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WINTER GRAZING SMALL GRAINS in OKLAHOMA

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Winter Grazing Small Grains In Oklahoma

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Small grain crops are of growing importance for grazing in Oklahoma during the winter months. Many cool season grass species have been tried by researchers and farmers for winter grazing but none can compare with the small grains. The small grains are available when forage is in short supply and quality of the forage is uniformly high throughout the state. Fortunately, for the ever increasing cattle program in Oklahoma, five to six million acres of wheat are planted in addition to a sizeable acreage of oats, barley, and rye that may be used for grain production or entirely for grazing.

This publication reports results of recent research on small grains for pastures at several locations in Oklahoma. Included in the studies are: (1) animal preference or palatablity tests for three varieties of wheat, oats, barley and rye; (2) steer performance on various fertility and grazing intensity programs; (3) steer performance on small grain pastures with supplemental feeding; (4) methods of utilizing small grain pastures or protein for wintering beef cows on dry summer grasses; (5) fertility tests for forage production on wheat, oats, barley and rye; and (6) overseeding small grains on bermudagrass.

Previous Findings

Young small grain plants have a high protein content which may reach 30 percent and is seldom lower than 20 percent until head formation in the spring months. Production of grazing studies in Oklahoma and many southern states on small grain pastures show a good yield of high quality and very palatable forage which is readily converted into meat or milk. Lambs grazing wheat at the Ft. Reno Station made excellent gains at a lower cost than drylot feeding.

A six-year grazing test on the Stillwater Station with 400-500 pound beef animals grazing a mixture of rye, oats and wheat gained an average of 1.5 pounds daily for 150 days with an average gain of 233 pounds beef per acre. Results from grazing different varieties indicated little

Research reported herein was conducted under Oklahoma Station Project No. 1199.

difference in total production per acre for the season, but there was a wide variation on time of production between varieties of the same crop. A program of rotation grazing increased production 14 percent on small grain pastures. Early clipping of forage in the fall months before plant establishment lowered yields greatly.

Palatability Tests

Three widely used varieties of wheat, oats, barley and rye were selected for tests[1] on the basis of their upright or prostrate growth. Six small plots were planted to each variety and all varieties were randomized in a small area. Sufficient cattle were used to graze all forage on the entire area in four to five days (5 to 10 animals). Daily ratings were made by observation on animal grazing preference. Ratings were made in November, January or February, March and April.

Table 1: Three Year Summary of Animal Grazing Preference for Twelve Small Grain Varieties.

Crop	Variety	Growth Habit	Rank	Rating[1]
Oats	Arkwin	Upright	1	2.4
Oats	Cimarron	Intermediate	2	2.8
Oats	Wintok	Prostrate	3	3.4
Rye	Elbon	Upright	4	4.0
Rye	Balbo	Intermediate	5	4.5
Rye	Tetraplid	Prostrate	6	5.5
Wheat	Triumph	Upright	7	7.6
Wheat	Concho	Intermediate	8	7.7
Wheat	Cheyenne	Prostrate	9	7.7
Barley	Roger	Intermediate	10	8.6
Barley	Ward	Prostrate	11	8.9
Barley	Dayton	Upright	12	9.2

[1] Rating determined by an average of the 12 readings.

Table 1 shows the crop, variety, growth habit and average rating for three years. Animals had a tendency to graze all varieties of one crop before starting on another. Crop preference became more pronounced after the first grazing period in the fall. Oats were always preferred in the fall and barley was grazed last. Ratings between rye and wheat were usually close, with rye showing a little better score. In the winter

[1] These tests were conducted in cooperation with Dr. W. W. Huffine, Agronomy Dept., Okla. State University.

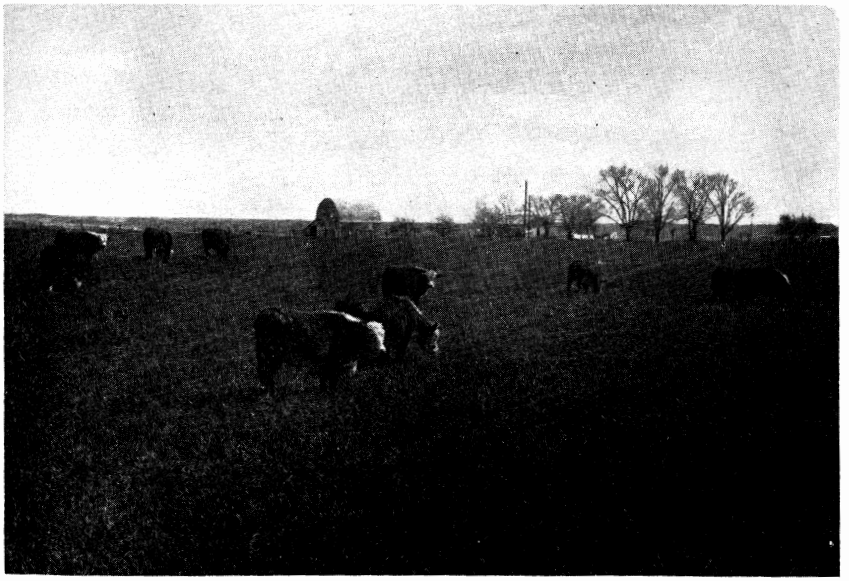
months rye and wheat often rated higher than oats due to leaf burn on the oats caused by cold temperatures.

Under good growing conditions Arkwin oats were always grazed first. The animals consumed all of the forage from the six plantings of Arkwin during the first days before trying another variety. Animals preferred Elbon over other rye varieties but the preference for one rye variety over another was not as great compared to oats. Tetraploid rye rated much lower in palatability than Elbon and Balbo. Palatability differences in wheat and barley varieties were not measurable.

The upright varieties were grazed first in oats, rye and wheat. Upright growth for more convenient grazing may be a factor in animal preference, but choice of Arkwin evidently involved other factors. Both Elbon rye and Arkwin oats were always grazed much closer than nearby varieties before the animals changed.

3-Year Grazing Performance of Steers

Eight pastures located on good Taloka soil in Eastern Oklahoma were summer fallowed in June, July and August and planted to a mixture



Steers on small grains pasture near Muskogee, Okla. The forage was still lush in spite of low rainfall and no irrigation.

of small grains the first of September. The mixture contained 50 pounds of Elbon rye, 25 pounds of Forkedeer Oats, 15 pounds of Kaw wheat and 10 pounds of Vetch per acre. The seed was drilled with 200 pounds of 10-20-10 and four of the pastures were treated with 40 pounds nitrogen per acre in November and again in March. Choice grade Hereford steers were assigned to the pastures on a basis of uniform weight, age, conformation and condition. The pastures were stocked with nine-month old steers weighing approximately 400 pounds, and one and one-half year old steers weighing an average of 675 pounds.

Table 2: Three Year Average Animal Performance on Winter Small Grain Pastures, Muskogee, Oklahoma, 1963-1965.

Month	Pasture Treatments			
	Light Graze 20-40-20	Heavy Graze 20-40-20	Light Graze 100-40-20	Heavy Graze 100-40-20
	Average Stocking Rate (Head Per Acre)			
Nov.	.79	1.09	.79	1.23
Dec.	.75	1.06	.81	1.15
Jan.	.72	.70	.81	.72
Feb.	.62	.50	.72	.50
March	.62	.62	.81	.56
April	.85	.87	1.28	.91
May	.88	.92	1.31	1.10
	Average Daily Gain (Pounds Per Head)			
Nov.	.95	1.10	.94	.90
Dec.	2.23	1.93	2.23	2.10
Jan.	1.72	1.22	1.85	.96
Feb.	1.58	1.32	1.60	1.08
March	.94	1.08	1.04	.98
April	2.14	1.94	2.46	2.39
May	1.31	1.37	1.09	1.91
Ave.	1.55	1.42	1.60	1.47
	Animal Gain (Pounds Beef Per Acre)			
Nov.	15	24	17	21
Dec.	52	64	58	75
Jan.	38	27	46	22
Feb.	28	18	34	15
March	18	12	28	15
April	56	52	90	65
May	28	30	35	53
Total	235	227	308	267

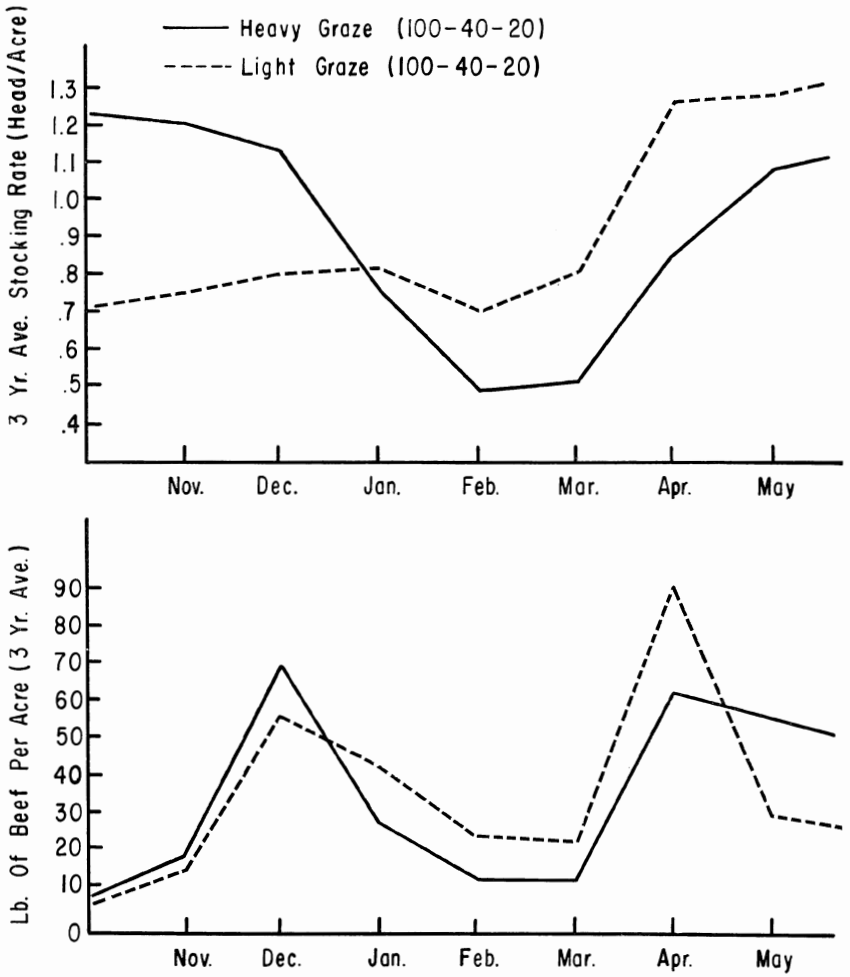


Fig. 1 Heavy stocking rates in Nov.-Dec. lowered stocking rates and beef production for Jan. through Apr. compared with lighter rate.

The average monthly three-year stocking rate, daily gain, and beef production is given in Table 2. There were two fertility rates and two stocking rates. The terms "light graze" and "heavy graze" refer to stocking rates in November and December. Although grazing did not start in the pastures until November or until a heavy growth of forage was present, a 25 percent increase in stocking rate in November and December lowered production for the remainder of the growing season.

Figure 1 shows that heavier grazing in fall months, before plants were established, lowered stocking rates during the rest of the grazing season. Figure 1 also shows that heavy grazing lowered beef production per acre from about December 15 to April 15. Daily gains were lower in pastures grazed with more animals during November and December. The effect of heavy grazing was more pronounced where higher rates of nitrogen were used. Not only was the stocking rate more uniform during the entire grazing season, but total beef production was increased from 267 to 308 pounds per acre at the light stocking rate which had less grazing in fall months.

A heavy growth of lush forage was always available for grazing in November; however, daily gains for all pastures were greater in December. Possibly the reason for the low gain in November is a lack of animal adjustment to the forage which contained 25 percent protein and 80 percent moisture. The 400 pound steers, removed from cows only one month before grazing started, adjusted to the pastures in November better than the older steers.

The rye component furnished most of the grazing. Oats were completely killed two out of the three years. Kaw wheat aided the pastures in April and May after growth of rye declined. Vetch contributed considerable grazing only one year but usually produced some growth and seed after grazing of the small grains had ceased in May. Vetch and some small grain seed were combined from the pastures two years during the three year test.

Application of 40 pounds of nitrogen per acre in November and again in March increased production 73 pounds of beef per acre over the 20-40-20 treatment where stocking rates were lower in the fall. The extra nitrogen under a heavy grazing program increased beef production only 40 pounds per acre. Increased production from nitrogen fertilization occurred in the spring months.

Some wheat soils are subject to grazing problems under excessive moisture conditions. Muddy fields were no problem in these tests. After the first rain and subsequent early grazing, the Taloka soil surface became firm and trampling of the forage was reduced to a minimum.

Yearling Performance Vs. 2-Year-Old Steers

An equal number of nine-month-old steers and one and a half year old steers were started in each pasture listed in Table 2. Table 3 summarizes the average performance of these steers on all pastures on the

Table 3: Animal Performance of One and Two Year Old Steers on Small Grain Pastures.

	1962 1963	1963 1964	1964 1965	3 Yr. Avg.
No. Days Grazed	200	175	205	193
		—Avg. Wt. in Pounds—		
Steer weight Nov. (9 Mo. Steer)	390	450	418	419
Steer weight Nov. (1½ Yr. Steer)	670	620	666	652
Steer weight May (1 Yr. Steer)	702	711	675	696
Steer weight May (2 Yr. Steer)	980	944	930	951
Steer gain for grazing period (1 Yr.)	312	261	257	277
Steer gain for grazing period (2 Yr.)	310	324	264	299
Average Daily gain (2 Yr. old steers	1.56	1.48	1.25	1.44
Average Daily gain (2 Yr. old steers)	1.56	1.85	1.29	1.56

basis of age. The group of older steers averaged 12 pounds more daily gain than the younger steers on all pastures.

The older steers showed a greater degree of finish than the younger steers at the end of the grazing period, with a possibility of some going directly to the packer. The younger steers were in excellent condition to start a short period of drylot feeding for final finish.

It was assumed that the older steers consumed more forage than the younger steers, but data from these studies do not answer the question of "how much more".

Supplemental Feeding on Small Grain

Chemical analysis of small grain forage in the pasture stage indicates a protein content far beyond requirements for finishing rations, but possibly less than the requirements for energy content. It would appear that grain-fed animals on this type of forage should be able to balance the nutritional requirements for fast growth. Several years of study on feeding grain free choice to one-year-old animals on small grain pastures were completed on the Stillwater Station. For a 150-day grazing period (November to May) the 500 pound animals consumed an average of five pounds of grain daily and gained ⅓ to ½ pound daily over the animals not fed grain. Drylot feeding would give a better conversion figure of grain for beef gain.

Similar to trials in other states, grain feeding on small grain pastures showed little advantage for the grain; however, the stocking rate could

Table 4: Effect of Grain Feeding on Carrying Capacity of Steers Grazing Small Grain Pastures.

	Ave. Lb. Grain[1] Consumed Daily	Animal Grazing Days Per Acre	Ave. Daily Gain[2] Pound/Head	Lb. Beef Per Acre
1963-1964				
Pasture no grain	—	213	1.3	276
Pasture & grain	5.4	253	1.75	442
1964-1965				
Pasture no grain	—	150	1.35	202
Pasture & grain	6.0	175	1.60	280
1965-1966				
Pasture no grain	—	196	1.49	292
Pasture & grain	5.0	248	1.79	443
Ave. 3 years				
Pasture no grain	—	186	1.38	257
Pasture & grain	5.5	225	1.72	388

[1]/ Ground Corn or Grain Sorghum
[2]/ Animals Average Approximately 450 Pounds at Start of Grazing in November.

be increased on the grain paddocks. A three-year study has been completed in an effort to measure the increased carrying capacity where grain is fed on pastures.

The grain intake, animal grazing days per acre, daily gain and beef production per acre are shown in Table 4. Results show approximately 20 percent greater carrying capacity where grain was fed free choice. An average consumption of 5.47 pounds of grain increased average daily gain by only .34 pounds. Sixteen pounds of grain were required to produce one pound of beef. However, on an acre basis, because of higher carrying capacity the conversion rate of grain was reduced to 9.4 pounds for each extra pound of beef produced as follows:

225 days grazing $\times$ 5.47 pounds grain fed = 1230 pounds grain per acre.
388 — 257 = 131 pounds beef gain per acre (on grain fed).
1230 $\div$ 131 = 9.4 pounds grain for each pound of beef gain.

Ground corn or grain sorghum was kept before the animals for the entire grazing season but daily consumption varied greatly from month to month. Good forage was always available for grazing, but the animals ate 10 pounds of grain daily during some of the winter months. When daily gains were high in the pastures without grain, little grain was eaten. Daily gains were always high in April, but grain intake was very low during the month. A daily gain of 1.72 pounds for the 175-day grazing period was not sufficient to condition the 450 pound steers for the packer.

Ground grain sorghum, corn and wheat were placed in separate feeders for free choice selection in an attempt to increase grain intake with grazing steers. Also high quality hay from oats, sudan, bermuda, sericea and prairie was placed in separate bunks for free choice selection. The animals ate three pounds of corn and grain sorghum but less than one pound of wheat daily. Only 1.4 pound of hay was consumed daily. Oats and prairie hay was chosen over the other species. The animals in these pastures gained less than animals fed grain without hay.

Wintering Cows on Small Grain and Grass

Small grain forages are an excellent source of protein for beef cows during winter months. Small grains and dry grasses maintain cows without supplemental feeding.

Most of the beef cows in Oklahoma are maintained during the winter on protein supplement and dry grasses. Since protein supplement is expensive and small grain forage is high in protein it seems logical to substitute the green forage for the protein supplement to furnish the .7 to .8 pounds of digestible protein needed daily by a 1000 pound dry cow. Dry cows, grazing good small grain pastures alone, may gain 2 to 3 pounds daily and require several acres for winter grazing. This method is not only expensive but cows become too fat for best performance.

Several years of exploratory testing was conducted to find a program whereby small grain and dry summer forage pastures could be combined to maintain the cow without supplemental feeding. Table 5 gives two years results of cows on small grain pastures part time, with dry lovegrass furnishing the bulk of the forage. The cows lost only 55 pounds weight in the winter of 1964-1965, including calving loss, while grazing one day on small grains and an average of 2.6 days on lovegrass. The loss of only five percent is considered low since up to 15 percent loss is possible without injury to cow performance. The loss of 92 pounds during 1965-1966 with a grazing program of one day on small grain and an average of 3.67 days on lovegrass is less than 10 percent or very good maintenance for the cows.

Table 5: Wintering Dry Cows on Small Grain and Weeping Lovegrass Pastures.

	1964-1965	1965-1966
Total days grazed	136	140
Days on lovegrass	98	110
Days on small grains	38	30
Average weight of cows, November	1030	1068
Average weight of cows, April 1[1]	975	976
Average weight loss (pounds)	55	92

[1] All calves dropped in March.

After weighing cows every month for several years it was found that they gained weight in November and December on a program of one day on small grains and four days or less on dry grass. A slight loss occurred in January and February with the greatest loss during March when the calf was dropped.

Table 6 outlines a winter grazing program for dry cows on small

Table 6: A Winter Program for Grazing Dry Beef Cows on Small Grain and Dry Summer Grasses.

November	1 day grazing small grains
December	5 days grazing dry grass
January	1 day grazing small grains
February	4 days grazing small grains
March	1 day grazings small grains
	3 days grazing small grains
150 day grazing period	32 days on small grains
	113 days on dry grass

grain pastures and dry grass. The proposed program is formulated from results shown in Table 5 and several years of preliminary grazing tests. A 1000-pound cow will graze approximately 25 pounds of Dry Matter (D.M.) daily on good small grain pastures and 15 to 20 pounds of dry grass. Forage from all the small grain contains at least 25 percent protein during November and December; therefore, a cow will get 6.25 pounds of protein daily from the green forage. A program of five days on dry grass and one day on small grains would insure an average of one pound protein daily. Also, quality of the dry grass is higher in the fall months. Small grain forage in January and February will average 20 percent protein. A grazing program of one to four days would insure one pound of protein daily for the five day period.

Several reasons can be given for more grazing of small grains in March (1-3 days suggested). Greatest loss of weight in cows occurs during the calving period. The green forage encourages greater milk flow for the calf and the dry grass is much lower in quality and quantity. Rye fits this schedule well since it usually makes rapid growth in March.

Grazing small grains 32 days with a daily intake of 25 pounds D.M. requires 800 pounds of forage to winter one cow. Rye in most situations will produce 2000 pounds or more forage before the first of April, making it possible to carry two or more cows per acre during the winter months. Carrying capacity on wheat is less than rye and little grazing is possible in March if the wheat is to be harvested.

Weeping lovegrass was used in the tests shown in Table 5 to provide dry grass for winter grazing. Similar tests were conducted with bermudagrass, with equal results. Native grasses, sudan or sorghum forage could be used in combination with small grain pastures if the cow has sufficient forage to graze 15 to 20 pounds daily.

Young 400-500 pound steers required one day grazing on small grains and two days grazing on good rye grass for a gain of ½ pound daily, which is necessary for growing animals.

Cows with calves were not used in this study but they would be expected to require more small grain grazing days compared to dry cows. Calves given access to the green pastures without the cows spent considerable time grazing alone during the winter.

The problem of moving cows often from one pasture to another may present a problem, especially for large herds or large fields. Aids for removing cattle from the small grain pasture are: allow no water or salt in the pasture, prepare a good resting area near the small grain pas-

ture, and if necessary train the cows to assemble for a small amount of feed.

Fertilization For Small Grain Forage

A three-year clipping test[2] was conducted on one variety of wheat, oats, barley and rye on Taloka soil at the Eastern Oklahoma Pasture Station. All fertilizers were disked into the soil immediately before planting except split applications of nitrogen in fall and spring. The three-year average total forage production for four varieties under 10 different fertility levels is given in Table 7.

Results indicate it was possible to double the forage production with a balanced fertilizer program. Oat production was low because of

Table 7: Summary of Three-Year Small Grains Fertility Test.*

Treatment	Crop	Total Dry Matter Per Acre			
		1962-63	1963-64	1964-65	3 Yr. Ave.
		— Pounds —			
0-0-0	Wheat	1852	1596	976	1475
"	Oats	926	1881	363	1057
"	Rye	1953	1476	1349	1593
"	Barley	1076	1456	798	1110
80-0-40	Wheat	2350	1999	2093	2147
"	Oats	1290	2410	1403	1701
"	Rye	2027	2509	3165	2567
"	Barley	1502	2543	2692	2246
0-80-40	Wheat	2223	1748	844	1605
"	Oats	1312	1969	554	1278
"	Rye	3038	2256	1794	2363
"	Barley	1994	2193	1098	1762
40-80-40	Wheat	2666	2209	1386	2087
"	Oats	2011	3084	1112	2069
"	Rye	3457	2488	2429	2791
"	Barley	2591	2132	1899	2207
80-40-40	Wheat	3295	2610	2518	2808
"	Oats	1990	2932	1649	2190
"	Rye	3658	3289	3897	3615
"	Barley	2964	4045	2917	3309

[2] These studies were done cooperatively with Dr. B. B. Tucker, Agronomy Dept., Oklahoma State University.

Treatment	Crop	Total Dry Matter Per Acre 1962-63	1963-64	1964-65	3 Yr. Ave.
160-80-40	Wheat	3222	2726	3390	3113
"	Oats	2031	2640	2440	3270
"	Rye	3713	3173	4996	3961
"	Barley	3857	4147	4126	4043
80-160-80	Wheat	3874	3139	2600	3204
"	Oats	2361	3362	1768	2497
"	Rye	3888	3496	3683	3689
"	Barley	3343	4785	2806	3645
80-80-40	Wheat	3119	2483	1944	2515
"	Oats	2044	3301	1770	2372
"	Rye	3322	3600	3063	3328
"	Barley	2983	3973	2823	3259
40-80-40 fall	Wheat	3246	2077	1432	2352
40-0-0 spring	Oats	1916	3204	1138	2086
	Rye	3646	3055	2441	3047
	Barley	2992	4188	1826	3002
80-80-40 fall	Wheat	3377	3032	2719	3043
80-0-0 spring	Oats	2012	3403	1996	2470
	Rye	3789	4660	3961	4137
	Barley	3522	5107	2940	3856

* Varieties and rates of planting were as follows: Kaw Wheat, two bushels per acre; Elbon Rye, two bushels per acre; Rogers Barley two bushels per acre; and Forkedeer Oats, three bushels per acre.

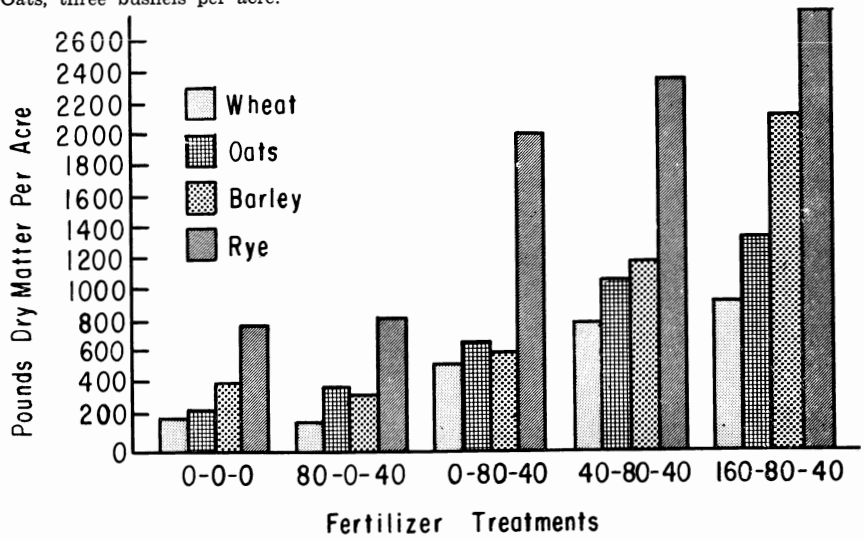


Fig.2 Response of forage growth to phosphorous and nitrogen fertilization during October, November and December.

severe winter injury during two years. Split application of nitrogen in fall and spring did not increase forage production over a single application in the fall at planting time. Phosphorus was important in establishment and early production of forage. Phorphorus stimulated growth more than nitrogen in the fall.

Figure 2 emphasizes the effect of phosphorus on early forage production for the first three clippings for the 1962-1963 tests.[1] Phosphorus without nitrogen produced twice as much forage than nitrogen without phosphorus up until February 6 (1963-64). A combination of nitrogen and phosphorus was necessary to reach maximum production.

None of the grazing tests reported were conducted on wheat grown for grain production; however, most of the information can be applied if wheat forage is available for grazing. The palatability and quality of all small grain crop forage are so high that animal performance is similar for all varieties, provided that the herbage is sufficient for ade--quate intake. Unfortunately wheat forage production is lower in the fall months compared with rye (Figure 2). Total forage production comparison is not too different between rye and wheat, but grazing must cease the first of March on wheat for grain production. Usually only one-third of the total forage of wheat is produced before March 1 while two-third of rye forage may be available for grazing before March 1.

Overseeding Small Grains on Bermudagrass

Bermudagrass is dormant approximately six months of the year in Oklahoma. Often small grains are drilled in bermudagrass pastures to obtain grazing in March and April when green forage is so badly needed. Inability to secure stands of small grains in bermudagrass sod is the greatest hinderance to this practice. Also, the cost of seed, fertilizer and drilling may become a factor.

Conventional grain drills can be used on sandy soils or under wet conditions, but under most conditions special drills are needed. Drills designed to plant in grass sod can be obtained, but often the row spacing is too wide, the drills are difficult to pull and they place the seed too deep in the soil. A drill of the type used for planting wheat in the stublemulch program in western Oklahoma has proven to be the most satisfactory during these tests. The drill has close spacing (8-10″) and the seed is drilled about one inch deep in a very small opening. The heavy sod and vegetation are no problem and the drill is easy to pull in the bermudagrass.

[1] Clippings made Nov. 13, '62; Dec. 18, '62, and Feb. 6, '63.

Steers grazing a mixture of rye and wheat overseeded on Bermudagrass near Muskogee, Okla., March, 1967.

Dry soil conditions in the fall months often makes it necessary to drill small grains in soil only under irrigation or in Eastern Oklahoma. October 15 to November 15 is the best time for seeding. Earlier plantings must compete with the bermudagrass for moisture and grazing injuries the small grain plant during emergence.

Small grains have been drilled in bermudagrass sod for several years on the Perkins, Muskogee and Heavener stations. Good grazing on the small grains is usually available in March or approximately 45 days before the bermudagrass greens up. Steers (500 pounds) grazing small grains from March 15 to May 1 have gained 1.5 to 2 pounds daily. Total production has varied from 50 to 150 pounds beef per acre during this period. It has been difficult to determine beef production attributable to the small grains after the first of May because the bermudagrass is in production by then.

On the Muskogee station, a starter fertilizer of 20-40-20 has been used for the small grain for pasture followed with 40 to 50 pounds of nitrogen applied in the early spring.

Small grains overseeded in bermuda have produced about half and required the same amount of nitrogen compared to small grains grown on cultivated soils.

Summary

Small grain pastures are an important source of protein for wintering cattle in Oklahoma. This publication reports results of studies made on various aspects of winter grazing small grain pastures.

Under favorable growing conditions animals preferred oats first, rye second, wheat third and barley last. Certain varieties were preferred over varieties of the same crop. Arkwin oats and Elbon rye were the most palatable of the small grains tested.

Heavy stocking rates on small grain pastures in November and December reduced stocking rates the remainder of the season, lowered daily gains and lowered total animal gain per acre. Application of 100-40-20 fertilizer per acre increased beef gain 73 pounds per acre over 20-40-20 treatments. Low daily gains in November were difficult to explain. High daily gains for steers were always in December and April. Most of the grazing was from rye, but wheat and vetch aided the forage program in April and May. Yearling steers averaged 1.44 pounds daily and two-year-old steers averaged 1.54 pounds daily for a three-year average of a 193 day grazing period.

Steers grazing good small grain pastures and fed grain free choice ate 5.47 pounds of grain daily and increased animal gains .34 pounds daily. Pastures without grain provided 186 days grazing per acre and with grain 225 days for an increase of 21 percent.

Dry cows grazing small grains 30 days and weeping lovegrass 110 days lost 92 pounds during the winter, including loss of weight from calving. Distribution of the days grazing on each crop is important.

Phosphorus was extremely important in the establishment and early forage growth of all small grain crops. Addition of nitrogen with phosphorus was necessary to produce maximum forage.

Oklahoma's Wealth in Agriculture

Agriculture is Oklahoma's number one industry. It has more capital invested and employs more people than any other industry in the state. Farms and ranches alone represent a capital invstment of four billion dollars—three billion in land and buildings, one-half billion in machinery and one-half billion in livestock.

Farm income currently amounts to more than $700,000,000 annually. The value added by manufacture of farm products adds another $130,000,000 annually.

Some 175,000 Oklahomans manage and operate its nearly 100,000 farms and ranches. Another 14,000 workers are required to keep farmers supplied with production items. Approximately 300,000 full-time employees are engaged by the firms that market and process Oklahoma farm products.

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