeded—desiccated	217b	242b	197b	118b	202b	375a	393a	325a	2069b

1972-73

	Nov. 20	Jan. 22	Feb. 26	Mar. 13	Apr. 4	May 10	Total
20 lb. N/acre							
Sodseeded—no desiccation	83a[2]	73a	271a	504a	541a	1091a	2563a
Sodseeded—desiccated	102a	90a	262a	579a	488a	925a	2446a
40 lb. N/acre							
Sodseeded—no desiccation	94a	178a	703a	921a	710a	1288b	3894a
Sodseeded—desiccated	123a	173a	761a	961a	650a	959a	3627a
60 lb. N/acre							
Sodseeded—no desiccation	81a	187a	841a	1024a	775b	1287a	4195a
Sodseeded—desiccated	105a	240a	925b	1037a	650a	1345a	4302a

1973-74

	Nov. 28	Jan. 4	Feb. 27	Apr. 24	Total
20 lb. N/acre					
Sodseeded—no desication	183a[2]	111a	369a	3068a	3731a
Sodseeded—desiccated	285b	107a	360a	2635a	3387a
40 lb. N/acre					
Sodseeded—no desication	310bc	335a	1118a	4147b	5910b
Sodseeded—desiccated	514d	348a	1089a	3457a	5408b
60 lb. N/acre					
Sodseeded—no desication	510d	481a	1603a	4604a	7198c
Sodseeded—desiccated	410cd	462a	1548a	4510a	6930c

Dry matter.

All values followed by the same letter are not significantly different at the .05 level of probability, as determined by Duncan's Multiple Range Test.

TABLE 2. EFFECT OF CHEMICAL DESICCATION OF COASTAL BERMUDAGRASS AND NITROGEN RATE ON EARLY PRODUCTION OF SMALL GRAIN-RYEGRASS

Treatment	1971-72 lb. DM*/acre to Jan. 15	1971-72 Percent of total	1972-73 lb. DM/acre to Jan. 15	1972-73 Percent of total	1973-74 lb. DM/acre to Jan. 15	1973-74 Percent of total
120 lb. N/acre						
No desiccation			156	6	294	8
Desiccated			192	8	392	12
240 lb. N/acre						
No desiccation	411	26	272	7	645	11
Desiccated	656	32	296	8	862	16
360 lb. N/acre						
No desiccation			268	6	991	14
Desiccated			345	8	872	13

*Dry matter.

enhanced when nitrogen solution (Uran) was used as a carrier. The synergistic effect on desiccation is reflected in the visual ratings (Table 3) and in the bermuda-rye data for ⅛- and ¼-pound-per-acre rates at the November 8 harvest (Table 4). Furthermore, the combination of fertilizer and herbicide appeared to seriously affect the stand of rye in the early seeding-date study. The consistently lower production throughout the season from Uran with ¼ pound per acre of paraquat as compared to ammonium nitrate was primarily due to stand reduction.

TABLE 3. VISUAL RATINGS (PERCENT) OF EFFECTIVENESS OF CHEMICAL DESICCATION OF COASTAL BERMUDAGRASS

Paraquat, lb./acre	Carrier	Days following application: 2	5	14
1/8	Uran	80*	70	40
1/8	H_2O	20	10	10
1/4	Uran	100	90	50
1/4	H_2O	60	60	30
1/4	H_2O + disk	80	70	30
1/2	H_2O	100	90	60

*Rating based on a scale of 100 = complete desiccation, 10 = slight desiccation.

Paraquat in aqueous solution but with dry ammonium nitrate had a lesser effect on the rye stand even at a higher application rate. This is reflected in the significantly greater yields of rye-ryegrass treated with ½ pound per acre of paraquat in ammonium nitrate as compared with the combination of paraquat at ¼ pound per acre and Uran.

Delaying the seeding date some 4 weeks, or until October 23, resulted in an 8-week delay in the first harvest (Table 4). The effects of the desiccant rate were minimized by the later seeding date. The adverse effects from combining paraquat and Uran on a stand of rye observed in the early date-of-seeding were not evident in the late seeding. This indicated a possible temperature interaction with the paraquat-fertilizer solution treat-

TABLE 4. EFFECT OF PARAQUAT RATE AND NITROGEN SOURCE ON RYE-RYEGRASS SODSEEDED IN COASTAL BERMUDAGRASS IN POUNDS OF DRY MATTER PER ACRE, 1972-73, OVERTON

Early seeding date (Sept. 19)

Paraquat rate, lb./acre	N source	Nov. 8 R-RG[2]	Nov. 8 B + R-RG[3]	Dec. 19	Jan. 29	Feb. 13	Mar. 5	Mar. 22	May 8 R-RG	May 8 B + R-RG	Total R-RG	Total B + R-RG
1/8	NH_4NO_3	100a[1]	606c	183b	336b	258b	644b	1210ab	1830a	2158a	4561ab	5395a
1/8	Uran	97a	507b	133ab	285b	185a	524a	1048a	1907a	2249a	4179a	4931a
1/4	NH_4NO_3	128a	562bc	155b	310b	256b	618b	1222ab	1959a	2310a	4648b	5433a
1/4	Uran	90a	408a	73a	217a	144a	385a	1118a	2174a	3054b	4201a	5399a
1/2	NH_4NO_3	122a	500ab	152b	341b	285b	685b	1305b	1840a	2170a	4730b	5438a

Late seeding date (Oct. 23)

Paraquat rate, lb./acre	N source	Jan. 4	Feb. 15	Mar. 13	May 7 R-RG	May 7 B + R-RG	Total R-RG	Total B + R-RG
1/8	NH_4NO_3	145a	594a	1073ab	2372ab	3650ab	4184b	5462ab
1/8	Uran	149a	611a	1016ab	2122ab	3264ab	3898a	5040ab
1/4	NH_4NO_3	144a	603a	1113b	2570b	3954b	4430c	5814b
1/4	Uran	137a	632a	1044ab	1872a	2880a	3685a	4693a
0[4]	Uran	226b	631a	967a	1973a	3035a	3797a	4859a

[1]Values followed by the same letter are not significantly different at the .05 level of probability, as determined by Duncan's Multiple Range Test.

[2]Rye-ryegrass.

[3]Bermudagrass + rye-ryegrass.

[4]Serious Hairy chess infestation.

TABLE 5. INFLUENCE OF PARAQUAT RATE AND NITROGEN SOURCE ON PRODUCTION (IN POUNDS OF DRY MATTER PER ACRE) OF SODSEEDED RYE-RYEGRASS AND OAT-RYEGRASS, 1973-74, OVERTON

Paraquat rate, lb./acre	N source	Clipping date: Nov. 19 R + RG O + RG[1]	Nov. 19 B + C-RG[2]	Jan. 10	Mar. 15	May 17 C-RG[3]	May 17 B + C-RG	Total C-RG	Total B + C-RG
Rye									
0	Uran	116a[4]	2437c	282a	342a	2629ab	2921a	3369a	5982a
1/4	Uran	167a	2233bc	334a	778bc	2542a	2824a	3821abc	6169a
1/4	NH_4NO_3	136a	1682ab	272a	863b	2812bcd	3124a	4083ab	5941a
1/4 + disk	NH_4NO_3	144a	1126a	296a	1181d	2859cd	3177a	4480bc	5780a
1/2	NH_4NO_3	143a	1172a	291a	998cd	2765bcd	3073a	4197ab	5537a
Oats									
0	Uran	225ab	2495c	465a	362a	2766bcd	3073a	3818abc	6395a
0	NH_4NO_3	274b	3421d	560a	342a	2726abc	3029a	3902ab	7352b
1/8	Uran	558c	2138bc	1016b	696bc	2599ab	2888a	4869bcd	6738ab
1/4	Uran	666c	2185bc	1302b	564ab	3096e	3440a	5628d	7491b
1/4	NH_4NO_3	544c	1733b	1028b	895bc	2810bcd	3122a	5277cd	6778ab
1/4 + disk	NH_4NO_3	576c	1277a	1104b	946cd	2969de	3299a	5595d	6626ab
1/2	NH_4NO_3	570c	1259a	1112b	979cd	2797bcd	3108a	5458d	6458ab

[1]Rye + ryegrass, oat + ryegrass.
[2]Bermudagrass + cereal-ryegrass.
[3]Cereal-ryegrass.
[4]All values followed by the same letter are not significantly different at the .05 level of probability, as determined by Duncan's Multiple Range Test, in columns across both species.

ment. However, final production figures still reflected lower yields from the combination of paraquat and Uran.

Although early production of small grain forage was significantly delayed by the later seeding date, total dry matter production from the rye-ryegrass was reduced by only 5-10 percent. Total forage produced, including Coastal bermudagrass, was essentially the same regardless of seeding date.

Effect of Seedbed Preparation

Preparation of a seedbed before seeding small grain and ryegrass usually required more than one trip with a heavy tandem disk if the sod was primarily bermudagrass. A flat-breaking plow or a rototiller will usually prepare a good seedbed with one trip over the sod. Equipment costs in seedbed preparation are high. However, data in Table 6 and Figures 3 and 4 show that production of small grain-ryegrass forage in the seedbed system is substantially better than from the same grasses seeded into chemically desiccated sod.

Production values were variable from year to year for both systems. Production at the first harvest (November) ranged from less than 100 pounds of dry matter per acre (sodseeded, 240 pounds of nitrogen, 1972-73) to more than 900 pounds in 1973-74 when the seedbed was prepared (Table 6). Relative production from sodseeded small grain-ryegrass, even with chemical treatment of bermudagrass, comprised a meager 20-30 percent of the production from prepared seedbed at the first harvest and increased to 60-100 percent by the April harvest.

Nitrogen fertilization increased forage yields substantially in all years and appeared to narrow the yield difference between the sodseeded and seedbed systems. For example, in the 1971-72 season, a poor year from the standpoint of total seasonal forage production, dry matter yields for the two systems at 120 and 360 pounds of nitrogen per acre were 1,005 and 2,198 pounds per acre and 2,154 and 3,429 pounds per acre, respectively. Relative production from sodseeded forage was 46 and 63 percent of that from prepared seedbed for these two extreme nitrogen rates.

In the season when production was highest (1973-74), 3,731 and 5,598 pounds per acre of dry matter were reported for the sodseeded and seedbed systems, respectively, at 120 pounds per acre of nitrogen. Comparative values at the high rate of nitrogen were 7,198 and 8,754 pounds per acre of dry matter. Relative percentages of the two systems were 66 and 82 percent for the low and high nitrogen rates, respectively. Therefore, ratio changes due to nitrogen rate were 17 percent in the year of low production and 16 percent when production was highest. The data thus indicate that relative production differences due to systems will be similarly affected by nitrogen rates regardless of season.

Another factor that had significant influence on the relative productivity of the two systems was climatic conditions during the growing season. Although early fall growth of small grains was directly related to average minimum temperatures in November (Figure 1), total seasonal production appeared more related to rainfall than to winter temperatures. The performance of sodseeded small grain compared with prepared seedbed small grain was related to rainfall in the early fall and throughout the winter and spring. Production ratios increased approximately 20 percent at both low and high

TABLE 6. PREPARED SEEDBED AND SODSEEDED PRODUCTION (IN POUNDS OF DRY MATTER PER ACRE) OF RYE-RYEGRASS AS AFFECTED BY NITROGEN RATES, OVERTON

System	N rate (lb./acre)	Clipping date								Total
		1971-72								
		Nov. 29	Dec. 20	Jan. 10	Feb. 14	Mar. 10	Mar. 21	Apr. 7	May 2	Total
Sodseeded	0	17a	74a	62a	73a	23a	131a	13a	34a	427a
Sodseeded	120	162b*	137b	123b	79a	55a	266b	69a	114a	1005a
Seedbed	120	345c	353c	256c	199b	356c	216ab	167b	306b	2198c
Sodseeded	240	148b	129b	134b	79a	128b	294b	373c	298b	1583b
Seedbed	240	316c	406c	232c	164b	507d	475cd	382c	528c	3010d
Sodseeded	360	178b	161b	165b	105a	198b	393c	518d	436c	2154c
Seedbed	360	435c	385c	266c	173b	735e	556d	393c	486c	3429d
		1972-73								
		Nov. 20	Jan. 22	Feb. 26	Mar. 13	Apr. 4	May 10	May 10		Total
Sodseeded	0	52a	25a	11a	25a	112a	704a			929a
Sodseeded	120	83a*	73a	271ab	504b	541b	1091c			2563b
Seedbed	120	109ab	371c	383bc	397b	959d	715a	941a		3875c
Sodseeded	240	94ab	178b	703d	921c	710c	1288d			3894c
Seedbed	240	149bc	623d	579cd	494b	1025de	857b	984a		4711d
Sodseeded	360	81a	187b	841d	1024c	775c	1287d			4195cd
Seedbed	360	168c	824e	594cd	397b	1088e	1228d	1458b		5757e
		1973-74								
		Nov. 28		Jan. 4		Feb. 27		Apr. 24		Total
Sodseeded	0	50a		14a		47a		742a		853a
Sodseeded	120	183a*		111a		369b		3068b		3731b
Seedbed	120	806c		694d		587c		3511bc		5598c
Sodseeded	240	310b		335b		1118d		4147cd		5910cd
Seedbed	240	920c		809de		1618e		5210e		8557e
Sodseeded	360	510b		481c		1603e		4604de		7198d
Seedbed	360	837c		871e		1741e		5305e		8754e

*All values followed by the same letter are not significantly different at the .05 level of probability, as determined by Duncan's Multiple Range Test.

rates of nitrogen and appeared to be associated with fall rainfall increases from 9 to 18 inches and winter-spring rainfall increases from 26 to 39 inches. Production ratios for total dry matter changed only slightly with lower fall and winter temperatures as long as rainfall did not change substantially.

The effect of seedbed preparation on the seasonal growth pattern of small grain-ryegrass over a period of 3 years is depicted in Figure 3. Generally, growth of the sodseeded cool-season annuals averaged less than 10 pounds of dry matter per acre per day for the months of November, December and January, regardless of year. At the same time, growth rates on prepared seedbed exceeded 10 pounds and approached 20 pounds per acre per day in some years. Plant performance in early and late fall 1973 exceeded by almost two-fold that of the first 2 years.

Seasonal growth patterns fluctuated slightly among years, but peak growth rates generally occurred in March and April. These growth rates in the better years were in the range of 60-80 pounds of dry matter per acre per day on sodseeded forage. At the same time plant growth in the seedbed system ranged from 80-100 pounds of dry matter per acre per day.

Effect of Small Grain Specie and Date-of-Seeding

Date-of-seeding and small grain specie had a significant effect on the growth pattern of the forage. Data in Figure 4 show that the growth rate of sodseeded oats in November and December was greater than that of rye, but these became almost equal in January and February. Spring growth was greater for oats than for rye when both were seeded in September; however, when seeded in late October, rye production in February and March exceeded oat production, with oat production again greater in April. It appears that late-seeded oats has a more difficult time establishing a good root system than rye. When soil temperatures increased in late March and April the oats made catch-up growth, and the growth rate exceeded that of rye.

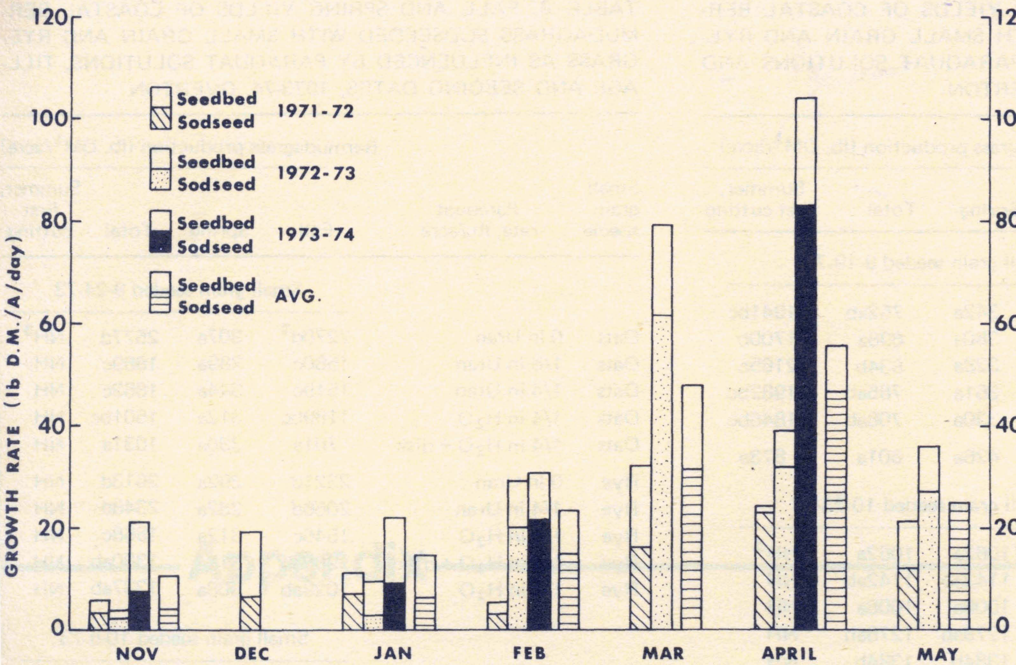


Figure 3. Influence of seedbed preparation and season on monthly growth rates of small grain-ryegrass mixtures at 240 pounds of nitrogen per acre.

Treatment Effect on Coastal Bermudagrass

Coastal bermudagrass is the predominate forage at the first harvest in a sodseeded system with small grain-ryegrass (Tables 7 and 8). Seeding date, rate and carrier of paraquat and tillage treatment have a substantial effect on competition from Coastal bermudagrass. Dry matter yields of Coastal bermudagrass growing in association with winter forage up to the first harvest ranged from a few hundred pounds in the first year (1972-73) to a ton in the second year. The September seeding dates for both years were only a few days apart. Difference in the growth can be largely attributed to warmer temperatures and higher rainfall (Appendix Table 1) during the 50-60 days following seeding in the second year. Paraquat significantly reduced regrowth of Coastal bermudagrass in the first year, when rate was increased from ⅛ to ½ pound per acre with water as a carrier. One-fourth pound per acre of paraquat with Uran reduced regrowth of the warm-season perennial more than paraquat with water as the carrier. The greatest suppression of fall growth of Coastal bermudagrass occurred when ¼ pound per acre of paraquat was followed with disking and oats rather than rye was used as the small grain. Oats are generally more aggressive than rye in the early season and therefore may compete better with Coastal bermudagrass.

As could be expected, seeding date had a great influence on the quantity of Coastal bermudagrass growing in association with small grain-ryegrass. When the seeding date was as late as October 23, fall production from the summer perennial was negligible (Table 7). In the following season delaying seeding from September 24 until October 8 resulted in reduction of bermudagrass in the small grain forage by approximately two thirds at the first harvest (Table 8).

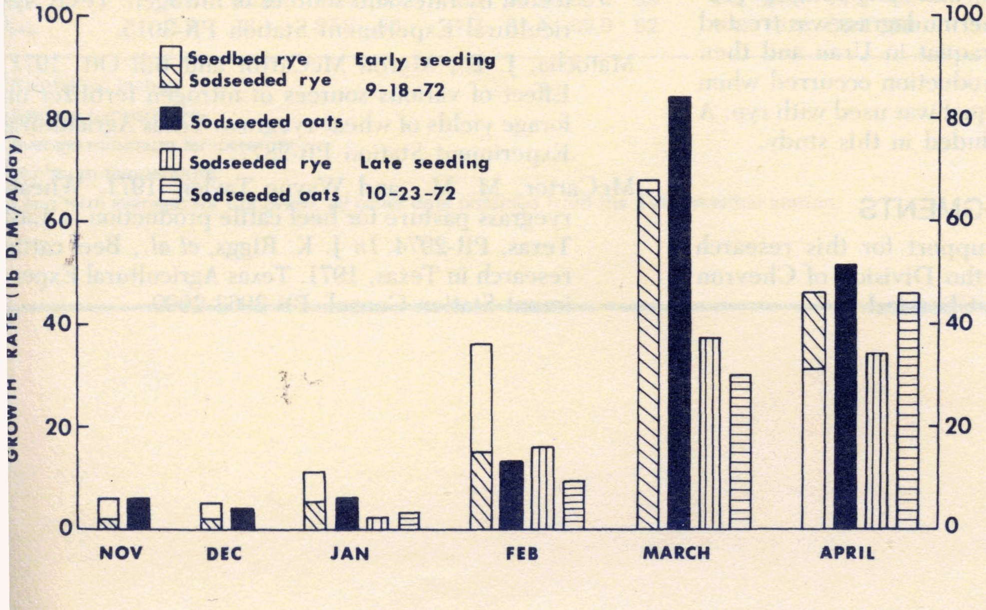


Figure 4. Influence of seedbed preparation, small grain specie and seeding date on monthly growth rates of small grain-ryegrass mixtures at 240 pounds of nitrogen per acre.

TABLE 7. FALL AND SPRING YIELDS OF COASTAL BERMUDAGRASS SODSEEDED WITH SMALL GRAIN AND RYEGRASS AS INFLUENCED BY PARAQUAT SOLUTIONS AND SEEDING DATES, 1972-73, OVERTON

Small grain specie	Paraquat rate, lb./acre	Bermudagrass production (lb. DM[1]/acre) Fall	Spring	Total	Summer, first cutting
		Small grain seeded 9-19-72			
Rye	1/8 in Uran	410bcd[2]	342a	752ab	1941bc
Rye	1/4 in Uran	318b	380a	698a	1700b
Rye	1/8 in H_2O	506d	328a	834b	2165c
Rye	1/4 in H_2O	434cd	351a	785ab	1982bc
Rye	1/2 in H_2O	378bc	330a	708ab	1846bc
Oats	1/4 in Uran	175a	426a	601a	873a
		Small grain seeded 10-23-72			
Rye	0 in Uran	0	1062a	1062a	NH[3]
Rye	1/8 in Uran	0	1142ab	1142ab	NH
Rye	1/4 in Uran	0	1008a	1008a	NH
Rye	1/8 in H_2O	0	1278ab	1278ab	NH
Rye	1/4 in H_2O	0	1384b	1384b	NH
Oats	1/4 in Uran	0	1371b	1371b	

[1]Dry matter.
[2]All values in columns followed by the same letter are not significantly different at the .05 level of probability, as determined by Duncan's Multiple Range Test.
[3]Not harvested.

Delayed seeding of small grain-ryegrass enhanced spring production of Coastal bermudagrass forage, as reflected in the last harvest of the winter forage (Table 7). This effect may be largely attributable to residual soil nitrogen. As a result of delayed seeding and nitrogen fertilization, more residual nitrogen was available for spring production of Coastal bermudagrass.

Regrowth of Coastal bermudagrass following the last harvest of the winter pasture (summer, first cutting) was affected to some extent by fall treatment of the summer perennial. Data in Table 7 show that early summer production was lowest when the bermudagrass was treated with ¼ pound per acre of paraquat in Uran and then seeded to oats. The highest production occurred when only ⅛ pound per acre of paraquat was used with rye. A control treatment was not included in this study.

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TABLE 8. FALL AND SPRING YIELDS OF COASTAL BERMUDAGRASS SODSEEDED WITH SMALL GRAIN AND RYEGRASS AS INFLUENCED BY PARAQUAT SOLUTIONS, TILLAGE AND SEEDING DATES, 1973-74, OVERTON

Small grain specie	Paraquat rate, lb./acre	Bermudagrass production (lb. DM[1]/acre) Fall	Spring	Total	Summer, first cutting
		Small grain seeded 9-24-73			
Oats	0 in Uran	2270d[2]	307a	2577d	NH[3]
Oats	1/8 in Uran	1580c	289a	1869c	NH
Oats	1/4 in Uran	1519c	344a	1863c	NH
Oats	1/4 in H_2O	1189bc	312a	1501bc	NH
Oats	1/4 in H_2O + disk	701a	330a	1031a	NH
Rye	0 in Uran	2321d	292a	2613d	NH
Rye	1/4 in Uran	2066d	282a	2348d	NH
Rye	1/4 in H_2O	1546c	312a	1858c	NH
Rye	1/4 in H_2O + disk	982ab	318a	1300ab	NH
Rye	1/2 in H_2O	1029ab	308a	1337ab	NH
		Small grain seeded 10-8-73			
Rye	1/8 in Uran	673b	0[4]	673b	720a
Rye	1/4 in Uran	500b	0	500b	611a
Rye	0 in H_2O	740b	0	740b	701a
Rye	1/4 in H_2O + disk	326a	0	326a	

[1]Dry matter.
[2]Values followed by the same letter are not significantly different at the .05 percent level, as determined by Duncan's Multiple Range Test.
[3]Not harvested.
[4]Last clipping of winter forage made earlier than in 9-24-73 seeding.

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Appendix

APPENDIX TABLE 1. CLIMATIC DATA RELATING TO WINTER PASTURE EXPERIMENTS AT OVERTON

	1970-71				1971-72				1972-73				1973-74				30-year average	
Month	R[1]	AT[2]	AMT[3]	MT[4]	R	AT	AMT	MT	R	AT	AMT	MT	R	AT	AMT	MT	R	AT
Sept.	4.9	77.9	67.5	50	5.3	76.5	65.2	50	5.0	79.6	68.7	47	6.9	75.6	65.9	52	2.6	78.3
Oct.	11.0	63.5	51.6	35	1.3	69.5	57.3	44	7.5	64.5	53.5	41	6.5	67.9	56.5	35	3.1	68.5
Nov.	1.2	52.8	39.8	22	2.6	55.4	42.3	29	5.0	48.3	38.5	28	4.9	60.5	49.0	33	4.1	55.7
Subtotal and Average	17.1	64.7	53.0		9.2	67.1	54.9		17.5	64.1	53.6		18.3	68.0	57.1		9.8	67.5
Dec.	3.2	53.6	41.9	20	5.9	52.8	43.4	29	3.2	42.5	31.3	17	4.0	47.1	32.9	18	4.6	49.2
Jan.	0.33	49.3	36.4	19	7.2	45.7	33.7	14	5.3	40.9	30.5	9	7.8	43.4	34.2	16	4.3	47.7
Feb.	4.1	48.9	36.0	14	.5	51.3	39.4	16	2.9	46.6	35.5	17	1.6	50.0	35.7	18	3.8	50.8
Mar.	0.61	54.6	40.9	20	2.0	60.0	46.3	26	7.7	55.9	41.8	33	3.5	62.3	50.3	28	3.8	57.0
Apr.	0.78	63.7	50.8	31	1.5	66.3	53.6	37	9.3	60.4	50.8	29	3.4	64.5	50.8	32	4.8	65.7
Subtotal and Average	9.02	54.0	41.2		17.1	55.2	43.3		28.4	49.3	38.0		20.3	53.5	40.8		21.3	54.1
May	1.7	70.2	58.6	41	1.5	71.1	58.0	47	1.5	70.1	58.3	42	4.3	74.9	64.9	50	5.7	73.6
June	0.96	82.0	69.5	63	5.2	78.9	67.3	50	12.4	77.0	66.8	57	3.7	74.8	64.1	50	3.4	81.2
July	2.2	82.5	71.4	56	2.8	79.3	68.6	55	4.0	81.8	71.3	65	0.62	80.5	68.0	64	3.5	84.2
Aug.	2.2	78.1	67.5	56	1.7	81.4	69.0	62	1.1	79.1	66.3	58	3.4	79.5	68.3	62	2.6	84.3

[1] Rainfall, in inches.
[2] Average temperature.
[3] Average minimum temperature.
[4] Minimum temperature.
[5] Long term averages for Longview; all other data obtained from the Tyler weather station.

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