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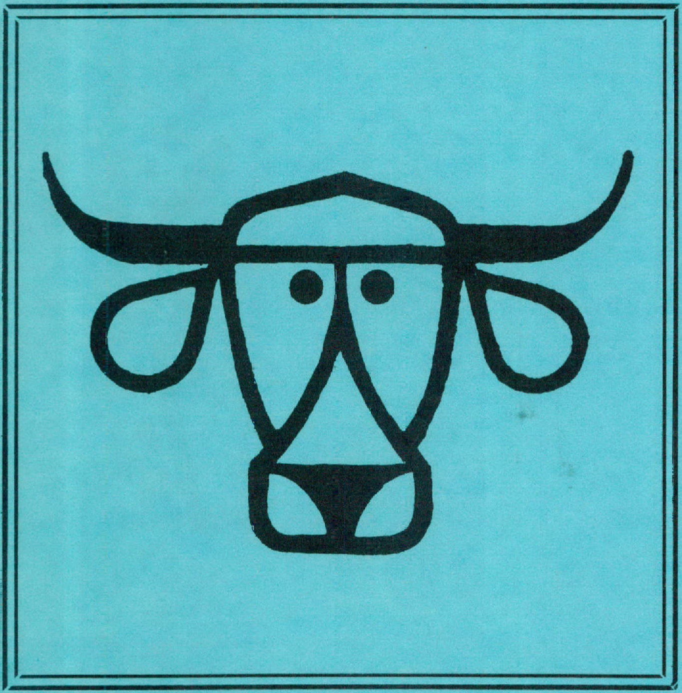

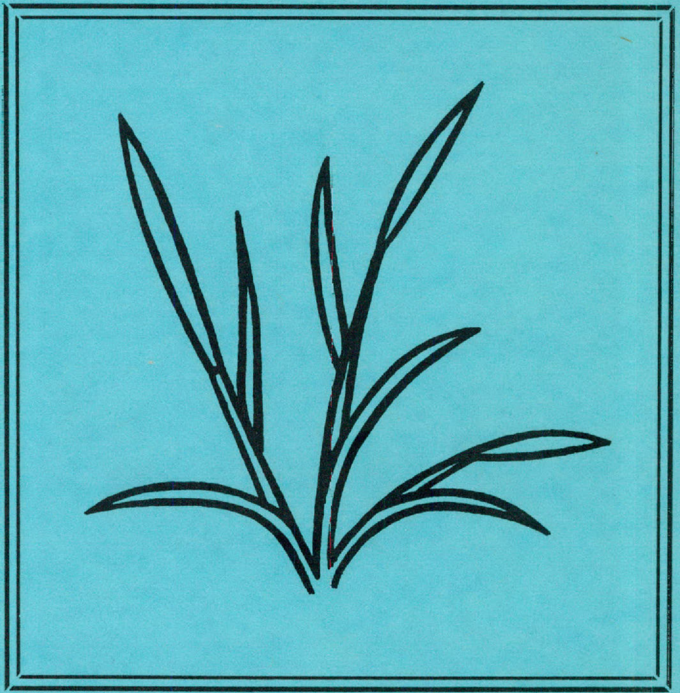

Forage Research in Texas

1982

The Texas Agricultural Experiment Station, Neville P. Clarke, Director, The Texas A&M University System, College Station, Texas

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Influence of Stocking Rates and Cow Weight Change on Weaning Weights and Subsequent Birth Weights of Calves and Cow Reproductive Performance

R. W. Godfrey, F. M. Rouquette, Jr. and R. D. Randel*

SUMMARY

Records covering an 11-year period were evaluated on a herd of fall calving F-1 Brahman x Hereford cows. Calf birth weights, 205-day adjusted weaning weights, calving intervals, and pregnancy data were collected annually. Cows and calves were placed on clover-ryegrass-bermudagrass pastures for 3 to 5 months during early- to mid-gestation. All animals were weighed at 28-day intervals while on the test pastures. In early to mid-July, calves were weaned and the cows removed from the test pastures and placed on bermudagrass paddocks where they remained until fall calving. During the breeding season cows were exposed to fertile bulls for a 90-day period.

The cow weight data was divided into 2 groups based on weight-loss or weight-gain while on the test pastures. The birth weight of the calves was similar (P >.10) for both groups of cows. The weight-loss cows weaned lighter (P <.01) calves than the weight-gain cows. There was a greater (P <.01) percentage of weight-gain cows than weight-loss cows pregnant at the end of the breeding season. Cows that lost weight and did conceive had longer (P <.01) calving intervals than cows that gained weight and conceived.

Introduction

Low nutritional levels have been shown to negatively influence the reproductive performance of beef cows. Other researchers have reported decreased weaning weights of calves whose dams were nutritionally restricted during late gestation. Also, the birth weight of calves has been shown to be decreased by poor cow nutrition during the last trimester of gestation. Either by design or default, maximum utilization of forages for prolonged periods leads to significant weight loss of lactating beef cows. This study was designed to determine the effect of weight change by the cow in mid-gestation on reproduction performance of the cow, and to ascertain the effect of cow performance on weanling and subsequent calf performance.

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Procedure

Records covering an 11-year period from a herd of fall calving F-1 Brahman x Hereford cows were analyzed. Calf birth weight, 205-day adjusted weaning weight, calving interval, and pregnancy data were collected annually. Cows with calves were placed on clover-ryegrass-bermudagrass pastures for 3 to 5 months during early- to mid-gestation. The cows were placed on the test pastures at 3 levels of forage availability (stocking rates). While on the test pastures the cows were weighed every 28 days. In early to mid-July, calves were weaned, cows removed from the test pastures, and placed on bermudagrass paddocks where they remained until the next calving season.

During the breeding season cows were exposed to a fertile bull for a 90-day period. Sire breeds during the eleven years have included Brown Swiss, Charolais, Santa Gertrudis, Brangus, and Simmental. Cows were rectally palpated 45 days after the end of the breeding season to determine pregnancy. The cow weight data was divided into 2 groups based on weight loss or weight gain by the cow while on the test pastures. The data was analyzed by the Students t-test and Chi-Square (Ott, 1977).

Results

The 11-year average of cow weight change is presented in Table 1. Cows in the weight-loss group lost 105 lbs while on the preweaning grazing treatments; whereas, cows in the weight-gain group gained approximately 116 lbs during the same period. In general, those cows which lost weight during the data collection period were assigned to the low forage availability or high stocked pasture; whereas, those cows which gained weight were assigned to the medium to high forage availability or lightly stocked pastures. Cows which lost weight weaned lighter calves ($P<.01$) (Table 1). There was a 70-pound weaning weight advantage for cows that gained weight during lactation. Table 2 shows the percent distribution of calf weaning weights as influenced by cow weight change.

Birth weights of subsequent calves were not affected by cow weight change during the first two trimesters of pregnancy (Table 1). Considering the breeds of bulls used during the 11-year period, birth weights were reasonably light at 75 pounds. Table 3 shows the percent distribution of calf birth weights as influenced by cow weight change.

Calving interval and pregnancy status of cows used in this data summary are shown in Table 4. Perhaps one of the most important considerations of those cows which lost weight prior to calving was that the calving interval was lengthened by more than one month. This not only affects weaning weights and dates, but also allows for more potential problems in matching forage systems with animal functions. The percent pregnant <u>vs</u> open cows selected in this data set were also significantly affected by cow weight change in the first trimesters of pregnancy (Table 4). From the data presented there is a definite carryover effect from high stocking rate pastures which were responsible for cow weight loss as well as a decline in body condition. The full implications of this carryover effect have not been ascertained, but are under current evaluation. It may be concluded, however, that weight loss by the cow during early to mid-gestation decreases the reproductive efficiency of the cow by lengthening the calving interval and decreasing the conception rate.

Table 1. Cow weight change during the grazing season and resultant calf weaning weights and birth weights.

COW GROUP	COW WEIGHT CHANGE (lbs)	(n)	CALF WEANING WEIGHT (lbs)	(n)	CALF BIRTH WEIGHTS (lbs)	(n)
WEIGHT-LOSS	-105.1±63.6[a]	(51)	439.5±59.2[a]	(51)	74.6±11.2[a]	(35)
WEIGHT-GAIN	+116.6±62.0[b]	(145)	509.6±64.2[b]	(138)	74.6±11.3[a]	(124)

[a,b] Values with different superscripts are statistically different (P .01).

Table 2. Percent distribution of calf weaning weight as influenced by cow weight change.

	WEANING WEIGHTS (lbs)					
COW GROUP	400	400-450	451-500	501-550	551-600	600
WEIGHT-LOSS	29.4%	29.4%	29.4%	5.9%	3.9%	1.9%
WEIGHT-GAIN	5.1%	13.0%	26.8%	28.9%	16.7%	9.4%

Table 3. Percent distribution of calf birth weights as influenced by cow weight changes.

	BIRTH WEIGHTS (lbs)					
COW GROUP	60	60-70	71-79	80-90	91-99	99
WEIGHT-LOSS	8.3%	33.3%	30.5%	19.4%	5.5%	2.8%
WEIGHT-GAIN	7.3%	33.1%	31.5%	20.2%	5.6%	2.4%

Table 4. Calving interval and pregnancy status of cows gaining or losing weight during the grazing season.

COW GROUP	CALVING INTERVAL (days)	(n)	PREGNANT (%)	OPEN (%)	(n)
WEIGHT-LOSS	397.25 ± 37.16^a	(24)	72.5^a	27.5^a	(51)
WEIGHT-GAIN	360.74 ± 41.84^b	(110)	90.3^b	9.7^b	(144)

[a,b]Values with different superscripts are statistically different (P .01).

Influence of Monensin on Gain of Stocker Calves Grazing Cool-Season Annual Grasses

F. M. Rouquette, Jr., J. V. Davis, and M. J. Florence

SUMMARY

A group of 60 calves, consisting of 20 heifers and 40 steers, was divided equally into two treatment groups: rye-ryegrass pasture only; rye-ryegrass pasture plus 200 mg monensin per head per day supplied in 2 pounds ground corn per head per day. Average initial weight of the February-born 1/2 Simmental 1/4 Brahman 1/4 Hereford calves was 495 pounds for hiefers and 565 pounds for steers. The monensin-corn fed calves had an average daily gain (ADG) of 2.11 pounds from November 18 to May 7 (170 days); whereas, the pasture only calves had an ADG of 1.73 pounds during the same period. Steers gained .36 pounds per day more than their heifer mates (2.03 vs. 1.67). With the exception of one 28-day period, consumption of the monensin-corn ration was approximately 90% of that offered.

Introduction

Monensin is one of several compounds used to promote animal performance. Previous studies have shown that monensin increases feed efficiency and/or weight gains of growing cattle. When used with small quantities of feed carrier (2 lbs/hd/da) and bermudagrass pastures, monensin fed at 200 mg/hd/da does not normally present a palatability problem. However, when used in combination with annual winter pastures such as small grains-ryegrass, monensin has been reported to be unpalatable, and thereby, limits total feed-monensin intake. The primary objectives of this trial therefore were to: (1) determine the acceptability of supplemental feed containing monensin when fed to calves grazing an 'Elbon' rye-'Gulf' ryegrass pasture; (2) determine the influence of monensin on animal performance; and (3) measure forage availability and estimate forage disappearance for calculating forage:gain ratios.

Procedures

Pasture. 'Elbon' rye was drilled into a prepared seedbed at the rate of 100 pounds of seed per acre and 'Gulf' ryegrass was planted at the rate of 20 pounds per acre on September 25. Six pastures were used with size of each ranging from 5.5 to 7.5 acres. Total fertilizer application during the growing period was 225-75-75 pounds per acre of N-P_2O_5-K_2O. Available forage was harvested at 28-day intervals throughout the trial. Forage was hand-clipped inside and outside of wire cages to provide an estimate of forage disappearance. Protein and *in vitro* digestible dry matter (IVDDM) analyses were also conducted on the forage samples.

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Animals. All calves used were the progeny of purebred Simmental bulls and F-1 (Brahman x Hereford) cows. Calves were weaned, given a multi-way blackleg vaccine, and allowed to graze bermudagrass until the winter pastures were ready to be grazed. Ten heifers and 20 steers were allotted according to weight and condition to both the control group and the monensin group. The steers were then separated into two groups of 10 head each for each treatment group to provide 3 replicates of 10 head each per treatment. All calves were provided with 2 lbs/hd/da of a ground corn creep feed one week prior to initiation of the trial. The 30 calves in the monensin group received 100 mg monensin/hd/da (1 lb of treated feed and 1 lb of untreated feed) during the first five days pre-trial. Thereafter, 200 mg monensin/hd/da was provided via 2 lbs feed. Feed refusals (orts) were recorded daily and discarded on a weekly basis. All calves were weighed twice at initiation and termination of the 170-day trial, and at 28-day intervals during the grazing period. Minerals were provided free choice to each of the six groups.

Results

Average daily gain (ADG) for each of the animal groups is shown for each weigh period in Table 1. Calves which were fed 2 lbs ground corn/hd/da plus 200 mg monensin gained considerably more during the first 56-day period than the non-fed groups. This may be due to the dry matter contribution of the ground corn, or a combination of both the feed and the 200 mg/da monensin. Regardless of the primary agent responsible, the most significant point is that during this first 56 days, the corn + monensin fed calves gained 1.0 lbs/hd/da more than the non-fed groups (1.33 lbs/da vs 0.34 lbs/da).

Table 2 shows group ADG summaries for both a 141-day and 170-day period. Because of the excellent growing conditions for Elbon rye during the winter period and the warm, early spring which promoted rapid maturation during March, the Gulf ryegrass was restricted somewhat in its normal growth patterns during March and April. Thus, the decline in animal performance from 4-8 to 5-7 was due primarily to forage conditions. Even so, the monensin-fed calves gained nearly .4 lb/hd/da more than the non-fed calves. The gain advantage of steers vs heifers was nearly identical to that of the treatment groups.

Feed refusals are summarized by animal weigh periods in Table 3. With the exception of the 2-11 to 3-10 period, about 90% of the monensin-supplemented ground corn was consumed. From 2-11 to 3-10, there were 5 frequencies of measurable rainfall. This may have influenced consumption, but does not satisfactorily explain the extreme refusals in Group III.

Forage dry matter available for grazing is shown in Table 4. Since this type pasture has a moisture content of 70 to 85% during this test period, there was more than adequate forage available on all paddocks. Although there was considerable fluctuation in available forage between paddocks and between periods, forage availability did not restrict animal intake. There was always an abundance of this high quality forage available for maximum intake under grazing conditions.

Table 5 presents an estimate of forage:gain ratios which were obtained via cage-difference technique in each paddock. The ratios were surprisingly similar and showed a slight numerical advantage for the monensin-fed calves. Forage:gain ratios, however, ranged from about 10:1 to 13:1 which were superior to those previously reported for monensin-bermudagrass trials.

Percent protein and *in vitro* digestible dry matter of available forage are presented in Table 6. These data further substantiate the equality of the paddocks and also show a decline in quality of the Elbon rye with advancing chronological and morphological age. The rapid decrease in calf ADG (Table 1) during the last 28-day period may be explained in part by the forage quality, but was also related to the physical nature of the maturing rye and the overall condition of the calves.

Table 1. Monthly average daily gain of calves grazing rye-ryegrass pastures (lbs/day).

GROUP	Initial Weight (lbs)	11-8 to 12-16	12-16 to 1-13	1-13 to 2-10	2-10 to 3-10	3-10 to 4-8	4-8 to 5-7	11-8 to 4-8	11-8 to 5-7
I Control	494	-.75	.50	1.64	2.75	2.62	1.28	1.36	1.35
II Monensin	496	.25	2.54	2.29	2.54	3.03	1.28	2.14	1.99
III Monensin	573	1.14	1.96	2.82	3.00	3.24	1.90	2.44	2.35
IV Control	567	-.04	1.57	2.07	2.86	3.48	1.41	2.00	1.90
V Monensin	569	-.14	2.25	2.50	3.36	2.86	1.03	2.17	1.98
VI Control	551	-.29	1.07	1.93	3.93	3.24	1.66	1.98	1.93

Table 2. Group summaries of average daily gain.

Groups	Average Daily Gain (lbs) 11-18- to 4-8 (141 days)	11-18 to 5-7 (170 days)
Monensin	2.25	2.11
Control	1.78	1.73
Heifers	1.75	1.67
Steers	2.15	2.02

Table 3. Feed offered, refused (orts), and calculated percent (%) consumption by period.

	II			III			IV		
	lbs								
Date	Offered	Orts	(%)	Offered	Orts	(%)	Offered	Orts	(%)
11-18 to 12-16	560	7	98.7	560	7	98.7	560	0	100.0
12-17 to 1-13	560	9	98.4	560	0	100.0	560	0	100.0
1-14 to 2-10	560	18	96.8	560	86	84.6	560	71	87.3
2-11 to 3-10	560	104	81.4	560	280	50.0	560	62	88.9
3-11 to 4-7	560	7	98.7	560	18	96.8	560	92	83.6
4-8 to 5-7	600	30	95.0	600	0	100.0	600	42	93.0

Table 4. Forage availability during winter grazing period.

DATE	I CONTROL (heifers)	II MONENSIN (heifers)	III MONENSIN (steers)	IV CONTROL (steers)	V MONENSIN (steers)	VI CONTROL (steers)	X
	GROUP						
	lbs/acre						
11-17-80	1872	1564	1564	2282	2410	2308	2000
12-17-80	2052	2820	1974	2821	2385	1795	2308
1-22-81	2411	2821	2641	2180	2128	2718	2483
2-20-81	1385	1051	2539	1513	2359	1692	1757
3-16-81	2231	2205	4154	2154	2744	4513	3000
4-14-81	2539	3103	3025	1846	3179	2308	2667
AVG	2082	2261	2650	2133	2534	2556	

Table 5. Estimated forage:gain ratios of treatment groups.

GROUP	ADG (11-8 to 5-7)	GAIN/ACRE (lbs)	FORAGE DISAPPEARANCE (lbs/acre)	FORAGE:GAIN RATIO (lbs:lbs)
I Control	1.35	416	5279	12.7:1
II Monensin	1.99	615	6770	11.0:1
III Monensin	2.35	589	6282	10.7:1
IV Control	1.90	525	6692	12.8:1
V Monensin	1.98	728	7744	10.6:1
VI Control	1.93	609	7127	11.7:1

Table 6. Percent protein (Pro) and *in vitro* digestible dry matter (DDM) of winter pasture.

Date	GROUP I CONTROL (heifers)		II MONENSIN (heifers)		III MONENSIN (steers)		IV CONTROL (steers)		V MONENSIN (steers)		VI CONTROL (steers)	
	Pro	DDM	Pro	DDM	Pro	DDM	Pro	DDM	Pro	DDM	Pro	DDM
11-17-80	25.8	85.2	29.4	85.7	21.9	88.5	24.8	88.1	22.5	84.1	25.9	83.0
12-17-80	20.4	87.9	19.7	85.5	17.1	88.9	21.3	83.5	22.7	86.0	22.9	86.2
1-22-81	18.3	88.8	21.9	88.8	17.1	85.3	19.0	82.1	21.9	88.9	21.9	84.6
2-20-81	22.5	82.3	23.5	81.7	21.2	80.5	23.7	80.6	23.8	81.7	26.5	85.4
3-16-81	17.2	81.0	20.4	82.4	16.9	82.7	21.0	84.3	17.5	77.1	19.3	79.5
4-14-81	16.3	73.0	18.1	71.9	13.6	64.0	19.1	73.8	17.8	77.3	16.0	67.7

Influence of Stocking Rate, Creep Feed, and Electrical Stimulation on Carcasses of Calves Slaughtered at Weaning

F. M. Rouquette, Jr. R. R. Riley and J. W. Savell*

SUMMARY

Forty fall-born calves were divided into four pre-weaning treatments and slaughtered when weaned at an average age of 262 days. Pre-weaning treatments consisted of grazing a bermudagrass-arrowleaf clover-ryegrass sward at three stocking rates with both a creep fed and non-creep fed group on the light stocked paddocks. Average stocking rates during the 133-day trial were .81, .81, 1.39, and 2.71 cow-calf units per acre for light stocked + ad libitum creep feed (LSC); light stocked pasture only (LSP); medium stocked (MS); and heavy stocked paddocks (HS), respectively. Weaning weights and corresponding average daily calf gains, respectively, were 789 and 2.86 (LSC); 734 and 2.55 (LSP); 650 and 2.31 (MS); and 597 lbs and 1.70 lbs/hd/da (HS). Light stocked creep fed calves had heavier carcasses, but did not differ from LSP calves with respect to USDA yield grade, longissimus muscle area, fat thickness, % KPH, or fat color. Fat color did not differ among groups, but rated relatively high (4.5 to 4.8) on a 5-point scale. Steaks from U.S. Good-Choice steers (Not-ES) were slightly more palatable than those from certain Not-ES calf sides but no definite trends with respect to pre-weaning treatments were evident. There were no palatability differences between steaks from Not-ES U.S. Good-Choice steers and steaks from ES calf sides. Retail steaks from ES sides had brighter (P<.05) muscle color on all days of display and were more desirable (P<.05) on day 0 of display than steaks from Not-ES sides. Neither stocking rate nor sex of calf substantially altered retail appearance of steaks. In addition, sex of calf did not drastically affect any of the physical or sensory traits evaluated.

Introduction

The rapid acceleration in costs of beef production has caused producers to seek alternative marketing procedures for maximizing net returns for their cattle. One of these alternatives has been that of maintaining continuous ownership of cattle from birth to slaughter, thereby eliminating the separate, traditional stocker and feeder ownership phases. The commercial operator who maintains ownership must produce an animal whose carcass not only meets the quality control criteria of lean, yet palatable, beef, but also that meets the profit demands of the total operation. One such approach to attaining this type lean beef is that of producing a suitable carcass weight and grade as rapidly as possible. By providing animals of superior genetic potential with that of nutritious

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forages, heavyweight weanling calves may be produced and slaughtered directly at weaning. The objective of this study was to evaluate the influence of stocking rate, creep feed, and electrical stimulation on carcass characteristics of heifers and steers slaughtered at weaning.

Procedure

Forty fall-born half-Simmental calves and their F-1 Brahman x Hereford dams grazed bermudagrass-arrowleaf clover-ryegrass paddocks from February 26 to July 8. Three stocking rates, light (LSP), medium (MS), and heavy (HS), were maintained throughout the pre-weaning grazing period. A fourth treatment group was maintained on light stocked paddocks and these calves received a 12% protein, commercially prepared creep feed (LSC). In the three non-fed groups, two steers, two heifers and their dams were assigned to each of two replicate paddocks. Four steers, four heifers and their dams were assigned to each of two replicate paddocks of the LSC groups. All animals were weighed at the start of the trial and at 28-day intervals throughout the 133-day grazing period. Paddock size ranged from 2.5 to 5.3 acres. A put-and-take, variable stocking rate technique was used to maintain the desired forage availability for each stocking rate. The HS paddocks had sufficient grazing pressure to maintain forage height at 2 in. or less. This grazing pressure allowed for less than 175 lbs/ac of dry forage available to the animals. Both the LSC and LSP paddocks had more than 2000 lbs/ac of available forage at all times. Forage availability on the MS paddocks averaged 785 lbs/ac during the trial. Forage availability and production were measured at 28-day intervals using the cage-difference technique. Forage inside and outside the cages was hand-clipped to a 0-in. height on all paddocks.

On July 8, all calves were weighed off pasture, transported 125 miles via trailer to a commercial slaughtering facility, and allowed to rest overnight. The calves were slaughtered at approximately 24 hours post-weaning, and each carcass split longitudinally into sides. The left sides were electrically stimulated (ES) using a Britton 300® unit, with 12 impulses of 550 volts (AC), 2 amps for a 3-second duration with a 2-second interval between impulses. At 96-hours postmortem, each side was ribbed and the following yield grades factors and quality characteristics were evaluated by Texas Agricultural Experiment Station personnel: carcass weight; lean, skeletal, and overall maturity; carcass conformation; degree of marbling; USDA quality grade (1972); lean color; firmness, and texture; subcutaneous fat color (1 = extremely yellowish orange; 5 = white); fat thickness over the longissimus muscle at the 12-13th rib interface; estimated percentage of kidney, pelvic, and heart (KPH) fat; longissimus muscle area; USDA yield grade; and amount of marbling.

On the fourth day postmortem, the wholesale rib was removed from both sides of each calf carcass. The longissimus muscle was removed from the 10th-12th rib area of each side on the fifth day postmortem and three steaks (each 1.0 in. thick) were cut beginning at the 12th rib end and proceeding cranially for shear force determinations, sensory panel evaluations, and for retail display. Ten wholesale ribs from U.S.

Good-Choice beef carcasses that were not electrically stimulated (Not-ES) were selected after five days aging, and one steak was cut from the 12th rib end of each for sensory panel comparisons. Steaks for sensory panel and shear force determinations were individually wrapped with polyethylene-coated paper, frozen, and stored at 10 F. The steaks prepared for retail display evaluations were placed in plastic foam trays (one steak per rib per tray) and overwrapped with polyvinyl chloride film. After packaging, all steaks were displayed (36 F, 1625 lux of incandescent light) for 3 days. At 24-hr intervals, a nine-member trained panel visually evaluated the steaks for muscle color, surface discoloration, and overall appearance.

For palatability evaluations, each steak was removed from the freezer, thawed (36 F), and broiled to an internal temperature of 160 F by use of a Farberware Open-Hearth Broiler. Steaks designated for shear force were cooled to room temperature (74 F), cores (.5 in. diameter) removed, and shear force determinations made with a Warner-Bratzler shear force machine. An eight-member trained sensory panel evaluated steaks for juiciness, muscle fiber tenderness, overall tenderness, flavor, panel-detectable connective tissue and overall palatability.

Results

Grazing pressures used to maintain desired levels of forage availability resulted in stocking rates of .81 cow-calf units per acre for the light stocked plus creep feed (LSC) and light stocked pasture only (LSP) groups, and increased to 1.39 and 2.71 cow-calf units per acre for medium (MS) and heavy stocked (HS) paddocks, respectively (Table 1). Weaning weights were not only affected by stocking rate, but were also enhanced by creep feeding and depressed by the unseasonably hot, dry weather during June and early July. Calves assigned to the creep-fed group gained slightly more than 1.7 lbs/hd/da during the last 28-day period and only consumed an average of 1.98 lbs/da creep feed during the entire trial. Gain per acre from the HS group was more than double that of either the LSC or LSP groups.

Mean values for USDA yield grade factors and subcutaneous fat color for calf carcasses from the four pre-weaning grazing treatments are presented in Table 2. Except for carcass weight, sides of calves from LSC and LSP did not differ in physical traits. As stocking rate increased, carcass weights were lighter with smaller longissimus muscle area, less adjusted fat thickness, and kidney, pelvic and heart fat, and better yield grade (lower numerical value). Carcasses from the HS calves were significantly different ($P<.05$) in these physical traits than carcasses from LSC calves.

Non-electrically stimulated (Not-ES) sides from calves on HS paddocks had higher ($P<.05$) lean maturity scores, and lower scores for marbling, USDA conformation, USDA quality grades, lean texture, and lean firmness scores than did Not-ES sides of LSC calves (Table 3). Not-ES sides from calves in LSC and LSP groups did not differ, and Not-ES sides from calves in LSP and MS groups did not differ in quality-indicating characteristics. Although the carcasses in this study were not ribbed until 96 hours postmortem, ES improved quality characteristics in 6 of 7 comparisons ($P<.05$) within the LSC group; 3 of 7 ($P<.05$) within the LSP group; 3 of 7 ($P<.05$) within the MS group; and 5 of 7 ($P<.05$) within the HS group.

Sensory characteristics and cooking losses of rib steaks from Not-ES and ES calf sides, and U.S. Good-Choice beef carcasses (Not-ES) are shown in Table 4. Steaks from Not-ES U.S. Good-Choice carcasses were generally superior to those steaks from Not-ES calves with respect to muscle fiber tenderness, overall tenderness, and overall palatability. Significant $P<.05$) differences between steaks from Not-ES calf sides from the stocking rate groups were found for juiciness, connective tissue amount, overall palatability and shear force values, but these differences did not suggest any clearly defined trends.

It has been reported that except for juiciness, grain-fed steers generally were more palatable than forage-fed calves at weaning, and it has been well-documented that grain-fed beef has superior physical and sensory traits than does forage-fed beef. Data from this study, however, (Table 4) suggests that the ES of carcasses from LSC, LSP, MS, and HS results in steaks that do not differ in palatability from Not-ES U.S. Good-Choice beef steaks. When comparing steaks from ES sides to their paired sides within each stocking rate, no significant differences were found within LSP, MS, and HS groups. However, within the LSC group, steaks from ES sides had higher ($P<.05$) sensory panel ratings for muscle fiber tenderness and overall tenderness.

Past research has indicated that forage-fed beef steaks deteriorate rapidly under retail sales conditions. Table 5 reports comparisons of retail appearance for boneless rib steaks from Not-ES and ES calf sides stratified according to stocking rate. At the beginning of the retail case period, steaks from Not-ES sides from LSC and LSP had brighter ($P<.05$) muscle color than steaks from Not-ES HS sides. However, no significant differences ($P>.05$) were observed between retail cuts from Not-ES sides for muscle color, surface discoloration and overall appearance after day 0. Unlike results for steaks from Not-ES sides, ES resulted in muscle color being increasingly less desirable with increased stocking rate and remained so for the duration of the display period. Among the stocking rate groups, ES sides were more desirable than Not-ES sides in the LSC and LSP groups.

With only minor exceptions, neither physical, sensory, nor retail carcass characteristics substantially differed ($P>.05$) with sex of calf. Thus, for calf carcasses there is no basis upon which price differentials for differences due to sex class can be justified. Heifer calves should be as valuable as steers if slaughtered at weaning; and this, alone, would result in a significant increase in positive cash flow at the producer level if the lack of difference was recognized by packers.

From these data, the use of weanling calf meat should not receive negative criticism because of age or size of carcass. The use of creep feed did not produce any significant advantages over non-fed, pasture-only calves with respect to physical or sensory carcass traits. There was evidence, however, that electrical stimulation of carcasses from creep-fed calves had a more positive effect on carcass characteristics than on those carcasses from non-fed calves. Therefore, unless the weight-gain advantage or USDA quality grade improvement is sufficient to offset the cost of the supplemental feed, it may be difficult to justify the use of creep feed in preparing calves for slaughter at weaning.

Table 1. Weanling calf performance from various stocking rate paddocks

Item	Light Stocked Creep Fed	Light Stocked Pasture Only	Medium Stocked	Heavy Stocked
Stocking rate, AU/ac	.81	.81	1.39	2.71
Age at weaning, days	265	265	258	259
Avg. weaning wt., lbs	789[a]	734[a]	650[b]	597[b]
Steer weaning wt., lbs	821[a]	763[ab]	692[bc]	622[c]
Heifer weaning wt., lbs	757[a]	698[b]	610[c]	572[c]
Calf ADG, lbs/da	2.86[a]	2.55[b]	2.31[b]	1.70[c]
Steer ADG, lbs/da	3.09[a]	2.73[ab]	2.53[b]	1.68[c]
Heifer ADG, lbs/da	2.63[a]	2.36[b]	2.08[b]	1.71[c]
Gain/ac, lbs/ac	308[a]	275[a]	427[b]	613[c]

[abc]Means within the same row with a common superscript are not different (P>.01).

Table 2. Mean values for USDA yield grade factors and subcutaneous fat color for calf carcasses stratified according to stocking rate.

Trait	Light Stocked		Medium Stocked	Heavy Stocked
	Creep Fed	Pasture Only		
Carcass weight, lbs	439^{a}	399^{b}	346^{c}	324^{c}
USDA yield grade[d]	1.9^{b}	1.6^{ab}	1.4^{a}	1.3^{a}
Longissimus muscle area, $in.^2$	9.9^{a}	9.8^{a}	9.5^{ab}	8.9^{b}
Adjusted fat thickness 12th rib, in.	$.18^{a}$	$.12^{ab}$	$.09^{b}$	$.05^{b}$
Kidney, pelvic and heart fat, %	2.4^{b}	2.1^{b}	1.8^{ab}	1.3^{c}
Fat color[e]	4.5^{a}	4.5^{a}	4.8^{a}	4.8^{a}

[abc]Means in the same row with a common superscript letter are not different (P>.05).

[d]All calves were yield graded according to USDA (1975) grade standards for carcass beef.

[e]5 = nearly white; 1 = yellowish orange.

Table 3. Mean values for certain quality-indicating characteristics from untreated (Not-ES) and electrically stimulated (ES) calf sides stratified according to stocking rate.

Trait	Not-ES				ES			
	Light Stocked				Light Stocked			
	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked
Lean maturity[d]	Ca^{50a}	Ca^{40a}	Ca^{48a}	Ca^{78b}	Ca^{39a}	Ca^{38a}	Ca^{29a}	Ca^{60b}
Skeletal maturity[d]	Ca^{66a}	Ca^{70a}	Ca^{63a}	Ca^{59a}	Ca^{66a}	Ca^{70a}	Ca^{63a}	Ca^{59a}
Overall maturity[d]	Ca^{59a}	Ca^{56a}	Ca^{55a}	Ca^{68a}	Ca^{53a}	Ca^{50a}	Ca^{51}	Ca^{59a}
Marbling score[e]	PD^{76a}	PD^{45ab}	PD^{35b}	PD^{10b}	PD^{66a}	PD^{36ab}	PD^{46ab}	PD^{16b}
Carcass conformation score[e]	Ch^{85a}	Ch^{53ab}	Ch^{28b}	Ch^{23b}	Ch^{85a}	Ch^{53ab}	Ch^{28b}	Ch^{23b}
USDA quality grade[e]	G^{99a}	G^{99a}	G^{88a}	G^{38b}	CH^{09a}	Ch^{11a}	Ch^{05a}	G^{69b}
Lean color[f]	7.3^{ab}	7.9^{a}	7.1^{ab}	6.4^{b}	7.6^{a}	8.0^{a}	7.4^{ab}	6.8^{b}
Lean firmness[g]	7.1^{a}	7.3^{a}	6.8^{a}	5.1^{b}	7.4^{a}	7.6^{a}	7.3^{a}	6.3^{b}
Lean texture[h]	6.4^{a}	7.1^{a}	6.4^{a}	4.6^{b}	7.3^{b}	8.0^{a}	7.2^{b}	6.1^{c}

[abc]Means in the same row within the same treatment (ES or Not-ES) with a common letter are not different (P>.05).

[d]Calves slaughtered at chronological ages of 3 to 9 months generally produce carcasses with physiological maturity indicators described as Ca^{00} to Ca^{100}, respectively in USDA (1972) grade standards for calf carcasses.

[e]Based on descriptions included in USDA (1972) grade standards of calf carcasses.

[f]8 = light grayish-red; 1 = very dark red or purple.

[g]8 = very firm; 1 = very soft.

[h]8 = very fine; 1 = very coarse.

*Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr et al., 1979). P>.05 was reported as nonsignificant (NS).

Table 4. Mean values for palatability characteristics and cooking losses of rib steaks from untreated (Not-ES) and electrically stimulated (ES) calf sides and U.S. Good-Choice beef carcasses (Not-ES)

	Not-ES					ES				
	Light Stocked					Light Stocked				
	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	U.S. Good-Choice	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	U.S. Good-Choice
Juiciness	5.5^{b}	6.0^{ab}	5.7^{ab}	6.1^{a}	5.8^{ab}	5.4^{b}	5.8^{ab}	5.8^{ab}	6.1^{a}	5.8^{ab}
Muscle fiber tenderness[d]	4.9^{b}	4.2^{b}	4.3^{b}	5.4^{ab}	6.2^{a}	5.8^{a}	5.4^{a}	5.8^{a}	4.9^{a}	6.2^{a}
Connective tissue amount[e]	7.5^{a}	7.4^{a}	6.8^{b}	7.5^{a}	7.4^{a}	7.5^{a}	7.3^{a}	7.3^{a}	7.3^{a}	7.4^{a}
Overall tenderness	4.9^{a}	4.3^{b}	4.0^{b}	5.4^{ab}	6.2^{a}	5.9^{a}	5.5^{a}	5.6^{a}	4.9^{a}	6.2^{a}
Flavor[d]	5.6^{a}	5.5^{a}	5.5^{a}	5.7^{a}	5.4^{a}	5.4^{a}	5.6^{a}	5.2^{a}	5.7^{a}	5.4^{a}
Overall palatability[d]	4.7^{abc}	4.1^{bc}	3.9^{c}	5.1^{ab}	5.3^{a}	5.1^{a}	5.1^{a}	5.2^{a}	4.7^{a}	5.3^{a}
Warner-Bratzler shear force, lbs	11.4^{a}	14.5^{b}	11.2^{a}	11.7^{ab}	-.-	9.9^{a}	10.6^{a}	11.7^{a}	12.3^{a}	-.-
Cooking loss, %	22.8^{a}	21.7^{a}	21.6^{a}	19.8^{a}	23.4^{a}	22.6^{a}	21.5^{a}	23.7^{a}	21.3^{a}	23.4^{a}

[abc]Means in the same row within the same treatment (ES or Not-ES) with a common superscript letter are not different (P>.05).

[d]Means based on eight-point descriptive scales (8 = extremely juicy, tender or desirable; 1 = extremely dry, tough or undesirable).

[e]Means based on an eight point rating scale (8 = none; 1 = abundant).

*Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr _et al._, 1979). P>.05 was reported as nonsignificant (NS).

Table 5. Mean values for muscle color, surface discoloration, and overall appearance for boneless rib steaks from untreated (Not-ES) and electrically stimulated (ES) calf sides stratified according to stocking rate.

Trait	Day	Not-ES				ES			
		Light Stocked				Light Stocked			
		Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked	Creep Fed	Pasture Only	Medium Stocked	Heavy Stocked
Muscle color^{d}	0	6.1^{a}	6.2^{a}	5.9^{ab}	5.5^{b}	6.6^{a}	6.5^{ab}	5.9^{bc}	5.6^{c}
	1	5.6^{a}	5.3^{a}	5.1^{a}	5.2^{a}	5.9^{a}	5.8^{ab}	5.5^{ab}	5.2^{b}
	2	5.5^{a}	5.3^{a}	5.1^{a}	5.2^{a}	5.9^{a}	5.7^{ab}	5.3^{b}	5.1^{b}
	3	5.2^{a}	5.3^{a}	4.9^{a}	4.7^{a}	5.7^{a}	5.5^{ab}	5.1^{bc}	4.6^{c}
Surface discoloration^{e}	0	6.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}	6.9^{a}
	1	6.0^{a}	5.7^{a}	5.6^{a}	6.2^{a}	5.9^{a}	6.0^{a}	5.6^{a}	5.6^{a}
	2	5.5^{a}	5.5^{a}	5.3^{a}	5.6^{a}	5.7^{a}	5.7^{a}	5.3^{a}	5.4^{a}
	3	5.0^{a}	4.9^{a}	4.5^{a}	5.3^{a}	5.0^{a}	5.2^{a}	4.7^{a}	4.6^{a}
Overall appearance	0	6.4^{a}	6.5^{a}	6.4^{a}	6.0^{a}	6.8^{a}	6.9^{a}	6.3^{ab}	6.0^{b}
	1	5.5^{a}	5.0^{a}	4.9^{a}	5.4^{a}	5.5^{a}	5.5^{a}	5.1^{a}	5.0^{a}
	2	5.2^{a}	4.8^{a}	4.8^{a}	5.1^{a}	5.4^{a}	5.4^{a}	4.8^{a}	4.8^{a}
	3	4.6^{a}	4.4^{a}	4.0^{a}	4.6^{a}	4.8^{a}	4.9^{a}	4.3^{a}	3.9^{a}

[abc] Means in the same row within the same treatment (ES or Not-ES) with a common superscript letter are not not different (P>.05).

[d] 9 = very light cherry red; 1 = very dark purple.

[e] 7 = no surface discoloration; 1 = total surface discoloration.

[f] 8 = extremely desirable; 1 = extremely undesirable.

[*] Means within a stocking rate group are significantly different due to electrical stimulation (P<.05) as determined by paired-t distribution (Barr *et al.*, 1979). P>.05 was reported as nonsignificant (NS).

Rotational vs. Continuous Grazing Bermudagrass Types

B. E. Conrad[1]

SUMMARY

There were no differences in average daily gains among animals grazing rotationally or continuously over a two-year period. The differences in animal performance due to bermudagrass type were at the two lighter stocking rates, where forage, on offer, far exceeded animal intake.

Introduction

Under grazing conditions the theoretical choices of forage utilization systems open to the producer may be many, whereas the practical uses may at best be limited to only a few, and the profitable uses may be further limited to only a couple of choices. The method of choice for the producer must be based on a number of objectives of which animal performance may be only one factor. The literature, popular beliefs and old wives tales may or may not be based on sound reasoning, but more often than not, with warm-season perennial grasses, there is no basis for expecting differences in animal performance between rotational and continuous grazing. The amount of forage on offer becomes the driving force in animal performance within certain boundaries.

Procedure

Pastures of Coastal and Callie bermudagrasses were established on the Texas A&M University farm in the Brazos River bottom near College Station. Santa Gertrudis steers with an average initial weight of 445 pounds in 1980 and 625 pounds in 1981 were used as tester animals. Pasture sizes varied from 8712 square feet per animal to 16,212 square feet per animal in increments of 2500 square feet. All pastures were well established and were 4 to 6 years old. Animals on the rotational pastures were on a 7 days on and 21 days off frequency. The grazing season was from May 8, 1980 to October 18, 1980 for a total of 161 days and from April 23, 1981 to October 7, 1981 for a total of 167 days. The pastures were fertilized with 100 pounds of nitrogen per acre in March and an additional 100 pounds in July.

Discussion

Average daily gains for the various stocking rates and hybrids by grazing systems are shown in Table 1. There were no differences between continuous and rotationally grazing averaged across grasses and stocking rates. Steers grazing Callie bermudagrass had an average daily gain approximately 12% higher than those grazing Coastal. At the heavier stocking rates the differences between the two hybrids were small, and there were no consistent trends between hybrids by grazing method. The greatest differences between the

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two hybrids were at the lighter stocking rates where animal selectivity was maximal.

Average daily gains on Callie have decreased slightly each year. Callie has persisted in the pastures from the standpoint of winter damage but has shown increasingly more leaf disease damage during the summer.

Table 1. Average daily gains of animals on two bermudagrass types grazed in rotational or continuous systems, 2 yr. average.

	Rotational	Continuous	Avg.
5 hd/ac.			
Callie	.35	.61	.48
Coastal	.42	.39	.41
Avg.	.39	.50	.45
3.85 hd/ac.			
Callie	.61	.59	.60
Coastal	.72	.65	.69
Avg.	.66	.62	.65
3.22 hd/ac.			
Callie	1.00	.94	.97
Coastal	.65	.83	.74
Avg.	.83	.89	.86
2.70 hd/ac.			
Callie	.93	1.11	1.02
Coastal	.87	.92	.90
Avg.	.90	1.01	.96

Animal Performance on Tifton-44, Coastal, and Brazos Bermudagrass

B. E. Conrad*

SUMMARY

Animal performance of steers grazing Brazos bermudagrass has been approximately 20% greater than those grazing Coastal bermudagrass. During the 1981 grazing season there were no differences in animal gains of steers grazing Tifton-44 and Coastal bermudagrass. Average daily gain and gains per acre were greater on Brazos than on the other two cultivars.

Introduction

Evaluation of potentially new bermudagrasses has clearly demonstrated that there are a number of the new hybrids which possess greater quality characteristics than Coastal with equal or near equal quantity capabilities. Many of the higher quality hybrids have been of the stoloniferous growth habit. These types in general have not been as cold hardy as Coastal and many are quite susceptible to leaf diseases. A number of potentially new cultivars which looked good in small plot studies have been eliminated when subjected to grazing for a number of reasons. The need for animal utilization data before a new cultivar is released becomes apparent.

Materials

Pastures of Coastal, Tifton-44 and Brazos bermudagrass were established on the Texas A&M University Farm in the Brazos River bottom near College Station, Texas. The pastures were fertilized at the rate of 100 pounds of nitrogen per acre in February with an additional 100 pounds in July. Each cultivar was grazed continuously at four stocking rates for 167 days.

Discussion

Average stocking rates for the three cultivars are shown in Table 1. Tifton-44 and Coastal were grazed at set stocking rates whereas Brazos was grazed at a variable rate. The average stocking rate for Brazos was slightly higher than for Coastal and Tifton-44. This increase was due to the allocation of animals based on forage on offer. At six animals per acre, dry matter available to the animal was generally deficient. At all other levels, dry matter on offer was sufficient to satisfy intake requirements but the amounts had various degrees of influence on grazing selectivity and estimated nutrient intake by the animals.

Tifton-44 was the first to green up in the spring followed closely by Brazos then Coastal. During the 1981 growing season and

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particularly in the early spring, the growth rate of all the bermudagrasses was such that by the beginning of the grazing season there were no obvious differences.

The influence of selectivity on average daily gains is clearly shown in greater animal performance for all cultivars. Animals on Tifton-44 and Coastal had almost identical average daily gains. The overall average daily gain for the steers on Brazos was approximately 20% greater than those on Coastal and Tifton-44. This trend has been repeatable over the past four years with Coastal and Brazos, but this is the first full season of grazing on Tifton-44.

Table 1. Animal performance on Tifton-44, Coastal and Brazos bermudagrass.

		Heavy	Medium Heavy	Medium Light	Light
Tifton-44	Hd/Ac	5.0	4.3	2.7	2.4
	Avg.Da.Ga.	0.42	0.56	0.86	0.98
	Ga/Ac	354	406	392	397
Coastal	Hd/Ac	4.84	3.85	3.22	2.7
	Avg.Da.Ga.	0.11	0.60	0.90	1.02
	Ga/Ac	89	385	484	460
Brazos	Hd/Ac	6.0	4.0	3.3	3.0
	Avg.Da.Ga.	0.34	0.66	1.09	1.31
	Ga/Ac	342	443	604	660

Factors Related to Diet Selection by Mature Crossbred Cows

Hagen Lippke*

SUMMARY

Mature crossbred cows, when offered ryegrass silage and sorghum silage ad libitum, selected diets that averaged 73% digestible organic matter (DOM) and 9.5% indigestible neutral detergent fiber (INDF). Dry matter intake averaged 2.63% of body weight (BW), which is 78% higher than the average voluntary intake when only sorghum silage and a small amount of cottonseed meal were offered. These values indicate selection of a higher quality diet by cows than yearling cattle selected from similar forages in previous experiments. Intake per unit BW was also higher for cows than previously observed for yearlings.

Body condition, which ranged from 4 to 7 on a 18-point scale, had a significant negative influence on dry matter intake.

Introduction

Numerical data that describe the selection behavior of grazing cattle are needed for useful modeling of beef cattle systems. Results from several experiments (1) and (2) have shown that yearling cattle select forage diets with about 67% DOM and 12% INDF. Furthermore, diets containing either more than 15% or less than 8% INDF were associated with reduced intake of dry matter and DOM.

This experiment was conducted to obtain comparable values for mature beef cows.

Procedure

Five mature, lactating, Hereford X Brahman cows and four dry cows of the same age and breeding were maintained and fed individually in 16' X 6' concrete stalls. The Simmental-sired calves of the lactating cows were maintained in stalls adjacent to their respective dams and allowed to nurse twice daily.

In Trial 1, all animals were offered sorghum silage ad libitum. Lactating cows were also given .9 lb and dry cows were given .2 lb of cottonseed meal daily. After a 5-day preliminary period, intake was measured for 7 days.

In Trial 2, ryegrass silage and sorghum silage were offered in separate containers at levels shown in Table 1. Intake was measured for 8 days after a 6-day adjustment period.

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Three lactating cows, three dry cows and two calves were used in Trial 3 to determine digestibility of the two silages. To eliminate orts, feed offered was reduced to 90% of the voluntary intake determined in Trial 2.

All cattle were weighed following a 16 hour fast at the beginning and end of the experiment; height of the cows was measured at the hook bone.

Results and Discussion

Average daily weight gains are shown in Table 2 according to treatments in Trial 2. Weighing conditions were not the same for the starting and ending weights for cattle that received ryegrass silage, and weight gains are consequently biased downward for these animals. It is clear, however, that when allowed, cows selected a diet that provided rapid weight gains for themselves and/or their calves.

The greater gut capacity of mature cattle, relative to BW, was clearly demonstrated in Trial 1 wherein INDF intake by cows (Table 3) was more than 20% greater than had previously been observed for similarly-fed yearling steers (3). Since INDF is considered to be the intake-limiting component of most forages, its manipulation, from the standpoint of either the plant or the animal, is of prime importance.

Composition and component digestibilities of the two silages, shown in Table 4, were sufficiently different to allow full expression of selectivity of diet quality in Trial 2. Neither dry matter intakes nor the digestibilities of the diets selected were significantly different for dry cows and lactating cows. Body condition, however, which was statistically expressed as weight/height, had a significant negative effect on intake. On a subjective 10-point scale, body condition ranged from 4 to 7 among both dry and lactating cows.

Surprisingly, the quality of the diets selected by all cows on treatment 4 (Table 3) was notably higher than the diets selected by yearling cattle in previous experiments (3). Dry matter intake also was much higher for cows on treatment 4. However, the average and range of INDF intakes were very similar to the earlier findings with yearling steers. This gives further support to the hypothesis that cattle attempt to select diets that will simultaneously meet their physiological drives for energy and INDF.

Feed intake data from the calves is not valid due to the occurence of three cases of infectious scours during Trial 2.

Table 1. Treatments for Trial 2.

Trt	Amounts Offered: Ryegrass silage	Amounts Offered: Sorghum silage	Number: Dry cows	Number: Lac. cows	Number: Calves
1	none	ad lib.	1	0	0
2	.3 X main.[1]	ad lib.	1	0	0
3	.6 X main.[2]	ad lib.	0	1	0
4	ad lib.	ad lib.	2	4	4
5	ad lib.	none	0	0	1

[1] An amt. anticipated to supply .3 X maintenance energy requirements.
[2] An amt. anticipated to supply .6 X maintenance energy requirements.

Table 2. Average daily BW gains.

Trt	Dry cows (lb)	Lac. cows (lb)	Calves (lb)
1	.7	-	-
2	1.3	-	-
3	-	.4	-
4	2.2	.9	2.3
5	-	-	2.5

Table 3. Daily intakes by cows in Trials 1 and 2.

Item	Dry Matter: Ryegrass (% BW)	Dry Matter: Sorghum (% BW)	DOM (% BW)	INDF (% BW)
Trial 1	-	1.49	.72	.41
Trial 2				
Trt 1	-	1.44	.70	.40
Trt 2	.32	1.46	.94	.42
Trt 3	.68	1.24	1.07	.38
Trt 4	2.12	.51	1.73	.25

Table 4. Composition and component digestibilities of ryegrass and sorghum silages.

	Ryegrass		Sorghum	
Component	Amount	Digest.	Amount	Digest.
	(%)	(%)	(%)	(%)
Organic matter	88.1	79.1	92.7	52.3
NDF[1]	44.5	76.9	71.6	50.9
INDF[1]	5.9	0	29.6	0

[1] Organic matter basis

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Cash Wheat Crop in a Cattle System for East Texas

L. R. Nelson, F. M. Rouquette, Jr. and R. D. Randel*

SUMMARY

Partial results on the potential of wheat for forage as well as grain for East Texas are given in this report. A 2-year study involving wheat for forage and grain has shown good potential as a profitable part of a system for East Texas. About 1-1/2 tons dry matter of high quality forage can be produced by wheat from mid-November until mid-February. This has resulted in average daily gains from 0.5 to over 2 lbs per day depending on weather conditions and the type of animal being grazed. In 1981, 37 bu/wheat/acre was harvested off the wheat in addition to the forage.

Objective

To determine the feasibility and profitability of a dual purpose wheat (grazing-grain) and ryegrass system. Further, to determine the seasonal forage supply from November through May. Lastly, to determine the grain yield potential of wheat which has been grazed through February 15th.

Methods

This study was initiated in the fall of 1980 and has a 2-year duration. In regard to wheat, there were four harvest treatments and five wheat varieties. The treatments were as follows:

1. Wheat grazed from November to mid-February and then allowed to produce grain.
2. Wheat clipped from November to mid-February and then allowed to produce grain.
3. Wheat clipped throughout growing season.
4. Wheat not clipped or grazed and harvested for grain only.

In addition, a 34 acre field was planted to wheat for grazing, and cattle weights were recorded at the beginning and in monthly intervals until mid-February when the cattle were removed and placed on a ryegrass pasture. The total amount of grain was measured to determine mean yields per acre.

The wheat varieties planted in each of the four treatments in 1980 were Coker 68-15, McNair 10-03, Tx-73-93, Tx 72-9 and Arthur 71. In 1981, two of these lines (Arthur 71 and Tx-72-9) were dropped form the study and

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were replaced by TAM-106 and Northrup King 812 in an effort to increase grain yields.

All wheat treatments were planted into a prepared seed bed. A preplant fertilizer application rate of 60 lbs/acre of N P_2O_5 and K_2O was applied each year. Prior to the first year of the study, ag lime at a rate of 1½ ton/acre was applied. Wheat was topdressed with 100 lbs/N in October to all clipped and grazed plots, but not to the grain treatment. A 60 lb/N/A rate was applied to all wheat treatments in February.

Planting dates in 1980 were in late September, while in 1981 planting dates were in early September. Forage yields were taken with a flail-type harvester on the clipped plots. On the grazed plots, wire cages were employed to protect the forage and an estimate of yield was obtained by hand clipping an area within the caged area on a monthly basis. Cages were moved after each harvest. Cattle were weighed when they went on the study and approximately every 30 days.

Results

<u>Forage yields</u>: The forage yields harvested from the wheat plots during 1980-81 were quite low (Table 1). This was the result of very dry growing conditions during the entire growing season. In addition, there was some damage caused by lessor corn stalk borer (during the fall) and greenbugs (in the spring). In making comparison between varieties, there were three good forage yielding lines (Coker 68-15, McNair 10-03 and Tx-73-93) and two low yielding lines (Arthur 71 and Tx-72-9).

On the study clipped until February 16, very low yields were harvested. These yields would normally be much higher than this. Forage yields on the plots grazed until February 13 are higher compared to the clipped (not grazed) plots, however, this is thought to be the result of method of harvest rather than due to grazing. The results for 1981-82 (Table 2) indicate much higher forage yields resulted for all varieties. During both years, more forage was produced on the grazed plots than on the clipped only plots. This indicates the scalping effect of the clipping treatments retards regrowth. The grazing pressure in this study left more vegetation which could promote more regrowth. Total season forage harvests or grain yields were not available for 1982 at the time this report was written.

<u>Cattle gains</u>: In the 1980-81 season, 37 head (average weight - 371 lbs) were turned onto the wheat on November 21. Three weigh periods of about 30 days each were taken and the calves were removed after 89 days. The average daily gain (ADG) for the 1st, 2nd and 3rd weigh periods were 0.29, 1.08 and 1.65 lbs, respectively, for a mean ADG of 1.06 for the 89 days. The low ADG for the 1st period is the result of the calves becoming adjusted to the pasture situation. The 2nd and 3rd weigh period gains are more respectable and indicate a fairly good gain for January and February. The calves were made up of Angus and Brahman breeds for the most part, and were not cross-bred types. The actual total gain of 3,803 lbs of beef on the 34 acres resulted in a gain of about 112 lbs of beef per acre.

In 1981-82, tester animals were made up of 10 Brahman heifers, 15 Brangus heifers and 12 crossbred steers. Cattle were turned on the wheat on November 3rd with ample forage being available. The ADG for the three groups of cattle were as follows:

	(Nov 13-Dec 1)	(Dec 1-Jan 5)	(Jan 5-Jan 29)
Brahman heifer	1.3	1.3	0.2
Brangus heifers	1.2	1.3	0.9
Crossbred steers	3.9	2.3	0.7
Mean over all stocks	2.2	1.7	0.6

The overall gain in beef was 5,060 lbs or an average of 150 lbs/acre for 1981-82. The gains in January were the result of a 10 inch snow fall which covered the pasture for several days.

In 1981, we harvested about 37 bu/acre wheat grain from the study. We expect a higher grain yield in 1982 than in 1981. The economics of this system need to be studied, but appear to have economical potential.

Table 1. Forage yield of 5 wheat varieties mechanically clipped for entire growing season 1980-81.

Variety	Harvest date						Total
	Dec 12	Jan 23	Feb 16	Mar 13	Apr 7	May 7	yield
	Pounds of oven dry forage						
Coker 68-15	894	409	179	1711	920	613	4726
McNair 10-03	715	588	204	1607	741	919	4774
Arthur 71	486	0	102	1430	996	537	3551
Tx-72-9	460	128	102	1558	996	537	3781
Tx-73-93	843	460	154	1686	1124	716	4983
Mean	680	317	148	1598	955	664	4362
C.V.	19	51	37	12	9	23	
LSD (10% level)	169	206	70	237	105	191	
	Mechanically clipped until Feb 16th (not grazed)						
Coker 68-15	639	358	205				1202
McNair 10-03	664	562	307				1533
Arthur 71	486	77	26				589
Tx-72-9	333	102	0				435
Tx-73-93	588	384	205				1177
Mean	542	297	148				987
C.V.	18	39	32				
LSD (10% level)	125	147	59				

Clipped after regrowth of grazed plots

Variety	Harvest date				Total
	11/19/80	12/17/80	1/14/81	2/13/81	yield
	Pounds of oven dry matter				
Coker 68-15	1415	672	791	427	3305
McNair 10-03	1247	1008	863	644	3762
Arthur 71	1151	696	600	130	2577
Tx-72-9	983	814	192	274	2263
Tx-73-93	1223	624	408	728	2983
Mean	1204	763	571	441	

Table 2. Forage yields of 5 wheat varieties mechanically clipped until mid-February versus regrowth of grazed plots in 1981-82.

Variety	Harvest date				Total yield
	Dec 16	Jan 25	Feb 18		
Mechanically clipped until Feb 18, not grazed					
TAM 106	2324	1252	333		3909
Coker 68-15	1839	1047	330		3216
NK 812	1864	996	335		3195
McNair 10-03	1788	970	330		3088
Tx-73-93	1584	996	281		2861
Mean	1879	1052	322		3253
CV	46	20	16		
LSD	NS	NS	NS		
Clipped after regrowth of grazed plots					
	Nov 5	Dec 2	Jan 12	Feb 14	Total yield
TAM 106	577	1391	1343	408	3719
Coker 68-15	529	1415	1032	576	3552
NK 812	804	1391	1368	463	4026
McNair 10-03	493	1487	1547	557	4084
Tx-73-93	420	1463	1797	631	4311
Mean	565	1429	1417	527	3938

1980-81 Forage Production for Oats, Ryegrass, Rye, Triticale and Wheat

R. L. Nelson*

SUMMARY

It is important for producers to know which small grain varieties have the potential to produce high forage yields. This information is very valuable for cattlemen who will either graze out the small grain or pull cattle off and harvest grain. Therefore, in an attempt to simulate grazing, tests were clipped several times to compare varieties for forage yeild at various times during the growing season and for total yield. Separate tests were conducted for oats, rye, ryegrass, triticale and wheat. It is important to consider forage distribution throughout the growing season and not only total forage yield. Early fall and winter forage production may be of more value to a forage program than forage produced in April or May.

Objective

These trials were conducted to determine which varieties produce highest forage yields in East Texas. Second, to compare experimental and newly released lines with recommended varieties for their adaptation to East Texas growing conditions.

Experimental Procedure

Rye, wheat and oats were planted into separate tests on September 8. The triticale and ryegrass variety tests were planted on September 12th and 15th, respectively. Seed was planted into six-row plots spaced 8 inches apart, 10 ft in length. The four center rows were harvested at a height of about 2 inches with a flail-type harvester. Fertilizer application consisted of a preplant application at a rate of 60-60-60 ($N-P_2O_5-K_2O$) lbs/acre and a split N application of 100 lbs on October 1, 1980 and 60 lbs on February 17, 1981 for a total N application of 220 lbs/acre. Individual small grain forage tests were harvested when there was sufficient forage to cut. Normally, this would be when the forage was from 8 to 10 inches tall. No serious disease or insect pests were observed in these tests.

Moisture was limiting during most of the fall and winter. This required one irrigation during late September of about 1 inch to avoid losing stands of all small grain forage tests. Precipitation amounts in inches by months were: September--3.3; October--2.0; November--3.6; December--1.5; January--1.1; February--2.8; March--2.8; April--2.0;

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May - 7.9. We observed some winterkill on ryegrass and triticale, with the coldest temperatures occurring on February 12 when a temperature of 10° F was recorded. Winter injury on several triticale varieties was related to the harvest shortly before the severe low temperatures.

Results and Discussion

Forage yield data are presented in Tables 1 through 5. Highest overall forage yields in 1980-81 were produced by oats and rye, followed by triticale, ryegrass and wheat. Overall, the warmer than average temperatures did not result in higher forage yields because of fairly dry growing conditions. These same warm growing conditions did allow mid-winter (Jan & Feb) growth for oats (Table 1) and ryegrass (Table 2). Some freeze injury occurred on ryegrass, however, none was recorded on oats. Good yields on rye (Table 3) were obtained and, as would be expected, most of the forage was produced prior to March 30th. Good yields were harvested on the triticale test (Table 4). A large proportion of the triticale forage was produced prior to December 10th and after March 30th. The distribution of wheat forage (Table 5) indicates a uniform production until early April. If wheat is going to be harvested for grain, cattle would normally be taken off about February 15th. Therefore, forage from the first two harvests only would be available, which in this particular study would have equalled from 2500 to 3000 lbs of forage per acre.

When making comparisons between varieties within a table, difference between varieties of less than the LSD are probably due to chance only and should not be considered as important. Furthermore, data from one year may be misleading because of unusual weather conditions. Therefore, these data should only be used to give an indication of varietal differences. Recommendations should be made using at least 3-years data.

Table 1. Oat forage variety test at Overton, TX 1980-81.

Variety	Harvest date: Dec 3	Feb 12	Mar 5	Apr 6	May 8	Total Yield
	Pounds of dry matter per acre					
Walken	1162	1226	1584	2017	2248	8237
Coker 76-16	1621	1098	1354	2299	1762	8134
Coker 77-19	2006	1201	1200	1583	2043	8033
Coker 227	1135	1022	1864	2171	1787	7979
Big Mac	1081	1175	1737	1992	1890	7875
Coker 79-21	1270	1073	1507	2043	1966	7859
Four-Twenty-Two	1531	1379	1507	1507	1915	7839
Coker 73-23	1720	945	1354	1609	2120	7748
NF-95	1513	1200	1405	1941	1635	7694
NF-188	1126	1149	1558	1915	1941	7689
Coker 79-22	1756	1149	1124	1660	1967	7656
Ark 148-15	1306	1047	1533	1890	1788	7564
TAM-0-312	1351	1226	1405	1813	1762	7557
Coker 234	1441	971	1533	1890	1686	7521
NF-121	2153	869	1175	1966	1353	7516
New Nortex	1621	1047	1609	1532	1558	7367
Mesquite	1126	1303	1558	1839	1430	7256
Ora	1162	766	1558	2401	1303	7190
Bob	1396	945	1430	1788	1583	7142
Nora	1081	792	1430	2426	1252	6981
Mean	1428	1079	1471	1914	1749	7641
C.V.	24	20	13	12	17	
LSD (10% level)	405	259	230	272	351	

Planted on Sept. 8, 1980.

Fertilizer application preplant - 500 lbs of 12-12-12/acre, topdress N - 100 lbs/N/acre on Oct. 1st, 60 lbs/N/acre on Feb. 17th.

Table 2. Ryegrass forage variety test at Overton, TX 1980-81.

Variety	Harvest date: Dec 12	Jan 28	Mar 5	Mar 31	Apr 27	Total Yield	% Winter injury	Crown rust %
	Pounds of dry matter per acre							
Marshall	1098	945	1226	1966	2222	7457	5	45[2]
Tetrablend 444	1124	919	971	1634	1864	6512	30	30
Tx-0-R-78-1	1022	971	945	1558	1890	6386	30	10
Tx-0-R-80-4	1226	1124	894	1328	1711	6283	25	15
Common	1124	1073	1022	1430	1634	6283	40	25
Gulf	1175	971	818	1532	1737	6233	35	25
Fla. Reseeding	1175	945	843	1430	1813	6206	40	1
Sunbelt	1150	971	818	1532	1711	6182	30	25
Ga. Reseeding	1124	894	869	1405	1839	6131	40	50
Tx-0-R-80-5	1124	1098	818	1277	1813	6130	40	10
Meritra	971	766	869	1584	1890	6080	20	35
Mont. Selection	741	818	1022	1456	1864	5901	15	55
Shannon	1073	792	843	1380	1481	5569	30	45
Gulf - Vitavax (4 oz)[1]	1456	945	741	1354	1864	6360	30	-
Gulf - Vitavax (8 oz)[1]	1150	970	792	1328	1941	6181	30	-
Mean	1115	947	899	1480	1818	6259		
C.V.	16	15	14	12	12			
LSD (10% level)	207	170	146	210	246			

[1]Seed treated with 4 and 8 oz, respectively, of vitavax per 100 lbs of seed.

Planted on Sept. 15, 1980.

Fertilizer application preplant 500 lbs 12-12-12/acre, topdress N - 100 lbs/N/acre on Oct. 1st, 60 lbs/N/acre on Feb. 17th.

[2]Crown rust ratings were taken on May 20, 1981 at Angleton, TX. Ratings are on a percentage of leaf area covered with rust.

Table 3. Rye forage variety test at Overton, TX 1980-81.

Variety	Nov 20	Jan 23	Feb 27	Mar 30	Apr 24	Total Yield
	Harvest date — Pounds of dry matter per acre					
Wintergrazer 70-B	1981	1737	1711	2528	639	8596
NF 74	2297	1890	1379	2094	639	8299
NF 72	2116	1941	1405	2196	562	8220
NF 214	2116	1839	1507	2068	613	8143
Wintergrazer 80	2206	1558	1430	2299	537	8030
Bonel	1892	1583	1430	2145	792	7842
Maton	2297	1609	1405	1967	562	7840
GI-75	2162	1685	1277	2094	537	7755
Wintergrazer 70	2071	1686	1328	2068	409	7562
Gurley Grazer 2000	2297	1813	1048	1762	613	7533
Elbon	1711	1966	1303	1890	639	7509
Gurley Abruzzi	2207	1992	945	1788	562	7494
GI-75	2071	1788	1124	1864	537	7384
NAPB SR-80	1666	1839	1124	2171	511	7311
Wrens Abruzzi	2161	1788	537	2119	588	7193
McNair Vitagraze	2252	1915	588	1762	588	7105
Athens Abruzzi	1666	1763	1099	1813	588	6929
Northrup King SS1	2269	1634	511	1685	562	6661
Mean	2080	1779	1175	2017	582	7634
CV	22	14	15	15	27	
LSD (10% level)	543	298	198	372	185	

Planted on Sept. 9, 1980.

Fertilizer application preplant - 500 lbs of 12-12-12/acre, topdress N - 100 lbs N/acre on Oct. 1st, 60 lbs N/acre on Feb. 17.

Table 4. Triticale forage variety test at Overton, TX 1980-81.

Variety	Dec 10	Jan 27	Mar 4	Mar 30	May 7	Total yield	% Winter injury
	Harvest date						
	Pounds of dry matter per acre						
Kershen-B-858 (grain type)	3570	562	843	1405	1634	8014	20
Kershen-Commercial Blend	2564	307	1252	1609	1941	7673	0
Kershen-A-313-A-36	2462	716	1328	1354	1660	7520	5
Kershen-B-227-8	2159	690	1507	1609	1073	7038	0
Kershen-B-858	2347	818	996	1252	1481	6894	40
Kershen-A-313-A-15	1860	741	1252	1225	1711	6790	10
Kershen-A-876-6	2341	1099	1022	1048	1226	6736	60
Noble Foundation-12	3205	894	384	767	1227	6527	90
Noble Foundation-55	2774	588	537	945	1303	6147	60
Noble Foundation-185	2306	741	767	894	1200	5908	60
Coker 68-15	2433	971	1343	511	179	5437	10
Mean	2585	732	1002	1158	1356	6833	
C.V.	18	22	15	11	19		
LSD (10% level)	550	191	183	154	320		

Planted on Sept. 12, 1980.

Fertilizer application preplant - 500 lbs of 12-12-12/acre, topdress N - 100 lbs N/acre on Oct. 1st, 60 lbs N/acre on Feb. 17.

Table 5. Wheat forage variety test at Overton, TX 1980-81.

Variety	Harvest date: Dec 11	Feb 13	Mar 5	Apr7	Total yield
	Pounds of dry matter per acre				
Tx-0-73-133	1316	1609	1201	1507	5633
McNair 10-03	1504	1507	1073	1302	5386
Tx-0-76-40	1489	1328	1124	1251	5192
Tx-0-73-93	1219	767	1405	1762	5153
Tx-0-78-7303	1397	1252	971	1481	5101
Tx-0-73-61	1330	1124	1379	1099	4932
Tx-0-72-9	1035	614	1737	1507	4893
Oasis	1415	1124	1124	1201	4868
Delta Queen	1224	1456	741	1328	4747
Rosen	1456	1379	1022	792	4649
Coker 762	1046	1584	818	1175	4623
Coker 68-15	1340	869	1430	971	4610
Sturdy	1202	665	1277	1226	4370
Tx-0-74-39	1740	1022	742	843	4347
TAM-W-101	945	767	1609	996	4317
NF-21	1258	1124	766	1149	4297
NF-2	1310	1047	920	971	4248
Agent	1271	1098	1047	817	4233
Arthur-71	1164	741	1354	894	4153
Ark-150-31	1256	767	1328	766	4117
NF-25	1451	843	1099	664	4057
Southern Belle	939	690	1533	869	4031
Coker 797	1370	537	333	715	2955
Mean	1290	1039	1132	1099	4561
CV	18	19	18	22	
LSD (10% level)	287	242	245	287	

Planted on Sept. 8, 1980.

Fertilizer application - preplant 500 lbs of 12-12-12/acre, topdress 100 lbs of N/acre on Oct. 1st, 60 lbs of N/acre on Feb. 16.

Small Grain Forage Tests Under Irrigated and Dryland Conditions at Stephenville, Texas in 1980-81.

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SUMMARY

Wheat, rye, triticale, oats, and barley were tested for forage production under two moisture regimes. Triticale yields were highest in the irrigated test, while rye yields were higher in the dryland test. Barley produced the lowest yield in both moisture regimes. The average yield of the dryland test was 3285 pounds dry matter per acre versus 6681 pounds for the irrigated test.

Introduction

Small grain forage is highly nutritious for livestock. Cereals differ in time of production, palatability, cold hardiness and yield potential. Individual cultivars may also differ in yield potential. Irrigation may increase yields by allowing higher nitrogen rates or providing water when rainfall is deficient. Cold hardiness may also be improved under irrigation because of higher soil moisture during cold, dry periods. Cultivars of small grains need testing under local conditions to better estimate yield potential under irrigated and dryland conditions.

Materials and Methods

Irrigated and dryland tests of small grains were established on Windthorst fine sandy loam to determine effects of irrigation and cultivar on yield and protein content. Nine oat cultivars; three barley, rye and wheat cultivars; and two triticales were sown in plots having four rows twelve feet long spaced one foot apart. A randomized complete-block design with four replications was used. Fertilizer at the rate of 47-59-0 was applied and incorporated by disking before sowing. Tests were topdressed March 26, 1981 with 107-0-0.

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First and second cuttings were made with a flail mower when the taller cultivars were approximately ten inches tall. A sickle mower was used the third cutting.

Forage from the center two rows was collected from the twelve-feet length. The forage was weighed, and subsamples were dried at 70C to determine yields. Samples were retained for protein analysis.

Irrigation was applied with a solid-set sprinkler system as conditions indicated the need. Amounts of irrigation and rainfall received by harvest date are listed (Table 2).

Results and Discussion

Dry matter yields of irrigated small grains ranged from 3887 pounds per acre for 'Tambar 402' to 8335 pounds per acre for 6TA-131A triticale (Table 1). The mean of irrigated yields was 2.04 times that of dryland yields. Lowest and highest producing cultivars of triticale, wheat, and barley were the same whether irrigated or dryland. This was true for oats except that yield of 'Walken' was very slightly higher than that of 'Okay' under dryland conditions. 'Bonel' rye yield was highest under irrigation and lowest under dryland conditions.

Low yields, especially at the first cutting, may have been due to insufficient nitrogen and equipment problems. Yellowing of plants in October and November as well as noticeable border effect on both irrigated and dryland tests also indicated inadequate nitrogen. Probably insufficient nitrogen was applied and some nitrogen leached due to the 4.3 inches of rainfall during the week following seeding. In addition, an estimated 10-15% of the forage cut was not collected by the flail mower in the first two cuttings.

Insect and disease occurrence was minor. Barley leaf rust disappeared after the first freezing temperatures. Barley yellow dwarf virus appeared on oats in early April. Some greenbugs were noted, but control measures were not required.

Most of the forage produced was harvested in March and May (Table 2). Oats and triticale produced greater yield from mid-April to mid-May while rye growth occurred mid-February to mid-March. Dryland wheat and barley yields were slightly higher in March, whereas irrigated yields were higher at the May harvest. Irrigated wheat yields were considerably higher at the May cutting.

Total forage production was highest for the two triticales under irrigation, whereas dryland rye produced slightly more than irrigated rye (Table 2). Oats ranked second under irrigation and third under dryland conditions. Barley was clearly lowest under either moisture situation. Therefore, in subsequent tests more triticale cultivars will be included, and barley will be removed.

Table 1. Seasonal Distribution and Total Forage Production of Irrigated and Dryland Small Grains at Stephenville, Texas in 1980-81

		DRYLAND				IRRIGATED				
		Date of Harvest					Date of Harvest			
CULTIVARS	CROP	12/17	3/17	5/14	Total		12/18	3/23	5/21	Total
		Pounds Dry Matter Per Acre					Pounds Dry Matter per Acre			
Winter Grazer	Rye	170	3250	884	4304	6TA-131A	88	2419	5827	8335
6TA-131A	Triticale	52	1442	2638	4132	Okay	583	2746	4344	7673
Bonel	Rye	81	3219	807	4107	Grazer Blend	435	2196	5022	7653
Maton	Rye	108	2973	1023	4105	TAM 106	116	2500	4825	7441
Walken	Oat	76	1254	2727	4057	New Nortex	416	2109	4724	7249
Okay	Oat	210	1662	2130	4003	Coker 234	513	2131	4529	7174
New Nortex	Oat	70	1783	1948	3801	Four Twenty Two	203	1945	4948	7097
Grazer Blend	Triticale	211	1321	1932	3464	Bonel	302	3965	2784	7052
Big Mac	Oat	114	1352	1904	3370	Walken	212	2188	4640	7040
TAM 106	Wheat	26	1639	1619	3284	Big Mac	343	1883	4791	7016
Mesquite	Oat	103	1193	1949	3246	Mesquite	548	1646	4761	6955
Coker 234	Oat	99	1408	1672	3179	Maton	248	4203	2446	6898
Four Twenty Two	Oat	70	1239	1829	3136	Nora	300	1910	4247	6457
Nora	Oat	100	1180	1812	3092	Coker 68-15	550	2861	2996	6407
Coker 68-15	Wheat	146	1840	987	2973	Winter Grazer	376	3890	2092	6357
Sturdy	Wheat	55	1331	1306	2692	Coronado	518	1128	4447	6093
Coronado	Oat	163	894	1405	2463	Post	231	2050	3611	5892
Post	Barley	46	722	1354	2123	Sturdy	169	1973	3667	5810
Tambar 401	Barley	86	1394	619	2101	Tambar 401	430	2566	2578	5574
Tambar 402	Barley	288	1453	332	2074	Tambar 402	1380	1414	1093	3887
Mean		114	1627	1544	3285		396	2386	3919	6701
CV		25.81	11.22	24.61	13.55		38.46	16.96	13.91	9.6
LSD 0.05*		46	258	537	629		215	572	770	909

* The difference in yield between any two cultivars must be at least as large as the LSD 0.05 listed for each date in order to be 95% certain that the difference is not due to chance.

Table 2. Seasonal Distribution and Total Forage Production of Five Small Grains Grown Under Irrigated and Dryland Conditions at Stephenville, Texas, 1980-81.

	Harvest Date-Dryland				Harvest Date-Irrigated			
Cereal	12/17	3/17	5/17	Total	12/17	3/23	5/21	Total
	---------------Pounds Dry Matter Per Acre---------------							
Rye*	120	3147	905	4172	309	4019	2441	6769
Triticale**	132	1382	2285	3799	261	2307	5425	7993
Oats***	112	1329	1931	3372	404	1965	4603	6972
Wheat*	76	1603	1304	2983	278	2445	3829	6552
Barley*	140	1190	768	2098	680	2010	2427	5117
Rainfall(In.)	8.58	3.73	1.81		8.58	3.73	2.83	
Irrigation(In.)	0	0	0		4.85	2.00	2.00	

* Average of three cultivars ** Average of two cultivars

*** Average of nine cultivars

Perennial Grass Variety Test--Angleton

G. W. Evers*

SUMMARY

Dry matter production during the second year of a dallisgrass and hybrid bermudagrass variety test ranged from 7216 to 9622 lb/ac. Coastal, Tifton 44 and Alicia produced in excess of 9000 lb/ac.

Introduction

Hybrid bermudagrasses are the most popular and widely grown grasses in the Southeastern United States. They are primarily adapted to deep, well drained sandy and loam soils which are predominant in that area of the United States. Performance of these hybrid bermudagrasses in comparison to dallisgrass on poorly drained, clay rice soils has never been documented.

Methods and Materials

Coastal, Callie, Alicia, Tifton 44 and SS-16 bermudagrasses and dallisgrass were established in the fall of 1979 on a Lake Charles clay at Angleton. Plots were 6 x 15 ft in a Randomized Block design with four replications. Five hundred pounds of 13-13-13 per acre were applied on March 20 plus 50 lb nitrogen on June 19 and July 30. Three pounds of Princep per acre were applied on Feb. 17. Plots were harvested six times during the year.

Results and Discussion

The six grasses separated into a high yielding (Coastal, Tifton 44 and Alicia) and low yielding (dallisgrass, Callie and SS-16) group with a difference of about 2000 lb/ac (Table 1). Coastal had the most production and Callie and SS-16 the least at the first harvest. The most striking performance difference was the very low dallisgrass production (191 lb) compared to the bermudas (711 to 940 lb) at the Oct. 27 harvest. The preceeding growing period was hotter and drier than normal. The morphological and physiological factors which make dallisgrass tolerant of wet soils may also limit dallisgrass growth during very dry periods. The 1980 yields are also presented for comparison.

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Table 1. Forage production of hybrid bermudagrasses and dallisgrass at Angleton.

Variety	May 12	June 18	July 15	Aug. 18	Sept. 18	Oct. 27	Total	1980 Total
	Cutting dates							
	lb/ac							
Coastal	2547 a*	1908 ab	1760 bc	1558 a	978 b	871 a	9622 a	7274 a
Tifton	1845 bc	2127 a	2057 a	1599 a	985 b	940 a	9553 a	8633 a
Alicia	2112 ab	1805 b	1961 ab	1454 ab	1114 b	711 a	9157 a	8933 a
Dallisgrass	1639 cd	1506 c	1485 c	1265 bc	1366 a	191 b	7452 b	9263 a
Callie	1356 de	1535 c	1720 bc	1033 c	993 b	747 a	7384 b	7447 a
SS-16	1147 e	1428 c	1744 bc	1172 c	921 b	804 a	7216 b	9903 a

*Yields within a column followed by the same letter are not significantly different at the .05 level, Duncan's Multiple Range Test.

Evaluation of Bermudagrass Hybrids

Ethan C. Holt and P. A. Rich[1]

SUMMARY

Twenty-two new bermudagrasses and three standards were established in a replicated test in 1980. Due to weed competition and a very dry summer in 1980, some of the sources did not become well established until 1981. Yields in 1981 ranged from less than 2 tons to more than 8 tons per acre. Forage digestibility which is one of the important characteristics averaged from 50% for Coastal to 62% for the top ranking source. None of the sources ranked at the top for both yield and quality, though several sources exceeded Coastal in both characteristics. Most of the highest quality sources were damaged by low temperatures in the 1981-82 winter. Further evaluations are needed to identify the best combinations of yield, forage quality, cold tolerance and ground cover density.

Introduction

Bermudagrass is the most important tame pasture grass in Texas, and Coastal is by far the most important improved variety in terms of total acreages. Research in recent years has shown that forage quality in bermudagrass can be improved through breeding. Improved quality is reflected in turn in increased animal performance. The important characteristics of an improved bermudagrass cultivar are higher dry matter digestibility, winterhardiness, ground cover density and stand maintenance under grazing, and yield. Coastal bermudagrass is a highly productive cultivar with adequate winterhardiness for most of the state and adequate ground cover to resist common bermudagrass invasion even under intensive grazing. Thus, Coastal serves as a standard for these characteristics. The major improvement needed over Coastal is forage quality and winterhardiness for North Texas.

A study was initiated in 1980 to evaluate 22 new genotypes of bermudagrass for the characteristics described above.

Experimental Procedure

Twenty-two genotypes of bermudagrass not previously evaluated in Texas were made available for study in the spring of 1980. Fourteen of these are hybrids from the USDA bermudagrass breeding program at Tifton, Georgia (Dr. G. W. Burton) and eight originated from a field where an observation nursery had been grown previously on the J. Pybas ranch near Gainesville, Texas as types surviving two preceding severe winters.

KEYWORDS: Bermudagrass genotypes, yield, IVDMD, winter damage.

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Four rooted sprigs were planted four feet apart in the center of 6 x 20 foot plots, 4 replications, on June 4, 1980. The plot area was treated with a preemergence herbicide following sprigging, but prostrate milkweed developed and competition retarded spread and ground cover development, especially in the slow spreading genotypes.

The test was harvested five times in 1981: May 13, June 30, July 30, September 11, and November 19. Nitrogen was applied at the rate of 60 pounds per acre in late March and following the June 30 and September 11 harvests. Forage samples were saved from each harvest and analyzed by the in vitro technique for dry matter digestibility.

Results and Discussion

Forage yields (total of 5 cuttings) ranged from 8.7 tons per acre to less than 2 tons per acre. Yield data were variable probably because of inadequate establishment of some genotypes at the time harvesting was initiated. Statistically significant differences occurred only between the highest yielding genotypes and a few of the lowest yielding genotypes.

Forage quality, averaged for the five cuttings, ranged from 62.0% IVDMD to 49.8 or more than a 12-unit difference. All of the genotypes exceeded Coastal numerically but only the extremes were statistically significant.

None of the sources were ranked at the top for both yield and quality. The highest yielding source (P-7) was ranked 21 in quality, and the highest quality source (B-2) was ranked 18 in yield. Several of the higher quality genotypes exceeded Coastal in yield. Several of the genotypes show promise for improvement over Coastal in both characteristics.

Because several of the plots were not well established until late in the season, it seems likely that yield rankings will change in 1982. For the same reason, ground cover density ratings were delayed until 1982.

The plots were rated on April 1, 1982 for relative amount of winter damage. It is obvious that the highest quality materials encountered considerable winter damage. Low temperatures on January 13-14 were 6 to 7^{o} F. Damage seemed to be more severe in this test than in adjacent areas in that Coastal and Brazos showed no damage in three other tests. The late cutting (November 19) may have been a contributing factor to winter damage on some of the new materials. However, late defoliation did not result in damage to Coastal and Brazos in other tests.

Table 1. Forage yield and quality of bermudagrass hybrids, Brazos River bottom near College Station, 1981

Hybrid or genotype	Total yield and (rank)tons/acre	IVDMD and (rank) %	Winter damage rating (1=none)	Recovery 4/30/82 (1=good)
B-1	8.2 (4)	57.4 (10)	8.5	4.8
B-2	5.7 (18)	62.0 (1)	7.8	4.5
B-3	7.0 (13)	61.9 (2)	7.0	3.3
B-4	7.2 (12)	59.4 (5)	5.8	3.3
B-5	3.0 (22)	61.5 (3)	9.7	5.0
B-6	8.6 (2)	57.0 (9)	6.0	3.0
B-7	7.7 (10)	55.4 (14)	5.3	2.8
B-8	6.2 (17)	58.9 (6)	7.5	3.0
B-9	7.7 (8)	59.5 (4)	7.8	4.0
B-10	5.4 (19)	57.0 (9)	2.5	1.8
B-11	4.0 (21)	54.8 (17)	5.0	3.5
B-12	7.9 (7)	56.5 (12)	5.3	2.5
B-13	8.3 (3)	56.8 (11)	4.3	2.8
B-14	8.0 (6)	58.2 (8)	4.0	2.0
P-1	8.2 (4)	55.2 (15)	1.3	1.0
P-2	8.0 (5)	55.5 (13)	1.3	1.0
P-3	8.0 (5)	53.9 (20)	1.3	1.0
P-4	7.2 (11)	54.1 (18)	1.3	1.0
P-5	7.7 (9)	54.9 (16)	1.3	1.0
P-6	6.9 (14)	54.9 (16)	2.3	1.0
P-7	8.7 (1)	52.7 (21)	1.8	1.0
P-8	6.5 (16)	55.5 (13)	2.8	1.8
Costal	6.5 (15)	49.8 (22)	4.0	2.0
Tifton 44	1.9 (23)[1]	54.0 (19)	2.0	3.0
Brazos (SS-16)	4.3 (20)[1]	58.5 (7)	4.3	2.3
LSD	4.1	9.1		

[1] Plots did not become well established until after the third planting.

Dallisgrass Variety Test

G. W. Evers, B. L. Burson and P. W. Voigt*

SUMMARY

Eight dallisgrass plant introductions were compared to common dallisgrass under Gulf Coast conditions. All lines were higher yielding than common with six of the lines producing an additional ton of dry matter per acre over common. No insect or disease problems were observed.

Introduction

Dallisgrass is a warm season perennial grass which is well adapted to poorly drained heavy soils. Once established it requires little maintenance, although it does respond to fertilization. When mixed with white clover, 1½ acres will support a cow and calf with only 40 to 60 lbs. phosphorus per acre each fall. Because dallisgrass reproduces by apomixis (asexual reproduction), no crosses can be made to develop improved dallisgrass varieties. Different dallisgrass types were collected by Dr. Byron Burson while on a plant exploration trip in South America. Some of these plant introductions were evaluated and compared to common dallisgrass under Gulf Coast conditions.

Methods and Materials

Eight dallisgrass introductions and common dallisgrass were started from seed in peat cups in the greenhouse. Seedlings plus peat cups were transplanted in a Lake Charles clay at Angleton on April 30, 1981. Seedlings were placed 1 ft apart within a row. Plots consisted of four rows, 1.5 ft apart, 12 ft long. The study was fertilized with 48 lb of nitrogen and 60 lb of phosphorus per acre at transplanting and an additional 50 lb/ac of nitrogen on July 30 after the first cutting. Sencor was applied at .5 lb/ac the day after transplanting for weed control. Plots were harvested on July 17, Sept. 10 and Oct. 28 at a 4 in height.

Results and Discussion

All plant introductions were more productive than common dallisgrass (Table 1). Numbers 461, 544, 554, 455, 426, and 458 yielded an additional ton of dry matter over common dallisgrass.

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The first years results are encouraging for finding a higher yielding dallisgrass. All introductions produced seed althogh seed quality and germination were not determined. No insect or disease problems were observed.

Table 1. Dallisgrass Variety Test at Angleton - 1981.

Plant Introduction	July 17	Sept. 10	Oct. 28	Total
	-----------------------	lb/ac	-----------------	
461	4117 abc*	3679 a	657 a	8453 a
544	4279 ab	3516 a	585 ab	8380 a
554	4589 a	3219 a	569 ab	8377 a
455	4356 ab	3218 a	519 ab	8093 a
426	3733 abc	3581 a	645 ab	7959 a
458	3841 abc	3459 a	638 ab	7938 a
460	3573 bc	3159 a	639 ab	7373 ab
555	3557 bc	3158 a	354 ab	7069 ab
common	3283 c	2423 a	325 b	6031 b

*Yields within a column followed by the same letter are not significantly different at the .05 level according to Duncan's Multiple Range Test.

Management Effects on Irrigated and Dryland Forage Sorghum Cultivars at Stephenville in 1981

Ronald M. Jones and J.C. Read*

SUMMARY

Twelve cultivars of the Sorghum genus were seeded to determine differences due to cultivars, irrigation, planting date, maturity, and regrowth. Dry matter yields of single-cut irrigated forage sorghums ranged from 1.08 to 6.14 tons per acre. Yields of most forage sorghum types were significantly greater than the sudan types at boot stage. Cultivar 'FS-25a+' produced significantly more forage than 'Atlas' at soft-dough. Yields of sudan types were not significantly different at the boot stage. May 22 was a significantly better planting date than April 9 although Atlas yields were higher for the earlier planting. Irrigation hastened booting by 5-9 days for cultivars seeded April 9. Cultivars planted dryland May 22 generally reached boot stage 21 days sooner than those planted April 9. Second cutting yields of 'FS-1a', 'Sweet Sudan', and 'Trudan 8' were as large as the first under dryland conditions. Two harvests of dryland cultivars produced more dry matter than a single harvest of irrigated cultivars cut at booting. Regrowth rate of Trudan 8 was fastest while FS-1a was slowest.

Introduction

Forage sorghums are used for hay, silage, and grazing by beef and dairy animals. Many cultivars of both sorghum and sudan types are available from commercial sources. Since the genetic base among types is narrow, performance of selected cultivars within each type is reasonably representative of those available. Knowledge of yield and quality potential of forage sorghums under various management options is essential to the producer.

The purposes of this study were: (1) to determine the effect of planting date and irrigation on the growth potential and forage quality of selected cultivars (2) to determine yields of forage sorghum and small grains in double-crop rotation (3) to determine the maturity stage for harvesting optimum yield and quality (4) to determine the effect of a second harvest on yield under dryland conditions. This paper reports the results of the first year of a two year study.

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Materials and Methods

Plots were established on Windthorst fine sandy loam in 1981 in four separate tests designated A, B, C, and D. Twelve cultivars of the Sorghum genus were included in test A. These included the cultivars 'Hoti', 'FS-25 a+', 'FS-4', 'NK 300', 'Red Top Kandy', 'Kow Kandy', 'TE Haygrazer II', 'SX-17', 'Atlas', 'FS-1a', 'Trudan 8', and 'Sweet Sudan'. The latter four cultivars were selected for tests B, C, and D. Tests A and B were irrigated while tests C and D were dryland. Tests A and C were seeded April 9; tests B and D were seeded May 22. Plots in test C were split after the first harvest. Regrowth was harvested from one split-plot, and the other was destroyed by plowing. Test B and D were split in September and one-half was seeded to 'Grazer Blend ' triticale while the other half was fallowed. Each test had four replications in a randomized, complete-block design.

Fertilizer was broadcast on the area March 27 at the rate of 148-48-48 and incorporated by disking. A cone-type seeder unit mounted on a field crop planter was used to place one seed per row-inch. Plots forty feet long had three rows spaced 36 inches apart.

Tests A and B were designed for irrigation by a solid-set sprinkler system but received only three separate one-acre-inch applications primarily to aid seedling emergence. Rainfall received by cultivars in test A ranged from 7.91 - 10.73 inches by boot stage, 9.47 - 10.73 inches by anthesis, and 10.73 inches by the soft-dough stage. Cultivars in test B had received 8.07 inches by boot stage. Plant height prevented irrigation when it might have been beneficial.

Plants were cut at a height of three inches from four feet of the center row at each harvest. Each cultivar in test A was harvested when it reached the boot, anthesis, and soft-dough maturity stages. Cultivars in the other tests were harvested at the boot stage. Weight of harvested plants was determined, and subsamples were weighed and subsequently dried at 70C to determine dry matter per acre. Subsamples were retained for determination of protein content and *in vitro* dry matter digestibility.

Results and Discussion

Irrigated forage sorghum yields ranged from 1.08 to 6.14 tons dry matter per acre depending upon cultivar and growth stage at harvest (Table 1). Yields from a single harvest of the forage sorghum types (except for FS-1a) were significantly greater than those of the sudan types at the boot stage. Yields of FS-25a+, Hoti, and Red Top Kandy were significantly greater than the sudan types and other forage sorghums at anthesis. Cultivars of the sudan types were not significantly different at the boot stage, but at the soft-dough stage other sudan types produced significantly greater yields than Sweet Sudan. FS-25a+ produced significantly greater yield than Atlas, NK 300, and FS-1a at soft -dough, while FS-1a produced significantly less than other forage sorghum types at the boot and soft-dough stages.

Trudan 8, FS-1a, and dryland Sweet Sudan produced higher yields when seeded May 22, while Atlas and irrigated Sweet Sudan yields were higher when seeded April 9 (Table 2). Lack of response to irrigation was probably due to cool soil temperatures following the April planting and to adequate rainfall following the May planting. The forage sorghum types produced more forage than the sudan types under both irrigated and dryland conditions.

Irrigation hastened booting by 5 - 9 days for the cultivars seeded April 9 (Table 3). Failure of irrigation to hasten booting of the May planting was due to adequate rainfall. Atlas, Trudan 8, and Sweet Sudan planted dryland on May 22 reached boot stage 21 days sooner than when planted April 9. However, the calendar date at booting was later for the May planting.

Dry matter production of FS-1a, Sweet Sudan, and Trudan 8 at the second cutting equaled or exceeded production at the first cutting under dryland conditions (Table 4). Yield of Atlas was substantially less at the second cutting, but total yield was slightly higher than the others. Yields at booting from two harvests of dryland FS-1a, Atlas, Sweet Sudan, and Trudan 8 were greater than those from a single harvest of these cultivars under irrigation (Tables 1,4). Trudan 8 had the fastest regrowth since it produced 2.67 tons/acre in the 32 days following the first cutting. FS-1a required 53 days to produce 2.23 tons per acre when it again reached boot stage.

Table 1. Forage Yields of Irrigated Sorghum Cultivars Harvested at Three Growth Stages at Stephenville, Texas in 1981.

		Tons Dry Matter Per Acre**		
Forage Sorghum Types	Seed Source	Boot	Anthesis	Soft-Dough
FS-25a+	DeKalb AgResearch	4.44	5.77	6.14
Hoti	R. C. Young	3.99	5.35	5.91
FS-4	DeKalb AgResearch	3.52	4.07	4.98
Red Top Kandy	R. C. Young	3.47	6.09	5.90
Atlas	Warner Seed	3.00	4.19	5.17
NK 300	Northrup, King & Co.	2.79	3.62	5.05
FS-1a	DeKalb AgResearch	1.13	2.99	4.03
Mean		3.19	4.58	5.32
Sudan Types				
Kow Kandy	R. C. Young	1.58	3.32	4.37
Sweet Sudan	R. C. Young	1.56	2.50	2.97
TE Haygrazer II	Taylor-Evans	1.39	3.10	4.94
SX-17	DeKalb AgResearch	1.39	3.19	4.77
Trudan 8	Northrup, King & Co.	1.08	3.32	4.43
Mean		1.40	3.09	4.30
L.S.D.(0.05)*		0.68	0.80	0.94

*Difference between two yields within a growth stage must exceed the L.S.D. value for that growth stage for the two yields to be significantly different with a 5% chance of error.

** Mean of four replications

Table 2. Effect of Irrigation and Planting Date on Dry Matter Production of Forage Sorghum Cultivars Harvested at Booting. Stephenville, Texas, 1981.

Forage Sorghum Types	Planted April 9		Planted May 22		Mean
	Irrigated 1/	Dryland 2/	Irrigated 1/	Dryland 3/	
	Tons Per Acre 4/				
Atlas	3.00	3.37	2.75	2.75	2.97a*
FS-1a	1.13	2.00	4.19	4.36	2.92a
Sudan Types					
Trudan 8	1.08	1.31	2.40	2.39	1.81b
Sweet Sudan	1.56	1.46	1.39	1.58	1.50c

Mean - May Planting 2.73a*　　Mean - Dryland 2.41a
Mean - April Planting 1.86b　　Mean - Irrigated 2.19b

1/ Three inches of water applied
2/ 'Atlas', 'FS-1a' and 'Sweet Sudan' received 9.47 inches rainfall; 'Trudan 8' received 8.34 inches
3/ Received 8.07 inches rainfall
* Means followed by the same letter are not significantly different at the 0.05 level
4/ Mean of four replications

Table 3. Effect of Irrigation and Planting Date on Number of days to Booting of Forage Sorghums Grown at Stephenville, Texas in 1981.*

	Planted April 9		Planted May 22	
Cultivar	Irrigated	Dryland	Irrigated	Dryland
Atlas	75	80	59	59
FS-1a	61	70	68	67
Trudan 8	61	66	45	45
Sweet Sudan	70	75	52	54

* See footnotes of Table 2 for irrigation and rainfall information

Table 4. Seasonal Distribution of Dry Matter Production of Forage Sorghum Cultivars Grown Under Dryland Conditions at Stephenville, Texas, 1981.

	Harvest Dates		Tons Dry Matter Per Acre 1/		
Cultivar	Cutting 1*	Cutting 2**	Cutting 1*	Cutting 2**	Total
FS-1a	June 19	Aug. 12	2.00	2.23	4.23
Atlas	June 29	Aug. 12	3.37	1.31	4.68
Sweet Sudan	June 24	Aug. 12	1.46	1.36	2.82
Trudan 8	June 15	July 17	1.31	2.67	3.98

* Planted April 9 and cut at booting. 'Trudan 8' received 8.34 inches rainfall while other cultivars received 9.47 inches.

** Planted April 9 and cut at booting. 'Trudan 8' received 2.43 inches rainfall, and other cultivars received 1.33 inches between harvests.

1/ Mean of four replications

Selection and Evaluation of Heavy Seed Weight Synthetic Cultivars of Kleingrass

M. A. Hussey and E. C. Holt [1]

SUMMARY

Selection for heavy seed in kleingrass, Planicum coloratum L., has resulted in an increase in seed weight of 53 percent over the base population with three cycles of selection. Evaluation of large seeded synthetics has shown them to be superior to Kleingrass 75 and to the other experimental synthetics tested in stand establishment characteristics.

Yield data from 1981 indicate no statistical difference in forage production between Kleingrass 75 and the heavy seed weight selections. Forage yields from this test ranged from 7300 to 9500 pounds of dry matter per acre. There appeared to be little difference between the selections for in vitro dry matter disappearance, although two makarikariense types of Panicum coloratum tended to have lower IVDMD values at all harvest dates.

The first two years of this study at College Station have indicated that Verde Kleingrass is superior to Kleingrass 75 in stand establishment and early growth, but does not differ from Kleingrass 75 in forage quality or in dry matter production.

Introduction

Kleingrass is an important warm season perennial grass adapted to most regions of Texas (4). Although the species does not possess the yield potential of some of the other introduced species, it does produce favorable dry matter yields in the drier regions of the state. Grazing studies at both Beeville and McGregor have indicated a greater average daily gain for calves grazing kleingrass than for those grazing Coastal Bermudagrass (Cynodon dactylon (L.) Pers.), demonstrating the importance of kleingrass in many areas of Texas (1).

Kleingrass has generally been reported to have good forage quality when compared to other warm season grasses and has also been shown to be important to wildlife. In areas in which kleingrass has been planted quail populations have also shown subsequent increases. Studies at Texas A&M have confirmed that kleingrass seed is acceptable to quail. In a feeding trial quail were found to consume kleingrass seed as 28% of their diet when given a free choice between kleingrass seed and a standard game bird mix (2). One limiting factor

KEYWORDS: Kleingrass 75, Panicum coloratum L., Verde Kleingrass, synthetic, heavy seed weight, forage quality.

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which has been cited in the use of kleingrass seed as a potential food source for gamebirds is the small size of the kleingrass seed which may make it more difficult for birds to locate adequate seed to meet their nutritional requirements.

Recent work at College Station has focused on improving seed size in kleingrass. Improvements in seed size have been shown to be releated to improved seedling vigor in many small seeded species (3, 5), and has also been shown to have potential in improving stand establishment characteristics in kleingrass. Improved stand establishment characteristics coupled with the potential value of larger seed for gamebirds has made selection for heavy seed an important objective in the kleingrass breeding program.

Materials and Methods

Selection for improved seed weight in kleingrass has been carried out for three generations by selecting both within and among half-sib families. Each cycle of selection has involved hand harvesting individual plants within the nursery. The inflorescences from each of these plants were then threshed seperately by rubbing the seed on a rub board. The seed were blown in a constant air stream to remove all the chaff and then the seed were counted. Two lots of one hundred seed each were counted from each plant and then weighed to the nearest one-tenth milligram. The average of these two weights were used to represent the weight of each plant. Selection pressure was placed on the populations only for seed weight without respect to any other characteristic.

To evaluate the effect of selection for seed weight on forage yield and quality, six experimental synthetics, Kleingrass 75, and Verde Kleingrass (Table 1) were planted in a test in the spring of 1980 at College Station on a Norwoood silty clay loam soil. Each line was planted at a rate of 44 pure live seed per square foot (3 lbs. per acre based on Kleingrass 75). The seed were planted using a belt planter into 100 square foot plots (5 x 20 ft.) at a depth of 0.5 - 1.0 inches. The plots were fertilized with 50 lbs. of N, P, and K four weeks after planting and with an additional 50 lbs. of nitrogen per acre in July. Similar fertilization occurred in 1981.

Evaluation of seedling growth was made 28 days after planting in the spring of 1980, by harvesting two feet of row from each plot and counting the number of seedlings present. These seedlings were dried for 48 hours at 60° C to determine the average weight per seedling. Plot yields were determined by harvesting a 3 x 17 foot swath from each plot with a flail type mower. Samples for *in vitro* analysis were harvested prior to the six week yield harvest and whole plant digestibilities were calculated by taking the sum of the IVDMD's of the leaf and stem fractions.

Results and Discussion

Three cycles of selection for heavy seed have been successful in increasing seed weight in kleingrass from a mean weight of 79.3 mg/100 seed in the base population to 121.6 mg/100 seed in cycle 3. This increase in seed weight has resulted in the reduction in the standard deviation for seed weight in this population (Table 2), and an average increase in seed weight of 17 percent per cycle of selection.

Field evaluations of heavy seed weight synthetics and other selected experimental lines were conducted in 1980 and 1981. In the establishment year, the heavy seed weight synthetics were superior to Kleingrass 75 in early growth (Table 3). While no significant difference in plant number was observed, the heavy seed weight genotypes had superior seedling vigor as measured by seedling weight and a visual score.

Dry matter yields for 1981 are shown in Table 4. There were no significant differences in yield between any of the lines at the three-week harvest frequency. Although some differences were observed at the six week harvest frequency, only 78-31 which yielded 9500 lbs./acre was significantly different in yield from Kleingrass 75.

Data from *in vitro* analysis of each synthetic were not statistically analyzed (Table 5), although there appeared to be little difference in IVDMD's among the synthetics tested. Only the makarikariense forms of *Panicum coloratum* appeared to have a lower digestibility than Kleingrass 75. Kleingrass 75-25, a synthetic selected on the basis of high *in vitro* dry matter digestibility, did appear to be slightly higher in DMD at all harvest dates than the other synthetics in the test.

Initial results from this study are promising in that they indicate selection for large seed in kleingrass (Verde Kleingrass) has not resulted in any change in the quality or yield, but has resulted in a new cultivar superior to Kleingrass 75 in stand establishment characteristics. Further research is presently being conducted throughout Texas to determine the area of adaptation and persistence of these heavy seed weight synthetics.

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Table 1. Experimental Kleingrass Synthetics. Seed Evaluation Data.

Synthetic	Seed Weight (mg/100 seed)	Protein Content %	Seed Per Pound	Basis of Selection
75-25	66.1	13.8	687000	High DMD
79-34	61.6	14.4	737000	High DMD
Klein 75	70.1	15.0	648000	----------
Verde	90.9	15.3	500000	Large Seed Size
78-30	100.9	15.0	450000	Large Seed Size
79-35	107.8	14.4	421000	Large Seed Size
78-31	98.8	13.1	460000	makari type
78-32	89.2	12.5	509000	makari type

Table 2. Summary of Three Cycles of Selection for Heavy Seed in Kleingrass

	Cycle 0	Cycle 1	Cycle 2	Cycle 3
Mean	79.3[1]	100.8	102.6	121.6
Range	25.0-131.6	63.7-144.1	74.9-138.1	84.7-165.2
Std. Dev.	13.7	11.0	10.8	7.1
Klein 75	----	83.2	81.0	81.3
% Increase	----	27.1	1.8	18.5
Parent-Progeny Corr.	0.61	0.78	0.28	0.29

1 All values expressed as mg / 100 seed.

Table 3. Stand Establishment of Kleingrass Synthetics. College Station-1980.

Synthetic	Plant Number[1]	Seedling Weight mg / seedling	Visual Rating[2]
75-25	17.0 A[3]	8.9 BC	4.0 C
79-34	14.7 A	10.1 ABC	4.3 C
Klein 75	19.0 A	11.3 AB	4.8 BC
Verde	25.9 A	13.5 AB	7.8 A
78-30	25.5 A	13.5 AB	7.5 A
79-35	25.9 A	13.7 A	7.0 A
78-31	23.9 A	6.6 C	5.0 BC
78-32	22.4 A	9.7 ABC	5.8 B

1 Number of plants per 2 ft. of row.

2 Visual rating 1=no stand 10=100% stand

3 Means within a column followed by the same letter do not differ at the 0.05 level as determined by Duncans Multiple Range Test.

Table 4. Seasonal Dry Matter Production of Experimental Kleingrass Synthetics Harvested at Three and Six Week Intervals. College Station-1981.

Synthetic	3 Week[1]	6 Week
75-25	5433 A [2]	7509 BC
79-34	5249 A	8072 BC
Klein 75	6236 A	7932 BC
Verde	6522 A	8688 AB
78-30	6053 A	7194 C
79-35	6142 A	7767 BC
78-31	4591 A	9499 A
78-32	5295 A	7757 BC

1 All values are pounds of dry matter / acre.

2 Means within a column followed by the same letter do not differ at the 0.05 level as determined by Duncans Multiple Range Test.

Table 5. *In vitro* Dry Matter Disappearance (IVDMD) of Experimental Kleingrass Synthetics. College Station-1981.

Synthetic	6-12	8-4	9-16	Seasonal Average
75-25	56.2	61.9	64.0	60.7
79-34	56.5	57.5	61.7	58.6
Klein 75	54.4	59.0	63.7	59.0
Verde	57.1	60.6	61.8	59.8
78-30	58.4	59.7	56.7	58.3
79-35	58.0	58.4	62.2	59.5
78-31	54.8	53.8	54.6	54.4
78-32	56.5	57.7	57.1	57.1

Total Alkaloid and Nitrate Content of Eleven Pearl Millet Lines

Beverly B. Krejsa, F. M. Rouquette, Jr., L. R. Nelson, E. C. Holt, B. J. Camp

SUMMARY

Eleven forage-type pearl millet lines were grown during the summer of 1980, sampled, and analyzed for total alkaloid and nitrate content. Millet leaves (making up 62% of the whole plant sampled) contained more total alkaloid and less nitrate than stems. Large differences in alkaloid and nitrate content existed between the millet lines. Alkaloid content increased six-fold from the lowest to the highest entry, and nitrate content increased four-fold over the same span. Each pearl millet line ranked similarly for alkaloid and nitrate content; alkaloid and nitrate accumulation occurred simultaneously in this study. Drought tolerant entries accumulated higher levels of alkaloid and nitrate than the other entries.

Introduction

Pearl millet is frequently planted in late spring to provide mid-summer annual grazing for young growing cattle or for lactating dairy cows. It has been reported that pearl millet became unpalatable when growing under apparent drought stress conditions in East Texas. Laboratory analyses revealed that the unpalatable millet forage contained higher than normal levels of total alkaloids and potentially toxic levels of nitrates. The primary objectives of this study were to: (1) examine factors which may affect alkaloid and nitrate accumulation in pearl millet forage; (2) determine if alkaloid and nitrate levels varied between different pearl millet breeding lines; and (3) ascertain if alkaloids and nitrate indeed accumulate simultaneously in these breeding lines.

Procedures

The pearl millet lines included in this study were:

1. Millex 24[1] - hybrid pearl millet
2. Tift 23DA[2] - female parent of many pearl millet hybrids in U.S.
3. Tift 23B trichomed - normal pearl millet

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[1] Courtesy of Northrup-King Seed Co.

[2] Lines 2-11 courtesy of Dr. W. W. Hanna, Research Geneticist, USDA Coastal Plain Experiment Station, Tifton, GA 31794.

4. Tift 23B trichomeless - smooth mutant that shows drought tolerance (identical to 23B trichomed except for tr gene)
5. Tifleaf 1 - hybrid
6. Gahi 3 - hybrid
7. Inbred 383 - male parent of Tifleaf 1
8. Inbred 186 - male parent of Gahi 3
9. 78-10414-6 - drought tolerant experimental line
10. 78-9815-10 - drought tolerant experimental line
11. 78-10294-1 - drought tolerant experimental lines

The lines were seeded on June 24, 1980 at 20 lb/acre on an upland Darco soil. The lines received 100 lb/acre each of N, P_2O_5, and K_2O at planting, plus an additional 50 lb/acre N on July 29, 1980. Millet samples were taken on August 8, 1980, divided into leaf and stem components, and analyzed for total alkaloid and nitrate content. Total basic alkaloids were extracted and measured by titration with p-toluenesulfonic acid. Nitrate levels were determined with a specific ion electrode.

Results

Mean leaf alkaloid content for the 11 millet lines, 89 ppm total alkaloid, was significantly higher than the mean stem content, 20 ppm ($P<0.01$). Mean leaf nitrate content, 3,859 ppm nitrate , was significantly lower than the mean stem content, 10,830 ppm ($P<0.01$). Pearl millet line alkaloid levels differed significantly ($P<0.05$) (Table 1). Line nitrate levels also differed significantly ($P<0.05$) (Table 2). The millet lines ranked similarly for alkaloid and nitrate content, and were significantly and positively correlated ($r = 0.45$, $P<0.01$). Of particular interest is that Tift 23DA, female parent of many U.S. millet hybrids, falls into the highest alkaloid and nitrate range. Also of importance is that three out of four drought tolerant entries rank in the highest alkaloid range, and all four entries appear in the highest nitrate range. Thus, in this study, alkaloid and nitrate levels differ between millet lines, and these antiquality agents accumulate simultaneously. Also, lines showing more drought tolerance seem to accumulate higher levels of total alkaloid and nitrate. None of the line nitrate levels entered the accepted potentially toxic range, which begins at about 15,000 ppm nitrate.

Table 1. Whole plant alkaloid content for 11 pearl millet lines.

Line	Whole Plant Alkaloid Concentration (ppm)
Tift tr 23B	121 a
Inbred 186	112 ab
78-10294-1	99 abc
78-9815-10	77 abc
Gahi 3	73 abc
Tift 23DA	54 abc
Tift Tr 23B	47 abc
Tifleaf 1	37 bc
Millex 24	29 c
Inbred 383	27 c
78-10414-6	20 c

[abc]Alkaloid contents followed by the same letter are not significantly different at the 0.05 level using Duncan's New Multiple Range Test.

Table 2. Whole plant nitrate content for 11 pearl millet lines.

Line	Whole Plant Nitrate Concentration (ppm)
Tift tr 23B	9809 a
78-10294-1	8356 ab
78-9815-10	7969 ab
Tifleaf 1	7261 ab
Tift 23DA	7238 ab
78-10414-6	6825 ab
Inbred 186	5747 abc
Gahi 3	5691 abc
Tift Tr 23B	4892 bc
Millex 24	4877 bc
Inbred 383	2406 c

[abc]Nitrate contents followed by the same letter are not significantly different at the 0.05 level using Duncan's New Multiple Range Test.

Rate of Application and Source of Nitrogen on Yield of Coastal Bermudagrass

F. M. Rouquette, Jr. and M. J. Florence*

SUMMARY

Nitrogen was applied to Coastal bermudagrass at the rate of 400 lbs/acre as either ammonium nitrate, urea, Nitroform®, or a percentage mixture of ammonium nitrate:Nitroform. The various sources were applied either as a single application at the beginning of the growing season, or as equally split applications throughout the season. Nitroform was also applied at the single application rate of 600 lbs/acre nitrogen. The 2-year average yields ranged from 12,453 lbs/acre dry matter for Nitroform in a single application to 14,413 lbs/acre dry matter for the 80:20 mixture of ammonium nitrate:Nitroform. In general, nitrogen supplied in a single application as any source and the high percentage mixture of Nitroform (20 $AmNO_3$:80 Nitroform) had the lowest average yield of the ten treatments.

Introduction

The need for nitrogen in the production scheme of Coastal bermudagrass has been well established. With the ever-increasing demand for fossil fuel products and by-products, the method of application and the source of nitrogen fertilizers are critical to the economic stability of forage-livestock operations in the Southeastern U. S. Current bulk fertilizer application costs are $15.00 to $20.00 per ton. Therefore, if less applications can be made through the use of heavier rates of nitrogen and/or slow release nitrogen fertilizers, the economic impact for the producer may be significant. The primary objective of this trial was to determine the influence of application rate and source of nitrogen on Coastal bermudagrass using conventional and slow-release sources of nitrogen.

Procedure

Nitrogen was applied to Coastal bermudagrass as ammonium nitrate (33.5-0-0), urea (45-0-0), and Nitroform® (38-0-0) at the rate of 400 lbs/acre in single and split applications. Nitroform was also supplied in a single application at the rate of 600 lbs/acre nitrogen (Table 1). Phosphorus (0-46-0) and potassium (0-0-60) were applied at initiation of the growing season at the rate of 100 lbs/acre P_2O_5 and 200 lbs/acre K_2O, respectively. Treatments were replicated four times in a randomized complete block design, and the bermudagrass was harvested at the hay stage of growth.

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Results

During 1980, dry matter production of Coastal bermudagrass ranged from 8,121 lbs/acre from Nitroform supplied in two applications of 200 lbs/acre each to 11,435 from the 80:20 mixture of ammonium nitrate:Nitroform (Table 2). However, the reverse combination of ammonium nitrate:Nitroform (20:80) produced one of the lowest yields. Dry matter production was also apparently suppressed by the single applications of both ammonium nitrate and Nitroform at 400 lbs/acre nitrogen. In general, yields were relatively low on all treatments.

Dry matter yields during 1981 were nearly double those of the preceding year on some treatments (Table 3). Both the urea and Nitroform sources, when supplied in a single application, produced the least amount of forage. The other 8 treatments were surprisingly similar in production. The 2-year average yields are shown in Table 4. The lowest dry matter production occurred on the 400 lb/acre nitrogen rate of Nitroform supplied in a single application; whereas, the highest yield occurred with the 80:20 mixture of ammonium nitrate:Nitroform.

Table 1. Nitrogen rate and source treatments applied broadcast to Coastal bermudagrass.

Treatment	N rate (lbs/ac)	N source	Application
1	400	Ammonium nitrate	100 lbs initial 100 lbs after each cut
2	400	Ammonium nitrate	One application
3	400	Urea	One application
4	400	Nitroform®	One application
5	600	Nitroform	One application
6	400	Nitroform	200 lbs initial 200 lbs mid-season
7	400	20% $AmNO_3$: 80% Nitroform	100 lbs initial 100 lbs after each cut
8	400	40% $AmNO_3$: 60% Nitroform	100 lbs initial 100 lbs after each cut
9	400	60% $AmNO_3$: 40% Nitroform	100 lbs initial 100 lbs after each cut
10	400	80% $AmNO_3$: 20% Nitroform	100 lbs initial 100 lbs after each cut

Table 2. Initial dry matter production of Coastal bermudagrass as influenced by rate and source of nitrogen.

Treatment	6-11-80	7-12-80	8-20-80	10-30-80	TOTAL
	lbs/acre				
1	5,857	1,173	883	3,184	11,097
2	4,406	1,823	672	2,253	9,154
3	6,006	1,894	615	2,196	10,711
4	5,165	1,250	764	1,921	9,100
5	6,186	1,492	936	2,317	10,931
6	3,786	947	1,125	2,263	8,121
7	3,764	903	999	2,905	8,571
8	5,265	1,519	1,088	3,331	11,203
9	4,831	1,118	1,060	3,336	10,345
10	5,877	1,159	1,038	3,361	11,435

Table 3. Second-year dry matter production of Coastal bermudagrass as influenced by rate and source of nitrogen.

Treatment	6-1-81	6-30-81	7-28-81	11-5-81	TOTAL
	lbs/acre				
1	5,385	4,198	3,622	3,682	16,887
2	6,236	3,766	3,430	4,018	17,450
3	5,841	3,934	2,746	3,274	15,795
4	4,869	3,694	3,118	4,125	15,806
5	5,877	3,850	3,334	3,670	16,731
6	5,673	4,066	3,466	3,802	17,007
7	5,553	4,054	3,574	3,718	16,899
8	5,526	4,030	3,778	4,006	17,342
9	5,217	3,982	3,886	4,149	17,234
10	5,337	4,341	3,850	3,862	17,390

Table 4. Two-year average production of Coastal bermudagrass as influenced by rate and source of nitrogen.

Treatment	1980	1981	2-yr Avg.
	----------	lbs/acre	----------
1	11,097	16,887	13,992
2	9,154	17,450	13,302
3	10,711	15,795	13,253
4	9,100	15,806	12,453
5	10,931	16,731	13,831
6	8,121	17,007	12,564
7	8,571	16,899	12,735
8	11,203	17,342	14,273
9	10,345	17,234	13,790
10	11,435	17,390	14,413

Soil Fertility Management for Selected Forages

A. S. Mangaroo*

SUMMARY

The forage yields of Klein, Limpo, Callie-Bermuda, Tifton-44 and SS-16 grasses were significantly increased by N fertilization applied at 262 kg/ha but not by P. Protein contents of the various forages were inversely proportional to DMY yields and did not increase appreciably by increase in N or P.

Procedure

Plots of each cultivar were established 1980 on the Hockley fine sandy loam of the Prairie View A&M University Cooperative Research Center. For this study there were 3 plots of each grass in each of 4 blocks (replications) representing 3 soil N levels of 22, 262, and 502 kg/ha N as NH_4NO_3, the first level being native N and the others being split applications of 60 and 120 kg/ha each in spring and following each harvest. Each block was split in 3 to accommodate soil P levels of 7, 207, and 407 kg/ha P as Superphosphate, the first level being native P and the others being split applications of 50 and 100 kg/ha each in the spring and following each harvest. In the spring all the plots were treated with K at 120 kg/ha and limed to pH 6.2. Cuttings were taken in May, June, July and September and dry matter yields (DMY) and crude protein determined.

Results

Analysis of variance (Table 1) of the seasonal (total) DMY of the forages as a function of soil N and/or P indicated that seasonal DMY were significantly influenced by replication, soil N and variety interaction. Seasonal DMY were not significantly influenced by soil P nor any of its interactions.

The mean seasonal DMY of the forages as a function of soil N level is given in Table 2. Significant increases in mean seasonal DMY were detected for all the grasses at the 262 kg/ha level of soil N. No signifcant increases in DMY for any cultivar were detected when the soil N level increased to 407 kg/ha, in fact in almost every instance it can be observed that a decrease in yield resulted. The latter DMY trends were also evident for each harvest date.

The percentage of crude protein in the forages at different soil N levels are given in Table 3. Tifton-44 and SS-16 which yielded the lowest seasonal DMY had the highest concentration of crude protein, 8.73 to 10.02%. Limpo and Kleingrass which showed the greatest seasonal DMY had the lowest concentration of crude protein, 6.98 to

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8.08%. Callie was intermediate. Increases in N and/or P level in the soil did not significantly affect protein concentration in Tifton-44 forage. Similar trends in protein contents at different N and P levels were evident for the various forages of other cultivars.

Table 1. Analysis of Variance of the Seasonal DMY of the Grasses as a Function of Soil N and/or P

Source of Variation	DF	PR>F
Replication	3	**
Nitrogen	2	**
N x Rep.	6	N.S.
Phosphorus	2	N.S.
N x P	4	N.S.
N x P x Rep	18	N.S.
Variety	4	**
N x Variety	8	**
P x Variety	8	N.S.
N x P x Variety	16	N.S.

* Significant at 5% level
** Significant at 1% level

Table 2. Mean Seasonal DMY (kg/ha) of the Forages as a Function of N Level

N Level	Klein	Limpo	Callie	SS-16	Tifton-44
22	7255	8196	6896	6400	7460
262	10588	10290	9977	8555	9044
502	10434	10172	8756	8577	8739

Table 3. Percent Crude Protein in the Forages

	Tifton-44			SS-16	Limpo	Callie	Klein
	PI	PII	PIII	PI	PI	PI	PI
NI.	8.93	8.73	8.70	9.18	6.89	8.03	7.73
NII.	9.14	9.81	8.63	8.64	7.33	8.71	7.04
NIII.	8.80	9.44	8.90	10.02	8.08	8.74	7.41

Evaluation of Alfalfa Response to Phosphorus and Potassium Fertilization

E. C. Holt and P. A. Rich[1]

SUMMARY

Brazos River bottom soils are generally high in phosphorus and potassium. A test was conducted in 1978-80 to determine if phosphorus and potassium fertilization improves the performance of alfalfa on these soils. Phosphorus was applied at the rates of 60, 120 and 180 pounds per acre as top dressing in 1978 and again in 1980. Potassium was applied at the rate of 120 pounds per acre in combination with 120 and 180 pounds of phosphorus. A significant response to phosphorus occurred in 1980 accounted for largely by the 60 pounds per acre rate. There was no response to potassium in addition to phosphorus.

Introduction

Alfalfa is well adapted to the Brazos River bottom soils which are high in phosphorus and potassium. A test conducted in the Brazos River bottom near College Station in the late 1940's showed no response the first year to 80 pounds of phosphoric acid annually but increasing responses in the succeeding two years (1). Some stand failures and poor performances in recent years have raised the question of adequacy of phosphorus and potassium. A test was initiated in 1978 to provide information on this question.

Experimental Procedure

'Moapa' alfalfa was seeded in 12-inch drill rows at the rate of 10 pounds of seed per acre on December 19, 1977. The soil is an alluvial Norwood fine silty loam (fine, loamy, mixed, thermic typic udifluvents) in the Brazos River bottom near College Station. The plots are 5' x 20' with harvest from the center 3' x 17'. The following fertilizers were applied at planting and again in April, 1980: 0-0-0, 0-60-0, 0-120-0, 0-180-0, 0-120-120, 0-180-120. Harvests were made in the 1/10-1/4 bloom stage on the dates shown in Table 1.

Results

Good stands were obtained and no winter damage occurred even though the test was planted late (Dec. 19). The yield data are given in Table 1. Average annual yields were 5 tons per acre and increased about 500 pounds per year. The only treatments that did not show an increasing trend in 1980 were the check (0-0-0) and 0-120-120.

Statistical analysis were conducted only on the three-year data so differences among years or among treatments within years have not

KEYWORDS: Alfalfa, hay, fertilization, phosphorus, potassium.

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been tested statistically. There appeared to be no trend or pattern among treatments until 1980 unless it was toward a reduced yield with higher combination rates of P and K in 1978. The three-year averages show a significantly higher ($P < .10$) yield with phosphorus than without phosphorus. The difference required for significance per cutting is 172 pounds. The K effect was not significant.

Visual inspection of the data indicate that the P effect did not show up until 1980. Both visual inspection of the data and the significant quadratic component indicate that the response is entirely to the first 60 pounds of P_2O_5. These data agree with those reported earlier (1) at this location and indicate that soil phosphorus is fairly adequate during the first one or two years, but that phosphorus fertilization is necessary for sustained production of high yields.

Literature Cited

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Table 1. Yield of Moapa alfalfa with varying phosphorus and potassium levels, Brazos River Bottom near College Station

Harvest	0-0-0	0-60-0	0-120-0	0-180-0	0-120-120	0-180-120
6/2/78	2510	2620	2590	2480	2190	2520
7/11/78	3720	3650	3590	3130	3510	3280
8/15/78	1530	1670	1420	1180	1420	1220
9/26/78	2530	2500	2240	2300	2390	2260
Total	10290	10440	9840	9090	9510	9280
6/12/79	2420	2360	2520	2450	2460	2380
7/18/79	3030	2900	2500	2870	2860	2860
8/14/79	2480	2690	3080	2660	2290	2790
9/24/79	2400	2510	2240	2170	2410	2360
Total	10330	10460	10340	10150	10020	10390
5/27/80	3480	4360	4480	4390	3830	4770
6/20/80	2120	2450	2420	2730	2100	2530
7/21/80	2150	2430	2600	2710	2270	2560
9/23/80	1550	1840	2010	1740	1770	2060
Total	9300	11080	11510	11570	9970	11920

Nitrogen vs Clover on Pensacola Bahiagrass

G. W. Evers*

SUMMARY

Pensacola bahiagrass production did not increase significantly above 225 lb N/ac. Total production of Pensacola bahiagrass overseeded with clovers was similar to bahiagrass receiving 150 to 200 lb N/ac. Mt. Barker subterranean and Yuchi arrowleaf clovers produced 2000 and 500 lb/ac respectively by Mar. 29. Summer nitrogen fertilization of clover-bahiagrass plots reduced Mt. Barker and Yuchi growth the following winter and early spring by 33 and 64%, respectively. Overseeded clovers provided as effective spring weed control as Princep.

Introduction

Clovers are overseeded on warm season perennial grasses in an effort to substitute symbiotically fixed nitrogen for expensive nitrogen fertilizer. The addition of clovers also extends the grazing season which reduces the winter feeding period. The extent of these clover benefits will depend on the forage species and the management, climatic and edaphic conditions under which they are grown. The effects of nitrogen rates, overseeding clovers and applying Princep for weed control was investigated on the production and distribution of Pensacola bahiagrass.

Methods and Materials

Pensacola bahiagrass was seeded on a Crowley very fine sandy loam at Eagle Lake in the spring of 1977. In 1978 and 1979 treatments were 0, 75, 150, 225 and 300 lb N/ac and 0, 75 and 150 lb N/ac plus 1 lb/ac of Princep applied in late February for weed control. Nitrogen treatments were divided in three equal applications on Apr. 1, June 1 and Aug. 1. Additional treatments were bahiagrass overseeded in the fall of 1978 with Yuchi arrowleaf and Mt. Barker subterranean clovers with no nitrogen or 50 lb N/ac on June 1 and Aug. 1.

Ninety pounds of phosphorus and 60 lb potassium per acre were applied each fall. Plots were 6 x 15 ft in a randomized block design with four replications. Plots were harvested about once a month with a flail mower at a 1 inch height. Botanical composition was estimated visually.

Results and Discussion

Forage production increased as nitrogen rate increased but with no significant gain above the 225 N rate for the nitrogen only treatments (Table 1). Approximately half of the total forage production occurred

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Table 1. Forage production of Pensacola bahiagrass overseeded with clover or receiving nitrogen fertilizer 1979.

	Harvest dates								
	Dec. 19	Mar. 29	May 7	June 11	July 9	Aug. 16	Sept. 11	Oct. 16	Total
	lb/ac								
0 N			635 f	1141 f	775 ef	882 de	369 bc	113 cd	3915 h
75 N			1026 ef	1587 de	1014 de	1212 bcd	360 bc	177 cd	5376 fg
150 N			1417 de	2065 bc	1351 bc	1421 b	382 bc	245 abc	6881 de
225 N			2474 a	2809 a	1499 ab	1425 b	494 bc	317 ab	9018 ab
300 N			2041 abc	2905 a	1498 ab	1953 a	536 bc	361 a	9294 a
0 N + Princep			1048 ef	1392 ef	655 f	619 e	328 c	108 d	4160 gh
75 N + Princep			1557 cde	1800 cd	1032 de	1112 b-e	367 bc	147 cd	6015 ef
150 N + Princep			1841 bcd	2371 b	1350 bc	1330 bc	551 bc	212 bcd	7655 bcd
Yuchi		548 b	2263 ab	1819 cd	1580 ab	617 e	347 c	146 cd	7320 cde
Yuchi + 100 N		197 c	2411 ab	2113 bc	1347 bc	763 de	651 b	240 a-d	7722 bcd
Mt. Barker	727 a*	1360 a	2341 ab	1490 def	1148 cd	669 e	602 bc	158 cd	8495 abc
Mt. Barker + 100 N	338 b	1058 a	2601 a	1529 def	1725 a	673 e	961 a	231 bcd	9116 ab

*Yields within a column followed by the same letter are not significantly different at .05 level, Duncan's Multiple Range Test.

by the second harvest on June 11. The low production in summer and early fall is due to the low water holding capacity of the shallow soil. A clay pan 10 to 14 inches below the soil surface restricts water and root penetration. Rainfall in excess of ½ to 3/4 inch is lost through evaporation or run off. Therefore rain or irrigation is required every 10 to 14 days to maintain grass growth.

Princep improved forage production at the first harvest at all three nitrogen rates but only the 75 N rate was significantly higher. In contrast to Coastal bermudagrass and dallisgrass, bahiagrass forms a thick tight sod which is very competitive to emerging weed seedlings.

Mt. Barker subterranean and Yuchi arrowleaf clovers produced 2000 and 500 lb/ac, respectively by Mar. 29. Total production of Pensacola bahiagrass overseeded with clovers was similar to bahiagrass receiving 150 to 200 lb N/ac. Applying 50 lb N/ac on June 1 and Aug. 1 to clover-bahia mixtures the previous growing season reduced forage production of Mt. Barker and Yuchi by 33 and 64%, respectively. Summer fertilization increased grass growth and vigor so that it was more competitive to the fall emerging clover seedlings.

There was little difference in weed production in the nitrogen only treatments at the May 7 harvest (Table 2). Applying Princep significantly reduced weed yields at each of the three low nitrogen treatments. Weed production on bahiagrass overseeded with clovers was not significantly different from the Princep treatments.

Table 2. Weed production on Pensacola bahiagrass at May 7 harvest.

	lb/ac		lb/ac
0 N	360 b*	0 N + Princep	7 d
75 N	640 a	75 N + Princep	158 bcd
150 N	385 b	150 N + Princep	45 d
225 N	363 b	arrowleaf	101 cd
300 N	313 bc	subclover	37 d

*Yields followed by the same letter are not significantly different at .05 level, Duncan's Multiple Range Test.

Nitrogen vs Clover on Coastal Bermudagrass

G. W. Evers*

SUMMARY

Coastal bermudagrass overseeded with Yuchi arrowleaf or Mt. Barker subterranean clovers produced as much fcrage as Coastal alone with about 100 lb N/ac. Mt. Barker and Yuchi produced 2400 and 500 lb/ac respectively by March 29. Applying 50 lb/ac on June 1 and Aug. 1 the previous growing season restricted clover growth by 60 percent. There was no significant difference in weed production on plots seeded with clover or sprayed with Princep.

Introduction

Major advantages of adding clovers to warm season perennial grasses are to extend the grazing season and use atmospheric nitrogen instead of expensive nitrogen fertilizer. The degree of improvement is dependent on adaptability and growth rate of the clover and grass and how they are managed and utilized. Performance of specific clover-grass mixtures needs to be characterized for the contrasting climatic regions of the state. Forage production and distribution of Coastal bermudagrass receiving various nitrogen fertilizer rates with and without Princep or overseeded with Yuchi arrowleaf for Mt. Barker subterranean clovers was determined on a fine sandy loam rice soil in Southeast Texas.

Methods and Materials

Coastal bermudagrass was sprigged on a Crowley very fine sandy loam at Eagle Lake in the spring of 1977. In 1978 and 1979 treatments were 0, 75, 150, 225 and 300 lb N/ac and 0, 75 and 150 lb N/ac plus 1 lb/ac of Princep applied in late February for weed control. Nitrogen treatments were divided in three equal applications on April 1, June 1 and August 1. Additional treatments were Coastal overseeded in the fall of 1978 with Yuchi arrowleaf and Mt. Barker subterranean clovers with no nitrogen or 50 lb N/ac on June 1 and August 1.

Ninety pounds of phosphorus and 60 lb potassium per acre were applied each fall. Plots were 6 x 15 ft in a randomized block design with four replications. Plots were harvested about once a month with a flail mower at a 1 inch height. Botanical compostion was estimated visually.

Results and Discussion

Forage production increased as the nitrogen rate increased on the treatments that received nitrogen only (Table 1). However, there was not a significant forage increase from the 225 to 300 N treatment. Coastal is more responsive to high N rates on deep soils. On this soil, root growth is restricted by a clay pan 10 to 14 inches below the soil surface. This frequently causes moisture to be the most limiting factor during summer and early fall. One third of the total yield was produced

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Table 1. Forage production of Coastal bermudagrass overseeded with clover or receiving nitrogen fertilizer 1979.

	Harvest dates								
	Dec. 19	Mar. 29	May 9	June 5	July 16	Aug. 22	Sept. 17	Oct. 18	Total
	lb/ac								
0 N			1576 d	805 f	792 c	345 def	248 e	228 d	3994 i
75 N			2198 cd	1088 ef	1545 b	390 c-f	532 cde	483 cd	6236 gh
150 N			3192 b	1792 cd	2143 a	454 b-e	624 b-e	807 ab	9012 de
225 N			4902 a	2379 b	2191 a	554 b	601 b-e	896 ab	11523 ab
300 N			4598 a	3373 a	2128 a	721 a	900 abc	985 a	12705 a
0 N + Princep			2263 cd	895 f	712 c	283 f	243 e	243 d	4639 i
75 N + Princep			3458 b	1498 de	1535 b	459 b-e	542 cde	420 cd	7912 ef
150 N + Princep			4537 a	2208 bc	2107 a	502 bcd	677 a-d	751 ab	10782 bc
Yuchi		483 bc	2911 bc	1492 de	2173 a	388 c-f	505 cde	271 d	8223 e
Yuchi + 100 N		190 c	2160 cd	1119 ef	1075 bc	405 bf	1036 a	667 bc	6652 fg
Mt. Barker	883 a*	1487 a	2912 bc	861 f	1027 bc	303 ef	300 de	347 d	8120 e
Mt. Barker + 100 N	405 b	562 b	2772 bc	1144 ef	2443 a	539 bc	948 ab	739 ab	9552 cd

*Yields within a column followed by the same letter are not significantly different at the .05 level, Duncan's Multiple Range Test.

by May 9 and over half by June 5. Applying Princep for weed control allowed a significant forage increase at the 75 and 150 N rate at the first harvest and for total yield.

Overseeding with clover did provide earlier forage production. Mt. Barker subterranean clover produced over a ton of dry matter by March 29. Summer nitrogen application the previous growing season restricted Yuchi and Mt. Barker growth by 60 percent. Nitrogen fertilization of clover-Coastal mixtures stimulated grass growth which made the grass sod more competitive to the fall emerging clover seedlings. Coastal overseeded with clovers produced as much forage as Coastal alone with about 100 lb of nitrogen.

Weed production in the nitrogen only treatments decreased as nitrogen rate increased (Table 2). The higher nitrogen rates caused a more competitive sod which restricted weed growth. Princep significantly reduced weed production at all three nitrogen rates. Weed yields on plots overseeded with clovers were not significantly different from the Princep treated plots.

Table 2. Weed production at May 9 harvest.

	lb/ac		lb/ac
0 N	1355 a*	0 N + Princep	122 de
75 N	1213 a	75 N + Princep	154 cde
150 N	990 ab	150 N + Princep	81 de
225 N	695 bc	arrowleaf	206 cde
300 N	590 bcd	subclover	330 cde

*Yields followed by the same letter are not significantly different at the .05 level, Duncan's Multiple Range Test.

Evaluation of Alfalfa Cultivars for Hay Production

E. C. Holt[1]

SUMMARY

Fourteen alfalfa varieties were evaluated for yield during a three-year period in the Brazos River bottom near College Station. Several varieties averaged over 6 tons production per acre over the three-year period even though two cuttings were lost because of insect damage. Alfalfa weevil and fall army worm were the insects causing the most damage.

Introduction

Alfalfa is recognized as the "Queen of Hay" plants because of its high level of potential production and excellent forage quality. Alfalfa is best adapted to deep, fertile, well-drained soils. While alfalfa is drought resistant in terms of plant survival, it requires large amounts of water for maximum production. Approximately 80% of the acreage grown for hay in Texas is found in the High Plains, Rolling Plains, and Trans-Pecos areas. The remaining acreages are largely in the Red, Brazos, and Rio Grande River bottoms. The High Plains, Trans Pecos, and Rio Grande River bottom acreages are essentially all irrigated. Average hay yield is about 4.7 tons per acre, ranging from less than 3 tons to more than 6 tons.

Experimental Procedure

The varieties listed in Table 2 were planted October 13, 1977 on alluvial Miller clay soil at College Station (Brazos River--bottom). Seeding rate was 15 pounds of seed per acre. Plots consisted of 5 12-inch rows, 20 feet long, replicated 5 times. Harvests were made in the early bloom stage except when delayed by rainfall. The plot area received 0-60-0 fertilizer at planting, April 1979 and April 1980. Approximately 3 acre inches of irrigation water were applied each on June 21 and August 15, 1978, July 3 and July 9, 1979. Rainfall recorded near the test site at College Station is shown in Table 1.

Results and Discussion

Alfalfa planted in the fall of 1977 at College Station produced 2 tons of hay per acre by the following May (Table 2). Four cuttings were harvested each in 1978 and 1979 and 3 cuttings in 1980. Regrowth following the August 1979 harvest was defoliated by fall army worms and not harvested. Similarly, the first growth in 1980 which should have been harvested in late April was defoliated by the Alfalfa weevil during a rainy period when we could not get into the field to control the insect.

KEYWORDS: Alfalfa varieties, hay yield, insect damage.

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There were no significant differences among varieties in production during the three-year period. Yield per cutting was as high in 1980 as in 1978. Yield per year was down in the third year but due to the loss of one cutting from insect damage which did not occur in 1978. Also, rainfall was very limited in 1980 and no irrigation water was applied.

There is some indication that some varieties were losing vigor while others were not. Arc increased in yield each year while Mesilla and Williamsburg decreased each year. The difference between Arc and each of the two decreasers showed a significant ($P<0.05$) linear relationship. Stands of all cultivars in the spring of 1981 appeared to be satisfactory for production.

Insects are a major problem at times in alfalfa production, fall army worms and alfalfa weevil referred to previously being specific examples. Both are controllable with insecticides but require close monitoring because excessive damage can occur within short periods. Alfalfa cultivars are available that are resistant to one or more of the following insects: alfalfa weevil, spotted alfalfa aphid, pea aphid, and potato leaf hopper. However, insecticides to control alfalfa weevil may be necessary at times even with resistant varieties.

Inadequate soil moisture may severely restrict alfalfa yields at times. Apparently this was the reason for the lack of a fall cutting in 1980. There was essentially no effective rainfall from May until September 8. Only erratic regrowth occurred after the August 1 harvest. Recovery was poor after early September rainfall until after the first of October. Conditions did not permit the late fall growth to reach the bloom stage.

The data in this report indicate that alfalfa with adequate insect control will produce in excess of 5 tons of hay annually and that stands may be expected to persist three or more years under most conditions in the Brazos River bottom. The performance of additional varieties in the Brazos River bottom has been reported by Holt (1). Less drought stress was encountered in the earlier study, and yields ranged from 5 to 8 tons per acre over a three-year period.

Literature cited

Holt, Ethan C. 1978. Evaluation of alfalfa varieties for hay production. Texas Agric. Exp. Sta. PR-3481. 6 P.

Table 1. Rainfall during the growing season, University Farm, Burleson County, near College Station

	Rainfall in inches		
Month	1978	1979	1980
March	2.72	4.77	5.65
April	1.62	3.93	1.44
May	2.49	9.23	5.97
June	3.85	1.13	.61
July	.87	5.01	.38
August	.45	1.12	.20
September	7.56	1.30	3.97
October	3.18	1.30	3.22

TABLE 2. HAY PRODUCTION OF ALFALFA CULTIVARS, BRAZOS RIVER BOTTOM, BURLESON COUNTY, NEAR COLLEGE STATION

Cultivar	Date of Harvest[1] 1978 May 16	1978 June 21	1978 July 18	1978 Sept 26	1978 Total	1979 April 25	1979 June 22	1979 July 23	1979 Aug 28	1979 Total	1980 June 2	1980 June 28	1980 Aug 1	1980 Total	Average per cutting[2]
1 Arc	4520	3100	2290	1780	11690	2690	4220	3200	2560	12670	6230	2510	2040	10780	3195
2 Olympic	4650	4430	2550	1910	13540	2310	4690	3220	2440	12660	5450	2760	1510	10020	3293
3 Kan 2A	4130	3940	2560	2080	12710	1400	3960	3040	2610	11010	5440	2720	2040	10200	3084
4 NAP B42	4830	4160	2640	2010	13640	2260	4630	3320	2470	12680	5590	2570	1810	9970	3299
5 Saranac	3810	4330	2150	1840	12130	1820	4130	2940	2720	11610	5010	2440	1830	9280	3002
6 WL512	4360	3960	2740	2020	13080	1420	3560	2910	2860	10750	4520	2620	2090	9230	3006
7 Apollo	4260	4050	2750	2120	13180	1910	4760	2830	2190	11690	5360	2780	2260	10400	3206
8 Team	4460	4000	2330	1970	12760	2880	4460	3360	2450	13150	5820	2680	1730	10230	3268
9 Williamsburg	4210	4320	2110	1890	12530	1780	4310	3300	2690	12080	4450	2390	1780	8620	3021
10 Dawson	3770	4050	2360	1770	11950	1920	5180	3010	2320	12430	4570	2170	1870	8610	2999
11 WL318	4390	4460	2540	1190	13290	2140	3830	3170	2810	11950	5170	2730	2270	10170	3219
12 Zia	3620	4120	2730	1910	12380	1650	4310	2870	2770	11600	4740	2650	1840	9230	3019
13 Mesilla	4370	3970	2530	2180	13050	1330	3880	2900	2430	10540	3460	2660	2020	8140	2885
14 Moapa	3760	4130	3000	2070	12960	1180	3470	2990	2740	10380	4700	2560	2190	9450	2981

[1] Pounds dry forage per acre

[2] Values not significantly different ($P > 0.05$)

Alfalfa Variety Performance in the Brazos River Bottom

E. C. Holt and P. A. Rich[1]

SUMMARY

Alfalfa produces relatively high yields of high quality hay on the Brazos River bottom alluvial soils. Twenty-four cultivars (varieties) were planted on Norwood sandy loam in late October 1979 and harvested five times and six times in the early bloom stage in 1980 and 1981, respectively. The first cutting in 1980, lost to alfalfa weevil damage and not included in the yields, averaged 2.2 tons per acre on undamaged plants. There was no effective rainfall from May 16 to September 7, 1980. The plot area was irrigated (approximately 3 inches) on July 18 and again on August 25, 1980. Several cultivars produced approximately six tons of hay each year with two tons of that being lost in 1980 due to alfalfa weevil damage and not included in the reported yields. If the estimated yield lost to alfalfa weevil damage is included in 1980, production in an extremely dry season with two irrigations was approximately the same as in 1981 which was a good rainfall year.

Introduction

Alfalfa is adapted to the alluvial soils of the Brazos River bottom. Four to six cuttings of hay may be expected with annual production in the range of five to six tons per acre. Alfalfa weevil is currently the most critical insect pest though other insects pose some hazard to either production or the harvested hay. Stand persistence is generally limited to two to four years. This study is being conducted to evaluate the potential of a number of cultivars for production and for stand persistence.

Experimental Procedure

Twenty four cultivars or experimental lines of alfalfa were seeded on November 14, 1979 on Norweed sandy loam soil (fine loamy, mixed, thermic, Udertic Haplustoll). Plots were 5 12-inch rows, 20 feet long, with 6 replications. The seeding rate was 20 pounds per acre. Plots were harvested and dry forage yields determined on May 23, June 20, August 1, September 24 and October 31, 1980; and April 3, May 20, June 29, July 27, September 11 and November 20, 1981. Erratic and very heavy alfalfa weevil damage occurred in May 1980 and rainfall prevented either insecticide treatment or earlier harvest. As a result, a reliable estimate of individual cultivar yield on that date was not possible and the May 23 harvest is not included in Table 1 yields.

The 1980 growing season was extremely dry, no effective rainfall between May 16 and September 26. Total rainfall during that 113-day period was 1.97 inches with no rain exceeding 0.3 inches. Drought stress occurred in irregular patterns in the plot area. Irrigation

KEYWORDS: Hay production, alfalfa, cultivars, alfalfa weevil damage.

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water was applied on July 18 and August 25, approximately 3 inches each time, to reduce variability among plots.

Results and Discussion

Forage yields are summarized in Table 1. The 1980 yields do not include the May 23 cutting which was damaged by alfalfa weevil. Samples harvested from undamaged areas on May 23 indicated an average yield of 2.2 tons per acre which corresponds to expected first cutting yields in the spring of about 2 tons per acre. Harvested yields were in the range of 3 to 4 tons per acre the first year and five to six tons per acre the second year, with a two-year average of 4 to 5 tons per acre. The latter would have been about one ton higher had one cutting not been lost. The yields, even if the May 1980 harvest is included, are a little below previous reports at this same site (Holt, 1978, 1980).

The effect of drought stress on yields was lessened by two irrigations but certainly not eliminated. We think that stands would have survived in the absence of irrigation and that considerable growth would have been made but the data would have been much more variable.

Yield differences among cultivars, approximately one ton each year, were not significant statistically. Cultivar rankings varied to some extent between years. Mesilla which ranked second the first year dropped to 12 the second year and WL 512 dropped from 7 to 16. On the other hand, Cimarron, Williamsburg, K7-28 and Riley moved up in rank in the second year. Florida 66a ranked at the top both years and Common was near the top both years. When insect and disease problems are not encountered, Common usually performs satisfactorily because it is a mixture of types. In the presence of specific diseases or insects, cultivars carrying specific resistance to that pest would be expected to show superior performance.

Literature Cited

1. Holt, E. C. 1980. The performance of alfalfa at selected sites in Texas. In Dairy Research in Texas. Texas Agric. Exp. Stn. CPR-37333751. PR-3748. P. 91-96.

2. Holt, E. C. 1978. Evaluation of alfalfa varieties for hay production. Texas Agric. Exp. Stn. PR-3481. 6 P.

Table 1. Yield of alfalfa cultivars, University Farm near College Station, 1980-81

Cultivar	Tons of dry forage per acre 1980[1]	1981[1]	Average
10 Florida 66a	4.36 (1)	6.12 (1)	5.24 a
4 Common	4.08 (3)	5.94 (2)	5.01 ab
14 WL 318	4.07 (4)	5.46 (4)	4.77 bc
2 Cimarron	3.86 (9)	5.58 (3)	4.72 bc
17 Hi-phy	3.95 (5)	5.40 (7)	4.68 bc
23 Mesilla	4.18 (2)	5.16 (12)	4.67 bc
15 Williamsburg	3.84 (10)	5.46 (5)	4.65 bc
5 Classic	3.86 (8)	5.31 (9)	4.59 bc
3 K7-28	3.80 (12)	5.37 (8)	4.59 bc
1 Riley	3.76 (14)	4.53 (6)	4.59 bc
20 NK-78010 (Raidor)	3.76 (13)	5.19 (11)	4.48 cd
16 WL 512	3.86 (7)	5.04 (16)	4.45 cd
9 Kanza	3.64 (19)	5.28 (10)	4.46 cd
13 Olympic	3.88 (6)	5.01 (17)	4.45 cd
18 NAPB 42 (Vanguard)	3.60 (20)	5.10 (13)	4.35 cd
6 Apollo	3.54 (22)	5.07 (14)	4.31 d
11 K7-29 (Bancor)	3.50 (23)	5.04 (15)	4.27 d
21 Arc	3.72 (16)	4.80 (19)	4.26 d
12 Saranac	3.76 (15)	4.74 (21)	4.25 d
24 Zia	3.66 (18)	4.80 (20)	4.23 d
22 Moapa	3.72 (19)	4.71 (22)	4.22 d
7 Dawson	3.82 (11)	4.59 (24)	4.21 d
8 Team	3.56 (21)	4.92 (18)	4.12 d

[1] Yields were not significantly different, Fisher's LSD, Numbers in ( ) are rankings within years.

[2] Mean separation based on BLSD at 0.05 level.

Evaluation of Temperate Annual Clovers

E. C. Holt and P. A. Rich[1]

SUMMARY

Twelve species of temperate annual clovers and one Medicago species were evaluated for early and total forage production at College Station in 1980-81. Berseem, persian and rose clovers made the best early growth. The best total production was by berseem and subterranian clovers, exceeding 7,000 pounds per acre, followed by rose clover with over 6,000 pounds per acre. Differences within species for both early and total production indicate potential for improvements by breeding.

Introduction

Legumes are needed in forage production because their nitrogen requirements can be met through biological nitrogen fixation. Perennial temperate legumes are generally poorly adapted in Texas because of the hot, dry summer climate. Self-seeding temperate annuals may meet part of the requirements. They have good forage quality and may extend the growing season several weeks when seeded in conjunction with warm-season grasses. This study was conducted to determine the potential of several species and sources within species for early and total forage production.

Experimental Procedure

Twenty-seven cultivars and plant introductions representing 12 Trifolium species and one Medicago species were planted on October 10, 1980 in plots consisting of 5 30-cm rows, 6 m long, 4 replications, on Norwood sandy loam soil. The fall and winter were mild, permitting above average plant growth. Three center rows, 5.1 m long, from each plot were harvested with a flail mower at about 4 cm height on March 25, 1981 for dry matter yield determination. On May 12, 1981, a 0.4 m^2 plant sample was removed from each plot at the soil surface level to estimate total dry matter development exclusive of the previously harvested material.

Results and Discussion

Berseem clover (*T. alexandrium*) made the best early growth, followed closely by persian (*T. resupinatum*), rose (*T. hirtum*) and arrowleaf (*T. vesiculosum*). *Trifolium diffusum* also made good early growth. If total plant top development had been measured at the first harvest, likely subterranean clover also would have shown good early production. Much of its development was likely below the mower height.

KEYWORDS: Temperate legumes, forage production, early production.

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The best total production was by berseem and subterranean clover followed by rose, T. balansae and T. diffusum. Arrowleaf production has been in the range of 6,000 to 7,000 kg/ha in previous studies but totaled only 4,300 to 4,900 kg/ha in this study. Arrowleaf is normally later in maturing than May 12, but made very little growth after that date in 1981.

Seedling vigor and early production is related to some extent to seed size. This could explain the superior early performance of berseem and rose clover and likely subterranean, had total top growth been measured. However, persian clover has smaller seed than arrowleaf, yet early growth equivalent to rose clover. Thus, its ability to emerge and grow rapidly after emergence is not dependent on seed size.

Several species including T. cherangeniense, T. striatum, and T. studeneri were entered in the test because they appear to be perennials. They remain green longer into the summer than other T. species observed at this location. However, none survived the extremely hot and dry conditions encountered in 1980 nor the much milder conditions encountered in 1981. Because of their failure to persist and their low early and total production, they will not be continued. T. diffusum, T. balansae, and T. petrisarvi appear to be about equal to some rose and arrowleaf sources. There may be conditions under which one or more of these species will be superior.

Table 1. Dry matter yield of temperate, annual legumes, College Station, 1981.

Entry number	Species	Cultivar or P.I.	Kg DM/ha 3/25	5/12	Total
20	T. alexandrium	Winterhardy	3410ab	4330bcd	7740
25	T. subterraneum	Nangella	1320jklm	5790a	7110
24	T. subterraneum	Woogenellup	1820ghijk	5200ab	7020
1	T. alexandrium	251213	3900a	3060efg	6860
26	T. subterraneum	Mt. Barker	1770ghijk	4570bc	6340
17	T. subterraneum	Miss. Sel.	1050lm	5220ab	6270
21	T. resupinatum	Abon	2370defg	3740cde	6110
27	T. resupinatum	Resel. Abon	2500def	3560def	6060
9	T. resupinatum	173974	2700cde	3000efg	5700
5	T. hirtum	311485	2790bcde	2880efg	5670
8	T. resupinatum	141503	3090bc	2310ghi	5400
2	T. balansae	120159	2320efgh	3000efg	5320
4	T. diffusum	120144	3010bcd	2310ghi	5320
23	T. hirtum	Wilton	3030bcd	2180ghi	5210
13	T. vesiculosum	233782	2320efgh	2660fgh	4880
7	T. petrisarvi	279926	3310abc	1570ij	4880
18	T. vesiculosum	Amclo	2750cde	1760hi	4610
16	T. vesiculosum	Yuchi	2840bcde	1590ij	4430
19	T. vesiculosum	Meechec	1930fghij	2360ghi	4290
6	T. lappaceum	120153	2410defg	1460ij	4070
10	T. species	383738	2110fghi	1740hi	3850
14	T. vesiculosum	233816	1530ijklm	2220ghi	3750
3	T. cherangeniense	226101	980m	2660fgh	3640
22	T. hirtum	Kondinin	3350abc	100k	3450
11	T. striatum	226676	1030m	1660hi	2690
12	T. studeneri	262239	1270klm	640jk	1910
15	M. obicularis	197351	1680hijkl	100k	1780

[1]Values followed by a common letter are not significantly different at the 0.05 level.

Forage Yields of Irrigated Legumes at Stephenville

Ronald M. Jones and J. C. Read*

SUMMARY

'Redman' red clover, 'Madrid' sweetclover, three cultivars of arrowleaf clover, four cultivars of subterranean clover, five cultivars of vetch, and two cultivars of crimson clover were tested for forage production. Redman produced 5719 pounds dry matter per acre, the highest yield in the test. 'Yuchi' produced more than the other arrowleaf clovers with 5031 pounds. Both 'Nova II' and 'Vanguard' vetch produced over 4900 pounds, which was higher than the other vetch cultivars. Vetch yields were reduced by early spring harvest. Madrid sweetclover produced 4558 pounds, and 'Clare' had the highest production of the subterranean clovers. Although total yield of 'Tibbee' crimson clover was low, early production was greater than any other winter hardy cultivar. Distribution of production among all cultivars ranged from early spring to early summer. All annual cultivars reseeded and produced acceptable stands in the fall of 1981, but common vetch and subterranean clover suffered freeze damage.

Introduction

Legumes have long been recognized as high quality forage and are used for silage, pasture, and hay. Since they have high nitrogen content and utilize atmospheric nitrogen, many species were used as green manure crops before relatively inexpensive nitrogen fertilizer became available. Greater use of legumes may again be necessary as the cost of nitrogen fertilizer continues to rise. This test is an effort to find high-yielding legumes that are well adapted to north central Texas.

Materials and Methods

Sixteen cultivars from seven species were seeded October 9, 1980 on Windthorst fine sandy loam. Fertilizer at the rate of 0-215-0 was applied September 18, 1980 and incorporated by disking. Seed were inoculated with appropriate Rhizobium species and seeded one-half inch deep at recommended rates in rows spaced one foot apart. Plots fifteen feet long and five rows wide were arranged in a randomized complete-block design with four replications.

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Irrigation was applied following planting to aid seedling emergence through crusted soil. Applications of 0.63, 1.0, 1.0, and 0.75 inch were made October 15, 24, 29 and November 14, respectively. Additional irrigation was applied December 1, February 17, and April 7 to supplement rainfall. Moisture that was received by the three harvest dates is shown below Table 1.

Forage was harvested with a flail-type harvester except that the final harvest of subterranean clover was hand clipped. The center three rows of each plot were cut at a height of two inches the full length of the plot. Subterranean clover was cut one inch above ground level from two randomly selected one square foot areas within each plot. The effect on vetch of multiple cutting and early harvest was determined by harvesting separate plots either one, two, or three times.

Results and Discussion

'Redman' red clover and 'Yuchi' arrowleaf clover produced 5719 and 5031 pounds dry matter per acre, respectively, which was more than all others in the test (Table 1). Distribution of yield differed in that 'Yuchi' production essentially ended with the May 12 harvest; 'Redman' growth continued through June, and 2924 pounds per acre were harvested near seed maturation July 15 (Table 1). 'Madrid' sweetclover also continued growth throughout June and was well past full bloom when cut July 15. This late production is attributed to ample rainfall received after the second cutting.

'Vanguard' and 'Nova II' vetch produced higher yields than other vetches and ranked third and fourth, respectively, among all legumes tested (Table 1). Cutting February 16 reduced the April 2 harvest; cutting for the first time on April 2 eliminated further growth (Table 2). Total yields were greater from a single cutting May 12.

'Clare' produced slightly greater yields than the other cultivars of subterranean clover (Table 1). Most of the forage was harvested May 12.

Total production of the crimson clovers was less than all other cultivars (Table 1). However, earliness of production and winter hardiness of 'Tibbee' crimson clover make it more desirable for early forage than all other cultivars tested.

All annual cultivars reseeded and produced acceptable stands in the fall of 1981. However, most were harvested in the bloom stage, and seed were produced only on nonharvested plot edges. Since subterranean clover produced seed at ground level, reseeding was not affected by harvesting.

The common vetch and subterranean clover cultivars suffered freeze damage in January of 1982 from near-record low temperatures of 3 and 4 degrees Fahrenheit on two consecutive days having maximum temperatures of

22 and 27 degrees F. Damage of subterranean clovers was apparently limited to dieback of stems to the crown of the plant. Damage to the vetch included killing of smaller plants as well as stems. Approximately 20% and 75%, respectively, of the stems of subterranean clover and vetch cultivars were killed. No difference in winter hardiness was observed among cultivars within each group.

Acknowledgement

The authors appreciate the contribution of inoculants by the Nitragin Company.

Table 1. Seasonal Distribution and Total Forage Production of Legumes Cut at Three Dates at Stephenville, Texas in 1981.

Legume	Cultivar	Harvest Dates April 2	May 12	July 15	Total[a]
		----Pounds Dry Matter Per Acre------			
Red clover	Redman	294	2501	2924	5719
Arrowleaf clover	Yuchi	772	4259		5031
Arrowleaf clover	Amclo	1330	3136		4466
Arrowleaf clover	Meeche	306	3294		3600
Vetch (Common)	Vanguard		4952		4952
Vetch (Common)	Nova II		4913		4913
Vetch (Common)	Cahaba White		4303		4303
Vetch (Hairy)	Common		4158		4158
Vetch (Common)	Vantage		3950		3950
Sweetclover	Madrid	0	2608	1950	4558
Subterranean clover	Clare	0	4227		4227
Subterranean clover	Tallarook	310	3817		4127
Subterranean clover	Woogenellup	430	3558		3988
Subterranean clover	Mt. Barker	221	3549		3770
Crimson clover	Tibbee	3227			3227
Crimson clover	Dixie	2391	800		3191
Rainfall (inches)		7.31*	1.79**	9.09***	
Irrigation (inches)		6.88*	2.00**	0	

*Since planting October 9, 1980 ** Since first cutting

*** Since second cutting a Mean of four replications

Table 2. Yields of Five Vetch Cultivars Cut in Different Combinations of Dates at Stephenville, Texas in 1981.

Dates	Cahaba White	Hairy	Nova II	Vanguard	Vantage	Mean
	Pounds Dry Matter Per Acre 3/					
Feb. 16	112	16	728	131	88	
April 2 1/	2374	2812	2215	2357	2862	
May 12*	-	-	-	-	-	
Total	2486	2828	2943	2488	2950	2739
April 2 1/	3391	3127	3170	3112	2770	
May 12*	-	-	-	-	-	
Total	3391	3127	3170	3112	2770	3114
May 12 2/	4303	4158	4913	4952	3950	4455

* Only a few plots produced measurable yield

1/ All cultivars were in vegetative growth stage

2/ All cultivars were in full bloom

3/ Mean of four replications

Evaluation of Subterranean Clover for East Texas

G. R. Smith*

SUMMARY

Forage production and reseeding ability of subterranean (sub) clover were evaluated for three years at Overton. Eleven varieties of sub clover were planted in 1978 and managed for reseeding in the fall of 1979. Eighteen varieties were established in 1980 and naturally reseeded in 1981. Mt. Barker, Tallarook, Mississippi Ecotype and Woogenellup were consistently the highest yielding varieties. Mt. Barker and Woogenellup reseeded well in two different years, but reseeding stands of Tallarook and other varieties were reduced following an abnormally wet spring and summer. Yarloop failed to reseed in both years tested. Most varieties of sub clover were undamaged by 5°F temperatures, but stands of the variety Seaton Park were severely reduced.

Introduction

Subterranean clover was grown experimentally in Texas as early as 1921. It was observed to be a potentially valuable reseeding pasture crop worthy of extensive testing. Sub clover is unimpressive in appearance due to its prostrate growth habit. The stems stay low to the ground and produce a dense carpet in good stands. Flowers are also produced low and when pollinated turn downward to the soil surface. This is an important characteristic of sub clover because reseeding can occur under grazing. This differs from most other clovers such as crimson and arrowleaf which require animals to be removed for seed to mature. Sub clover is one of several <u>Trifolium</u> species undergoing evaluation and breeding at Overton. Trials were conducted to determine yield potential and reseeding ability of commercial varieties and plant introduction lines of subterranean clover.

Procedures

Eleven varities of sub clover were seeded October 30, 1978 in 4.5- by 12-foot plots at Overton. Seed were planted in a prepared seedbed at the rate of 19 pounds per acre. Inoculum (Type WR) was applied at 3X the normal rate using a commercial sticker. Each plot consisted of six 10-inch rows. Four hundred pounds per acre of 6-24-24 was applied at planting to the Bowie fine sandy loam soil. Soil test (0-6 inches) indicated a pH of 6.2 and no lime was applied. Natural reseeding occurred in 1979 and 500 pounds per acre of 0-20-20 was surface-applied in October 1979.

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Eighteen varieties of sub clover were established October 1, 1980. Seeding rates and inoculum application were the same as the 1978 planting. One and one-half tons of lime was incorporated prior to planting and 0-20-20 applied at the rate of 500 pounds per acre. These plots were allowed to reseed in 1981 and 400 pounds per acre of 0-20-20 applied in September.

Results and Discussion

Three forage harvests were taken from the 1978 sub clover planting and six harvests from reseeding stands of the same test. Yarloop was the only variety that completely failed to reseed in 1979. Three forage harvests were taken from the 1980 sub clover variety test and 1981-82 stands were rated for reseeding.

Three year average yields of sub clover varieties included in all three harvest years are presented (Table 1). Mt. Barker, Tallarook, Mississippi Ecotype and Woogenellup were consistently the highest yielding cultivars of those tested. Two additional varieties and five plant introductions were evaluated in 1980-81, several of which show promise (Table 1).

Unusually high rainfall in May, June and July of 1981 resulted in early germination and death of many sub clover seedlings. All varieties in the trial were affected by this loss of seed but to different degrees (Table 2). For example, a large percentage of Tallarook seed germinated early, and poor stands were the result in the fall. Mississippi Ecotype was also adversely affected by early germination but to a lesser extent than Tallarook. Only a small percentage of Mt. Barker seed germinated early, and fall reseeding was excellent. The variety Yarloop again failed to reseed in 1981. Temperatures down to 5°F in January 1982 severely damaged the Seaton Park variety of sub clover. No significant cold damage was noted on other sub clover cultivars.

Table 1. Dry matter production of subterranean clover at Overton. 1978-81.

Variety	1978-79	1979-80[1]	1980-81	3-Yr Avg
	---	---	lbs DM/acre	---
Mt. Barker	3079 a[3]	4771 a	2936 a	3595
Tallarook	2561 b	4647 a	2673 ab	3293
Woogenellup	2510 b	4265 a	2413 a-c	3062
Miss. Ecotype	2318 b	4432 a	2898 a	3216
Dinninip	1874 c	1046 de	1521 fg	1480
Howard	1642 c	2636 b	1972 c-f	2083
Geraldton	545 d	624 e	1583 e-g	917
Daliak	480 d	771 de	1735 d-g	995
Seaton Park	479 d	1373 cd	1602 e-g	1151
Dwalganup	444 d	1912 c	1318 g	1224
Yarloop	412 d	0	1410 f-g	911
Nangeela[2]			2302 b-d	
Clare[2]			1300 g	
P.I. 277439[2]			2321 b-d	
P.I. 268067[2]			2229 b-d	
P.I. 277438[2]			2215 b-d	
P.I. 190568[2]			2118 b-e	
P.I. 291880[2]			1857 c-g	

[1] Naturally reseeding from 1978 planting

[2] Planted only in 1980 test

[3] Yields followed by the same letter are not significantly different at the 0.05 level using Duncan's Multiple Range Test.

Table 2. The effect of early germination on reseeding stands of sub clover.

Variety	June 15, 1981	Jan. 4, 1982
	--------% Stand--------	
Howard	72	35
Daliak	54	13
Geraldton	46	9
Dwalganup	11	60
Tallarook	89	16
Nangeela	73	75
Clare	11	54
Yarloop	3	16
Seaton Park	6	75
Dinninip	8	58
Woogenellup	52	76
Miss. Ecotype	88	30
Mt. Barker	19	71
P.I. 277438	43	83
P.I. 268067	16	91
P.I. 291880	48	50
P.I. 277439	49	43
P.I. 190568	71	61

Subterranean Clover Seeding Rates

G. W. Evers*

SUMMARY

Subterranean clover seed is more expensive than other clover seed so that it is critical to know the minimum seeding rate necessary for a satisfactory stand. On a prepared seedbed good stands were obtained with 4 lb of seed per acre. If early production is critical, seeding rates no lower than 12 lb/ac are necessary. Drilling seed in 5 inch rows resulted in slightly higher yields than broadcasting the seed or drilling in 10 inch rows.

Introduction

Subterranean clover (Trifolium subterraneum L.), also called sub-clover, is a relatively new clover to the Southeastern United States. Advantages of subterranean clover over other cool season annual clovers are: 1) prostrate growth which permits close grazing without loss of stand and 2) seed development and placement on the soil surface which promotes reseeding. Presently most of the subterranean clover seed is imported from Australia, which makes it more expensive than other clover seed. Therefore determination of the lowest seeding rate which still results in satisfactory forage production is necessary to keep seed cost per acre to a minimum. Subterranean clover forage production and distribution was evaluated at six seeding rates under three methods of establishment.

Methods and Materials

Mt. Barker subterranean clover was seeded Oct. 8 on a Lake Charles clay at the Angleton Research Station. Plot size was 5 x 15 ft in a split plot experimental design with four replications. Main plots were planting methods which included seed 1) broadcast, 2) drilled in 5 inch rows, and 3) drilled in 10 inch rows. Subplots were seeding rates of 4, 8, 12, 16, 24 and 32 lb/ac. After planting, all plots were rolled to insure good seed to soil contact. Plots were harvested at a 1 inch height with a flail mower.

Results and Discussion

There was only about 300 lb/ac difference in total yield between the methods of clover establishment (Table 1). However subclover seeded in 5 inch rows did produce significantly more forage. Seeding rate had its greatest effect on forage production at the first harvest (Table 2). There was no large increase in yield above 12 lb seed/ac. By the second harvest, only the 4 lb seeding rate produced significantly less forage

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than the highest seeding rates. Total forage production generally increased as seeding rate increased with the major difference between the 4 lb and higher seeding rates.

Table 1. Effect of planting method on subterranean clover production averaged over six seeding rates.

Planting method	Jan. 13	Feb. 27	Mar. 27	May 7	Total
	lb/ac				
Broadcast	845 ab*	1702 a	1346 b	1010 c	4902 b
5 inch rows	943 a	1670 a	1459 a	1155 b	5226 a
10 inch rows	811 b	1477 b	1397 ab	1272 a	4958 b

*Yields within a column followed by the same letter are not significantly different at the .05 level, Duncan's Multiple Range Test.

Table 2. Subterranean clover production at six seeding rates averaged over three planting methods.

Seeding rate	Jan. 13	Feb. 27	Mar. 27	May 7	Total
	lb/ac				
4	285 e*	1294 b	1329 a	1397 a	4305 d
8	606 d	1621 a	1457 a	1257 ab	4941 c
12	902 c	1655 a	1446 a	1028 c	5031 bc
16	1027 bc	1686 a	1435 a	1158 bc	5305 ab
24	1231 a	1711 a	1438 a	1018 c	5397 a
32	1145 ab	1733 a	1299 a	1018 c	5195 abc

*Yields within a column followed by the same letter are not significantly different at the .05 level, Duncan's Multiple Range Test.

Emergence and Seedling Vigor of Annual Trifolium Species

E. C. Holt and P. A. Rich[1]

SUMMARY

Temperate annual legume species differ in ability to emerge from deep planting, and the differences are not limited to seed size differences. Subterranean and berseem clovers emerged better from deep (40 mm) than from shallow (10 mm) planting, both with large seed, while persian, with the smallest seed, showed little difference between the two depths. Deeper planting generally tends to reduce total emergence. Deeper planting may favor initial nodulation (3) because of less moisture and temperature stress, and most species will emerge from deeper depths than usually suggested for planting. However, seedling size also is generally reduced by deeper planting, even if emergence is not affected. Surprisingly, plant height near maturity may reflect the effect of deep planting on early development of the seedling.

Seedling vigor (weight) varied three fold among species and up to two fold within species. While this relationship seemed to be accounted for in part by seed size, there was enough variation within similar seed sizes to suggest additional seedling vigor factors or causes.

The relationship between seed size and seedling vigor is much stronger than that between seed size and emergence percentage. This relationship holds both across species and generally among genotypes within species. Subterranean clover, with the largest seed, showed the least consistent relationship.

While none of the experimental materials in this study exceeded the commercial variety check in seedling vigor, the study indicates differences in seedling vigor and therefore the potential for improving seedling vigor.

Introduction

Temperate annual legumes, primarily Trifolium species, are increasing in use because of their potential for extending the grazing season, fixing nitrogen and improving forage quality. Because these legumes are usually seeded with a companion crop and/or overseeded on sod, the seedlings are subjected to varying degrees of competition during the establishment stage. Furthermore, the seedlings usually develop slowly resulting in little dry matter production until late winter. Two major needs in the annual legumes are the ability to emerge under less than ideal conditions and seedling vigor to improve establishment and early growth under less than ideal conditions, and

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KEYWORDS: Trifoliums, annual clovers, seedling vigor, seedlling emergence, planting depth.

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seedling vigor to improve establishment and early growth under competition.

Rich, Holt and Weaver (3) have shown that depth of planting is an important factor in rhizobia survival and nodulation of Yuchi arrowleaf clover. Further, nodulation is favored by deeper seed placement than is emergence. Other studies (1, 2, 4, 5) have implicated seed size as an important factor in emergence from deeper planting depths.

Seed size varies with the annual *Trifolium* species and even more widely among species. A field test was conducted to evaluate emergence and seedling vigor in several *Trifolium* species.

Experimental Procedure

Annual *Trifolium* clover species included in this study are arrowleaf (*T. vesiculosum* Savi), subterranean (*T. subterraneum* L.), persian (*T. resupinatum* L.), berseem (*T. alexandrium* L.), and rose (*T. hirtum* All.). One or more named varieties and two to four plant introductions within each species were included. The experimental materials are listed in Table 1.

Seed weight and viability were determined for each seed lot (Table 1). Seeding rate was constant but the number of viable seed per unit length of row was calculated and percentage emergence was based on the number of viable seed planted.

Each of the 25 seed sources was planted at two depths, 10 and 40 mm. The seed source-depth combinations were completely randomized within each of 4 replications. Individual plots consisted of a single row 2.13 m long, rows spaced 1 m. Planting was on November 12, 1980.

Plant counts and seedling weights were determined on January 12, 1981. Plants from a 60 cm section of row were removed at the soil surface, counted, dried, weighed and individual seedling weights calculated. plant height was measured on April 2, 1981.

Results and Discussion

Species Responses and Differences

Seed size ranged from 714 mg/100 seed to 60 mg/100 seed. Average seed weights by species in mg/100 seed were: subterranean, 572; rose, 280; berseem, 248; arrowleaf, 118; and persian, 79. A two fold difference in seed size occurred among sources within both arrowleaf and rose clovers.

Average values for the five species for emergence, seedling weight and seedling height at the two planting depths are shown in Table 2. Berseem showed the best average emergence and subterranean the poorest though the differences were not significantly different. Both berseem and subterranean emerged better from 4 cm than from 1 cm planting depth. The other three species emerged better from 1 cm depth, with arrowleaf showing the most depression with deeper planting. Emergence response to deep planting was not very closely related to seed size. Subterranean which had the largest seed showed the greatest increase (80%) in emergence with deep planting. However, berseem and rose which had somewhat similar size seeds showed different responses to deep planting, berseem increasing in emergence with deep planting (35%), and rose decreasing (-15%). Similarly, persian which had the smallest seed decreased less with deep planting (-9%) than arrowleaf (-28%) which had 50% larger seed than Persian.

Seedling vigor (above ground seedling weight) differed significantly among species and also with planting depth. Subterranean, berseem and rose had heavier seedlings than persian and arrowleaf clovers. Seedling vigor (weight) at 60 days post planting was related to seed weight. Deep planting (40 mm) reduced seedling weight approximately 12%. Species differed in plant height near maturity largely because of differences in plant growth habit. Subterranean clover, because of its prostrate growth habit, was the shortest type with berseem being significantly taller than the other species. The slightly slower initial development from deep planting was still reflected in plant height in early April, plants from 40 mm planting depth being 10% shorter on the average than from shallow planting. Berseem and subterranean were exceptions to this pattern.

The species data indicate that arrowleaf clover emergence is affected negatively by increasing planting depth more than is the emergence of the other species and that subterranean and berseem may be favored by deeper planting. Rich, Holt and Weaver (3) found that maximum emergence of Yuchi arrowleaf occurred with 10 mm planting depth but with no significant difference over a range of 10 to 25 mm. Seed size had a greater impact on seedling vigor than on emergence, even emergence from 40 mm planting depth. When seedling weights of all 25 seed sources and two planting depths are ploted against seed weights, the relationship was linear and significant (Figure 1). As seed weight increased, seedling weight at 60 days post planting increased. The spread among similar seed weights increased above 200 mg/100 seed.

Within Species Responses

Arrowleaf - Percentage emergence (Table 3) based on viable seed varied widely but was not related to percent viability nor to seed size (Figure 2A). Differences in emergence at the two depths appeared to be as great for heavier seed as for lighter seed. The only accession showing increased emergence with deeper planting was the poorest emerging accession and its seed weight was intrmediate. Seedling vigor varied markedly among the seven sources indicating considerable potential for improving these characteristics. However none of the plant introductions equaled the best available varieties for seedling vigor. Seedling vigor was related to seed size (Figure 2B). The loss in vigor due to deeper planting was as great with heavier seed as with lighter seed. Plant height varied about two fold primarily because of one short type among the accessions.

Subterranean - Seed viability was relatively low in all the subclover sources and especially in two of the sources, but was not a factor in emergence from viable seed. The range in emergence (Table

4) was about three fold with generally better emergence from deeper plantings. While the relationship between seed size and emergence was not close, there appeared to be a tendency for larger seed to result in less emergence (Figure 2C). On the other hand seed size showed a general though not close relationship to seedling vigor. Planting depth had no influence on either seedling vigor or plant height.

Persian - Though average percentage emergence ranged among sources from 36 to 62%, the differences were not significant statistically (Table 5). Some of the sources emerged better from 10 mm and some better from 40 mm. Emergence from deep planting was influenced by seed size (Figure 2E) but not emergence from shallow planting. Sources did not differ in seedling vigor (Table 5) and none of the plant introductions exceeded Abon in actual plant weight. Deep planting consistently reduced seedling weight at 60 days post planting but the difference was not significant statistically. Seed weight seemed to have a positive influence on seedling vigor (Figure 2F).

Berseem - Seed of only two plant introductions was available (Table 6). Emergence was better at 40 mm with all three sources and the sources differed significantly. Similarly, sources differed in seedling vigor and as a result of planting depth. The Winter Hardy selection was superior in seedling vigor to the two plant introductions.

Rose - Seed viability varied widely but did not seem to be a factor in emergence percentage of viable seed. Average emergence ranged from 14% to 62% with some sources emerging better from 10 mm and others from 40 mm planting depths (Table 7). Seedling vigor differed among sources and was significantly reduced by deeper planting. Even those sources that emerged better from deeper planting showed a negative effct of planting depth on seedling vigor. Both seedling emergence (Figure 2G) and seedling vigor (Figure 2H) showed a general positive relationship to seed weight.

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Table 1. Seed Characteristics of Trifolium accessions.

Entry no.	Trifolium species	Variety or P.I.	Seed wt. mg/100 seed	% germination
1	T. vesiculosum	Yuchi	138	70.0
17	"	Meechee	147	22.5
18	"	Amclo	126	40.5
2	"	233782	110	15.0
3	"	233816	121	42.5
4	"	279948	69	70.0
5	"	234310	114	55.0
6	T. subterraneum	Mt.Barker	714	11.0
7	"	190568	648	38.5
8	"	233866	496	37.5
9	"	277439	570	32.5
10	"	287998	442	18.0
11	T. resupinatum	Abon	97	79.0
12	"	120195	60	37.0
13	"	141503	87	61.0
14	"	173974	82	60.5
15	"	204937	67	56.0
16	T. alexandrium	Winter Hardy Exp.	273	75.0
19	"	251213	204	56.5
20	"	292967	268	35.5
21	T. hirtum	Kondinin	328	52.0
22	"	BN9873-58	286	24.0
23	"	311485	318	88.0
24	"	287974	167	73.0
25	"	348886	300	25.5

Table 2. The influence of species and planting depth on emergence, and seedling vigor of temperate legumes, College Station, 1980-81.

Species	Planting depth (mm) 10	40	Average
	% emergence, January 15		
Berseem	40	54	47.0
Persian	47	43	45.0
Rose	47	40	43.5
Arrowleaf	47	34	40.5
Subterranean	25	45	35.0
Average	47	34	
	Weight/seedling (mg), Janurary 15		
Subterranean	20.2	20.5	20.3a
Berseem	18.4	16.2	17.3a
Rose	17.1	14.1	15.6a
Arrowleaf	8.3	6.5	7.4b
Persian	7.8	6.3	7.1b
Average	13.6a	12.0b	
	Seedling height (cm), April 2		
Berseem	31	32	31.5a
Persian	24	20	22.0b
Rose	22	20	21.0b
Arrowleaf	21	19	20.0b
Subterranean	8	8	8.0c
Average	21.2a	19.2b	

Table 3. The influence of planting depth on emergence and seedling vigor of arrowleaf clover sources, College Station, 1980-81.

Entry no.	Variety or P.I.	Planting depth (mm) 10	40	Average
		% emergence		
3	233816	66.2	39.0	52.6a
2	233782	56.3	34.0	45.1ab
18	Amclo	52.3	34.5	43.1abc
4	279948	50.3	32.3	41.3abc
1	Yuchi	41.5	39.5	40.5abc
17	Meechee	46.5	33.0	39.8abc
5	234310	14.8	23.5	19.1c
Average		46.8a	33.7b	
		Weight/seedling (mg)		
17	Meechee	11.0	7.6	9.3a
1	Yuchi	9.6	7.5	8.6ab
18	Amclo	8.9	7.5	8.2ab
3	233816	7.6	7.6	7.6b
2	233782	8.8	6.0	7.4b
5	234310	8.6	5.9	7.2b
4	279948	3.8	3.4	3.6c
Average		8.3a	6.5b	
		Seedling height (cm)		
1	Yuchi	29.2	23.5	26.4a
18	Amclo	26.5	23.0	24.8ab
3	233816	22.0	19.0	20.5b
2	233782	21.2	17.8	19.5bc
5	234310	17.5	21.0	19.3c
17	Meechee	20.2	17.5	18.9c
4	279948	12.8	11.0	11.9d
Average		21.4a	19.0b	

Table 4. The influence of planting depth on emergence and seedling vigor of subterranean clover sources, College Station, 1980-81.

Entry no.	Variety or P.I.	Planting depth 10	40	Average
		% emergence		
9	277439	42.8	78.3	60.5a
8	233866	23.0	39.3	31.1ab
10	287998	34.0	28.0	31.0ab
6	Mt. Barker	8.5	27.0	29.3ab
7	190568	16.0	27.0	21.5b
Average		24.9b	44.5a	
		Weight/seedling (mg)		
9	277439	27.9	31.4	29.7a
6	Mt. Barker	24.6	21.4	23.0ab
7	190568	20.9	24.6	22.8ab
8	233866	23.3	16.0	19.7ab
10	287998	16.6	18.3	17.5ab
Average		22.7a	22.3a	
		Seedling height (cm)		
6	Mt. Barker	-	-	-
7	190568	8.5	10.2	9.4
9	277439	9.8	8.2	9.0
8	233866	5.0	6.5	5.8
10	287998	-	7.5	-
Average		7.8	8.1	

Table 5. The influence of planting depth on emergence and seedling vigor of Persian clover sources, College Station, 1980-81.

Entry no.	Variety or P.I.	Planting depth (mm) 10	40	Average
		% emergence		
11	Abon	58.5	66.3	62.4a
12	120195	45.5	48.5	47.0a
14	173974	50.8	32.0	41.4a
13	141503	37.8	42.0	39.9a
15	204937	46.5	26.3	36.4a
Average		47.4a	43.0a	
		Weight/seedling (mg)		
11	Abon	9.8	8.1	8.9a
14	173974	9.2	7.5	8.4a
13	141503	8.1	5.8	6.9a
12	120195	6.2	5.1	5.6a
15	204937	5.7	5.3	5.5a
Average		7.8a	6.4a	
		Seedling height (cm)		
12	120195	28.0	19.8	23.9a
14	173974	23.8	24.0	23.9a
11	Abon	24.8	20.8	22.8a
13	141503	24.0	20.5	22.2a
15	204937	21.5	13.8	17.6a
Average		24.4a	19.8a	

Table 6. The influence of planting depth on emergence and seedling vigor of berseem sources, College Station, 1980-81.

Entry no.	Variety or P.I.	Planting depth (mm) 10	40	Average
		% emergence		
16	Winter Hardy Exp.	52.0	61.8	56.9a
19	251213	50.0	60.5	55.3a
20	292967	17.5	40.3	28.9b
Average		39.8b	54.2a	
		Weight/seedling (mg)		
16	Winter Hardy Exp.	24.0	19.0	21.5a
19	251213	16.6	17.6	17.1b
20	292967	14.6	12.1	13.4c
Average		18.4a	16.2b	
		Seedling/height (cm)		
16	Winter Hardy Exp.	30.0	34.2	32.1
19	251213	31.8	30.2	31.0
20	292967	-	23.0	-
Average		30.9	32.2[1]	

[1]Value does not include entry 20.

Table 7. The influence of planting depth on emergence and seedling vigor or rose clover sources, College Station, 1980-81.

Entry no.	Variety or P.I.	Planting depth (mm) 10	40	Average
		% emergence		
21	Kondinin	75.0	49.5	62.3a
22	BN9873-58	65.0	53.8	59.4a
23	311485	50.3	58.0	54.1a
25	348886	34.0	22.0	28.0b
24	287974	10.0	18.0	14.0b
Average		46.9a	40.3a	
		Weight/seedling (mg)		
21	Kondinin	21.9	17.2	19.5a
25	348886	17.4	19.1	18.2ab
23	311485	20.8	14.6	17.7ab
22	BN9873-58	13.5	12.0	12.8bc
24	287974	12.2	8.0	10.1c
Average		17.2a	14.2b	
		Seedling/height (cm)		
21	Kondinin	29.2	24.2	26.8a
23	311485	27.5	23.5	25.5a
22	BN9873-58	20.2	18.5	19.4b
24	287974	19.0	17.8	18.4b
25	348886	14.8	17.0	15.9b
Average		22.2a	20.2a	

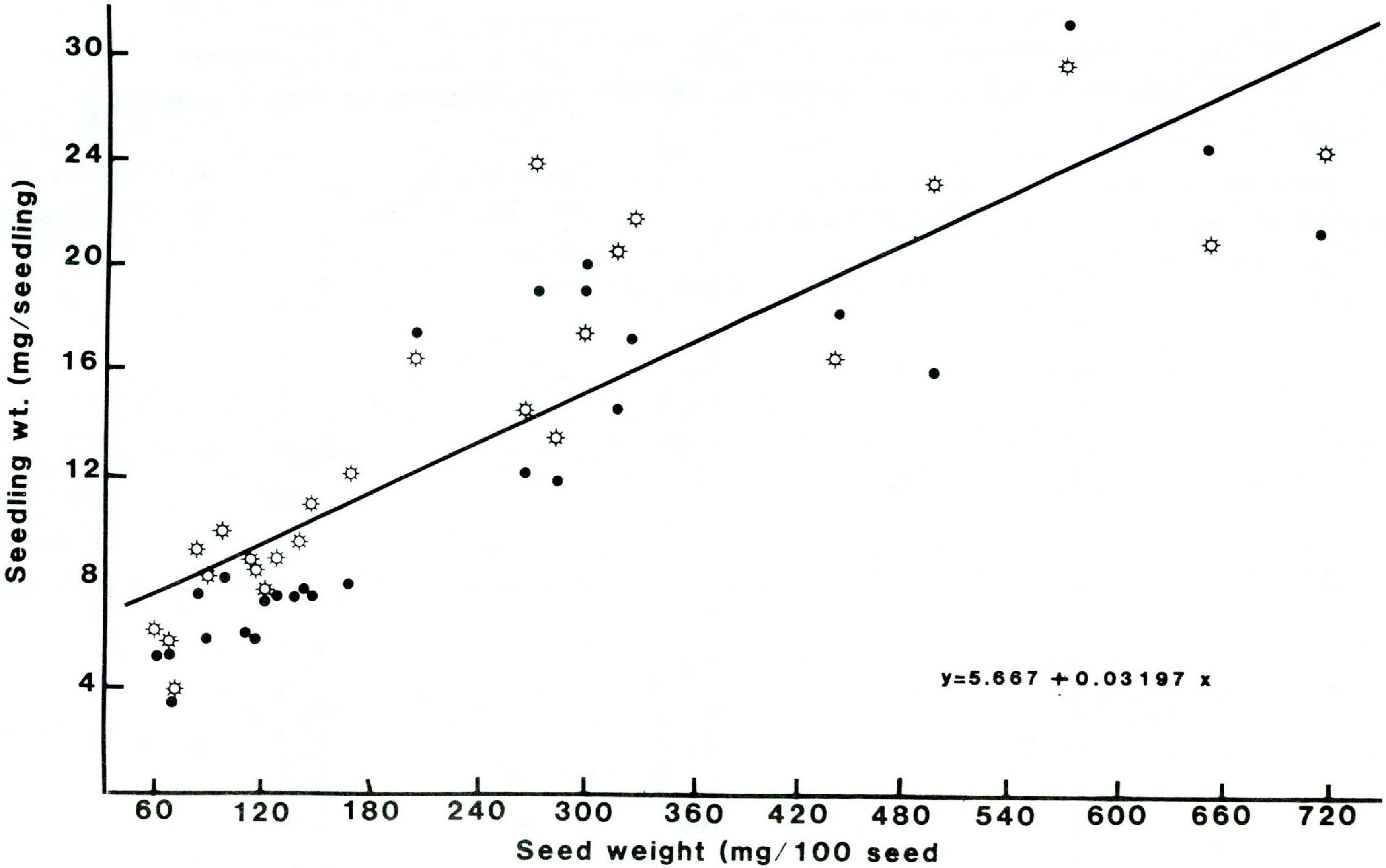

Figure 1. The relationship of seed size (weight) to seedling vigor (weight of tops) of temperate legumes (planting depth symbols: ☼ -10 mm, ● -40 mm).

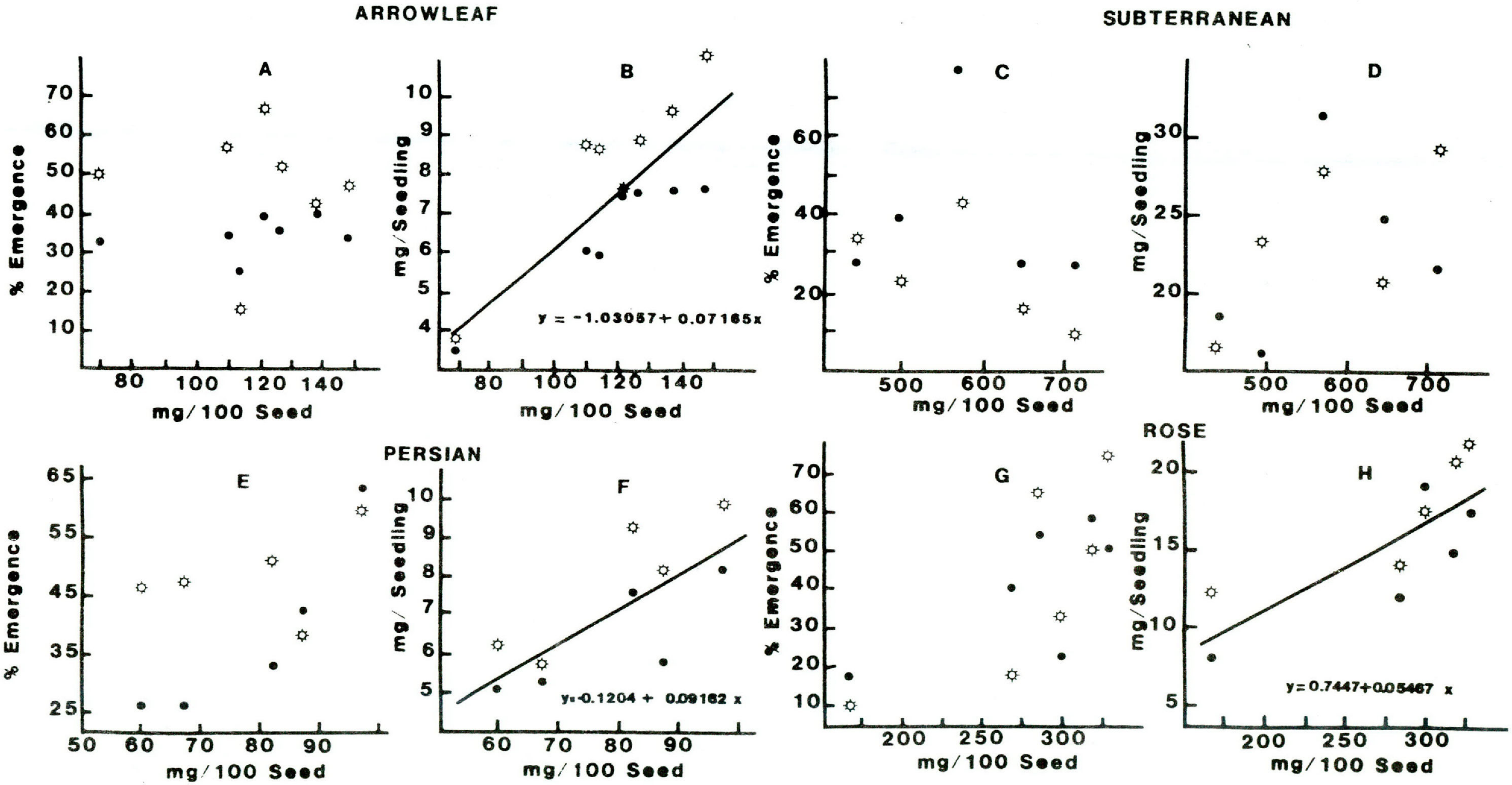

Figure 2. The relationships of seed size (weight) to seedling emergence and seedling vigor of four temperate legumes. (planting depth symbols : ☼-10 mm, ●-40 mm).

Establishment of Arrowleaf Clover and Annual Ryegrass in a 'Tifton 44' Bermudagrass Sod

F. M. Rouquette, Jr. and M. J. Florence*

SUMMARY

'Yuchi' arrowleaf clover was either drilled or broadcast on a 'Tifton 44' bermudagrass sod at seeding rates of 0, 5, 10, and 20 lbs/ac. At each seeding rate, arrowleaf was planted alone and in combination with 20 lbs/ac 'Gulf' ryegrass. Drilled clover produced 32% more forage than broadcast clover. Ryegrass planted alone and fertilized with nitrogen produced 2.5 times more dry matter forage than ryegrass planted in combination with arrowleaf. Clover yields were reduced by approximately 65% when ryegrass was included in the mixture. If planted alone, 5 lbs/ac arrowleaf seed would provide a reasonable stand and seed source for the succeeding year. If ryegrass was included in the mixture, 10 lbs/ac arrowleaf seed were necessary to provide an adequate stand for grazing and seed. Bermudagrass production from the various plots was surprisingly similar with a yield advantage of less than one ton per acre from the nitrogen fertilized plots vs clover-bermudagrass plots.

Introduction

Ryegrass and clovers are used in pasture systems to provide a high nutritive value forage for improved animal performance. In addition, clovers are added to the forage system to allow for nitrogen fixation. Arrowleaf clover is well-adapted to the East Texas area, but it often produces partial or total crop failures under certain combinations of climatic conditions and cultural practices. The objective of this trial was to determine the effect of clover seeding rate, method of planting in a bermudagrass sod, and the inclusion of ryegrass on individual and cumulative forage yields.

Procedures

'Yuchi' arrowleaf clover was planted alone and in combination with ryegrass on a 'Tifton 44' bermudagrass sod at 0, 5, 10, and 20 lbs/ac in mid-October. Ryegrass was planted at the rate of 20 lbs/ac. At each clover seeding rate, the seeds were drilled and broadcast in separate plots. All plots received 425 lbs/ac of 6-24-24 at time of planting. The ryegrass planted alone (0 lbs/ac clover) received 150 lbs/ac 33.5-0-0 at 30-45 day intervals beginning February 1 and terminating August 1 for a total seasonal nitrogen application of 325 lbs/ac. The fourteen treatment combinations were replicated three times. Forage samples were harvested

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with hand clippers from two one-square-foot areas within each plot. The forage species were separated into the various components in the laboratory.

Results

Dry matter production from the individual and collective forage components is presented in Tables 1-2. On the average, clover yields were increased 32% and ryegrass yields increased 24% by planting with a drill vs broadcasting the seed on the sod surface. The frequency and duration of rainfall after planting are the most critical factors which affect seedling vigor of broadcast planted clovers. The primary advantage of drilling seed is that the seed are placed in contact with the soil where the moisture relationships are superior to that of the sod surface. Arrowleaf planted alone produced 65% more clover forage than when planted with ryegrass. Ryegrass, on the other hand, when planted alone and fertilized with nitrogen, produced 2.5 times more forage than when planted with clover. Bermudagrass production on the nitrogen fertilized plots was only one ton greater than that from the clover-bermudagrass plots. Nitrogen fixation from the previous clover crop was partially responsible for this increased bermudagrass yield. The quantity and distribution of rainfall during the summer months was probably of equal importance in accounting for the total forage production.

Table 3 shows the effect of planting ryegrass on clover yields. The clover yield was reduced most (61%) when ryegrass was included at the low clover seeding rates. This was probably due to the area available for ryegrass germination and growth, and the degree of plant competition from the lower seeding rates of clover. If arrowleaf is planted alone, the 5-lb/ac seeding rate would provide a stand and seed source for succeeding crops. If ryegrass is included in the planting mixture, the seeding rate should be increased to 10 lbs/ac.

Table 1. Dry matter production of 'Yuchi' arrowleaf clover, 'Gulf' ryegrass, and 'Tifton 44' bermudagrass as influenced by seeding rate and planting method.

Clover Seeding rate (lbs/ac)	Planting Method	Dry Matter Yield (lbs/ac)			
		Clover	Ryegrass	Bermudagrass	TOTAL
0 lbs + ryegrass	Broadcast	0	3,773	16,948	20,721
0 lbs + ryegrass	Drilled	0	4,792	15,013	19,805
5 lbs alone	Broadcast	736	0	13,669	14,405
5 lbs alone	Drilled	1,449	0	14,169	15,618
5 lbs + ryegrass	Broadcast	297	1,487	12,174	13,958
5 lbs + ryegrass	Drilled	553	1,650	15,143	17,346
10 lbs alone	Broadcast	1,662	0	13,208	14,870
10 lbs alone	Drilled	1,855	0	15,231	17,086
10 lbs + ryegrass	Broadcast	1,248	1,340	13,256	15,844
10 lbs + ryegrass	Drilled	1,175	1,792	13,866	16,833
20 lbs alone	Broadcast	915	0	14,604	15,519
20 lbs alone	Drilled	1,465	0	13,481	14,946
20 lbs + ryegrass	Broadcast	741	1,766	13,096	15,603
20 lbs + ryegrass	Drilled	884	2,151	12,422	15,457

Table 2. Component forage production as affected by planting method and specie mixtures.

	Dry Matter Yield (lbs/ac)			
Treatment[1]	Clover	Ryegrass	Bermudagrass	TOTAL
Broadcast[2]	933	2,092		
Drilled[2]	1,230	2,596		
Clover Alone	1,347	-	14,060	15,407
Ryegrass Alone	-	4,283	15,981	20,264
Clover + Ryegrass	816	1,698	13,316	15,840

[1]Yields combined across all seeding rates.

[2]Bermudagrass yields not additive across seeding rates and planting method.

Table 3. Clover production as affected by seeding rate and ryegrass.

	Clover Dry Matter (lbs/ac)		
Seeding Rate	Yield	Yield Reduction Due to Ryegrass	
5 lbs alone	1,093		
5 lbs + ryegrass	425	668	61%
10 lbs alone	1,759		
10 lbs + ryegrass	1,212	547	31%
20 lbs alone	1,190		
20 lbs + ryegrass	813	377	32%

[1]Yields combined across method of planting.

Establishment of Subterranean Clover and Annual Ryegrass in a 'Tifton 44' Bermudagrass Sod

F. M. Rouquette, Jr. and M. J. Florence*

SUMMARY

'Mt. Barker' subterranean clover was either drilled or broadcast on a 'Tifton 44' bermudagrass sod at seeding rates of 0, 10, 20, and 40 lbs/ac. At each seeding rate, 'Mt. Barker' was planted alone and in combination with 20 lbs/ac 'Gulf' ryegrass. Drilled plantings of clover produced 49% more forage than broadcast plantings, whereas, there was only an 11% advantage for ryegrass under similar planting conditions. Ryegrass planted alone and fertilized with nitrogen produced 3.4 times more forage than clover alone, and 1.9 times more forage than clover plus ryegrass. The seasonal dry matter production from ryegrass-bermudagrass fertilized with nitrogen was approximately 1.6 times that forage produced from clover-bermudagrass or clover-ryegrass-bermudagrass.

Introduction

Subterranean clover was introduced into East Texas pastures more than forty years ago. However, due to problems associated with rhizobia strain specificity and general grazing management, the sub clovers did not appear to offer significant contributions to the overall forage-animal enterprise. With advanced research in soil microbiology, plant breeding, and clipping-grazing management, the sub clovers appear to offer some potential for the East Texas area. In order to evaluate alternative methods of establishing a sub clover stand, this study was designed to examine the effect of clover seeding rate, method of planting in a bermudagrass sod, and inclusion of ryegrass on both clover and grass production.

Procedures

'Mt. Barker' subterranean clover was planted alone and in combination with reygrass on a 'Tifton 44' bermudagrass sod at 0, 10, 20, and 40 lbs/ac in mid-October. Ryegrass was planted at the rate of 20 lbs/ac. At each clover seeding rate, seeds were drilled and broadcast in separate plots. All plots received 425 lbs/ac of 6-24-24 at time of planting. The ryegrass alone plots received 150 lbs/ac 33.5-0-0 at 30-45 day intervals beginning February 1 and terminating August 1 for a total seasonal nitrogen application of 325 lbs/ac. The fourteen treatment combinations were replicated three times. Forage samples were harvested with hand clippers from two one-square-foot areas within each plot. The forage species were separated into the various components in the laboratory.

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Results

Tables 1 and 2 show the individual and collective forage production from the various seeding rates and planting methods. Planting subterranean clover with a drill resulted in 49% more dry matter forage than a broadcast planting. Ryegrass which was drilled produced 11% more forage than that which was broadcast. Clover planted alone produced nearly double that amount of clover forage produced when planted in combination with ryegrass. Ryegrass when planted alone and fertilized with nitrogen produced 3.4 times more forage than clover alone; 2.7 times more forage than the ryegrass in the mixed planting; and 1.9 times more forage than the clover component in the mixed planting. In addition, the total seasonal yield of ryegrass-bermudagrass fertilized with nitrogen was approximately 1.6 times that of the non-nitrogen fertilized plots containing clover alone or in a mixture.

Table 3 illustrates the impact of ryegrass on clover yields when the two species are planted together. Subterranean yields were reduced by 65, 50, and 32%, respectively, on the 10, 20, and 40 lb/ac clover seeding rate plots that also contained ryegrass. Thus, the 10 lb/ac seeding rate of clover provided as much clover forage as the other seeding rates when seeded alone. With the addition of ryegrass, a higher seeding rate would be desirable to provide sufficient seed source for the succeeding year.

Table 1. Dry matter production of 'Mt. Barker' subterranean clover, 'Gulf' ryegrass, and 'Tifton 44' bermudagrass as affected by seeding rate and planting method.

Clover seeding rate (lbs/ac)	Planting method	Dry Matter Yield (lbs/ac)			
		Clover	Ryegrass	Bermuda	TOTAL
0 lbs + ryegrass	Broadcast	0	5,296	14,378	19,674
0 lbs + ryegrass	Drilled	0	5,635	13,169	18,904
10 lbs alone	Broadcast	1,298	0	9,997	11,295
10 lbs alone	Drilled	1,916	0	11,803	13,719
10 lbs + ryegrass	Broadcast	479	1,658	8,245	10,382
10 lbs + ryegrass	Drilled	655	1,776	8,626	11,057
20 lbs alone	Broadcast	1,174	0	8,425	9,599
20 lbs alone	Drilled	1,796	0	10,700	12,496
20 lbs + ryegrass	Broadcast	736	1,874	8,857	11,467
20 lbs + ryegrass	Drilled	747	2,637	10,041	13,425
40 lbs alone	Broadcast	1,289	0	11,958	13,147
40 lbs alone	Drilled	2,191	0	9,053	11,244
40 lbs + ryegrass	Broadcast	895	2,071	9,649	12,615
40 lbs + ryegrass	Drilled	1,473	2,082	9,004	12,559

Table 2. Component forage production as influenced by planting method and specie mixtures.

Treatment[1]	Dry Matter Yield (lbs/ac)			
	Clover	Ryegrass	Bermudagrass	TOTAL
Broadcast[2]	979	2,725		
Drilled[2]	1,463	3,033		
Clover Alone	1,611	-	10,323	11,934
Ryegrass Alone	-	5,466	13,824	19,290
Clover + Ryegrass	831	2,016	9,070	11,917

[1]Yields combined across all seeding rates.

[2]Bermudagrass yields not additive across seeding rates and planting method.

Table 3. Clover production as affected by seeding rate and ryegrass.

Seeding Rate	Clover Dry Matter[1] (lbs/ac)		
	Yield	Yield Reduction Due to Ryegrass	
10 lbs alone	1,607		
10 lbs + ryegrass	567	1,040	65%
20 lbs alone	1,485		
20 lbs + ryegrass	742	743	50%
40 lbs alone	1,740		
40 lbs + ryegrass	1,184	556	32%

[1]Yields combined across method of planting.

Forage Yields of Turnips, Rape and Kale Under Irrigated and Dryland Conditions at Stephenville

Ronald M. Jones**

SUMMARY

Six cultivars of the genus *Brassica* were seeded Spetember 29, 1981 in irrigated and dryland tests. Yields in the irrigated test ranged from 1693 to 2003 pounds dry matter per acre while dryland yields ranged from 1224 to 1749 pounds per acre. Cultivar yields were not significantly different, but irrigated yields were significantly and unexplainably higher than dryland yields Forage yields of 'Tyfon' turnip, 'Seven Top' turnip, and 'Dwarf Essex' rape were highest in both tests. Rape survival was 100%, kale survival was 20-40%, and other cultivars were killed by near-record low temperatures. Regrowth of rape averaged 1189 pounds dry matter per acre for two replications. Neither harvesting nor irrigating affected winter survival.

Introduction

Species of the genus *Brassica* may offer potential as a cool-season forage for livestock. Rape is an annual plant which has been used for hog pasture. Its nutritional value is nearly equal to legumes (1). Several turnip cultivars have been developed to produce large amounts of leaves. Cultivars producing enlarged roots may be desirable since the roots may be consumed by livestock during late fall or winter.

Management is needed to utilize turnip tops and roots. Since bloat is a potential problem, cattle should ingest only 100 pounds of tops per day. Flowers are poisonous to livestock, but those of 'Tyfon' (turnip X Chinese cabbage) are not. Cattle can easily pull turnip plants from the soil causing ingestion of soil and subsequent scours.* Another management problem of turnips is that plants will not generate new growth when cut or grazed below the growing point at two inches.*

The purpose of this study was to determine forage yield potential, growth patterns, winter hardiness, and protein content of six cultivars of the genus *Brassica* under irrigated and dryland conditions.

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* Tyfon, Mimeo. Report, Pacific Seed Production Co., P. O. Box 1141, Albany, Oregon 97321.

** Research associate, The Texas Agricultural Experiment Station, Stephenville.

Materials and Methods

Six annual cultivars of the genus *Brassica* were established in separate irrigated and dryland tests on Windthorst fine sandy loam. Fertilizer was applied at the rate of 100-60-0 and incorporated by disking. Plots measuring 5X12 feet were seeded September 29, 1981 with a garden-type planter. A carrot seed-plate metered eight pounds of seed per acre into rows spaced one foot apart. The four replications in the randomized complete-block design were separated by alleys four feet wide. Two rows of rape were seeded as border rows on the ends of all replications.

Irrigation at the rate of 1.5 inches per acre was applied to both tests October 1 to insure germination. Abnormally high rainfall of 7.50 inches during October made further irrigation unnecessary.

Plants were harvested November 24, 1981 by hand clipping four row-feet from two of the three center rows of each plot. Largest plants were about twelve inches tall. Clipping height was four inches for the irrigated test and two and one-half inches for the dryland test. Plant material was dried at 70C, and yields per acre were calculated. Following harvest, the plants in the dryland test and in two replications of the irrigated test were cut with a sickle mower to the same height used in hand clipping. Irrigation at the rate of one and one-half inches was applied December 15.

Root yield was determined by harvesting eight row-feet of plants on January 28, 1982. Rotten roots were discarded. Yield was determined on a fresh-weight basis.

The percentage of live plants in each plot was determined on March 8, 1982. Since irrigated rape had a good stand, it was then hand clipped to four inches. Dryland rape yield was estimated as a percentage of the irrigated yield.

Results and Discussion

Dry matter yields of a single harvest ranged from 1693 to 2003 pounds per acre for cultivars in the irrigated test (Table 1). Dryland yields ranged from 1224 to 1749 pounds per acre. Cultivars were not statistically different. 'Tyfon', 'Dwarf Essex', and 'Seven Top' tended toward highest yields since they ranked among the upper three cultivars in both the irrigated and dryland tests. Significantly higher yields of the irrigated test are inexplicable since soil, water, fertilizer, and other management factors were the same for both tests.

All cultivars except 'Dwarf Essex' rape and 'Improved Siberian' kale were killed by freezing temperatures before regrowth was sufficient for a second harvest. The two replications of irrigated 'Dwarf Essex' mowed at the first harvest produced 914 and 1483 pounds dry matter per acre the second harvest. Regrowth yield of rape in the dryland test was estimated at 20% of that of the lower yielding rape plot in the irrigated test. Irrigation water applied December 15 probably caused the difference.

Winter survival of rape was 100%, kale survival rate was 20-40%, and other cultivars were virtually destroyed (Table 2). Low temperatures of 3F, 4F, 8F, 9F, and 10F on January 10, 11, 13, 16, and 17, respectively, were the lowest of the winter. Survival was the same whether or not the cultivars were mowed November 25. Survival was also the same whether or not irrigation was applied during a dry period.

'Purple Top' was the only cultivar which produced edible roots. When the tops were mowed following the November harvest, root yields were 5.55 and 5.89 tons fresh weight per acre for the irrigated and dryland test, respectively. When the tops were not mowed, root yields were 13.35 tons fresh weight per acre in the irrigated test. Since the average dry matter content of roots is 8 percent,* this is equivalent to 2136 pounds dry matter per acre. This may be compared with 1965 pounds dry matter produced by irrigated oats March 23, 1981 at Stephenville.

Acknowledgments

The author acknowledges Mr. Troy Sellers, Agri-Business Consultant with Texas Power & Light Company who conceived the idea for these tests and provided the seed.

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Table 1. Forage Yields of Brassica under Irrigated and Dryland Conditions at Stephenville in 1981.

			Pounds Dry Matter Per Acre	
Scientific Name	Common Name	Cultivar	Irrigated 2/	Dryland 2/
Brassica rapa	turnip	Tyfon 1/	2003	1749
Brassica rapa	turnip	Seven Top	1959	1475
Brassica napus	rape	Dwarf Essex	1920+1189**	1521
Brassica rapa	turnip	Purple Top 3/	1869	1279
*Brassica oleracea**	kale	Improved Siberian	1718	1224
Brassica napus	turnip	Shogoin	1693	1403

* variety *acephala* ** Second harvest only two replications.
1/ Chinese cabbage X turnip 2/ Cultivars are non-significant at the 0.05 level. Irrigated yields were significantly higher than dryland yields.
3/ 'Purple Top' edible root yields were 5.89 and 9.45 tons fresh weight per acre for the dryland and irrigated test, respectively.

Table 2. Winter Hardiness of Six Cultivars of the Genus Brassica Grown at Stephenville, Texas, 1981-82.

		% Survival*	
Common Name	Cultivar	Irrigated	Dryland
rape	Dwarf Essex	100	100
kale	Improved Siberian	20-40	20-40
turnip	Purple Top	0	10
turnip	Seven Top	10	10
turnip	Shogoin	0	0
turnip	Tyfon	0	10

*Determinations were made March 8, 1982 following near-record low temperatures of 3F and 4F on January 10 and 11, 1982, respectively.

1.8M--8-82