A STUDY OF THE PERIODIC FORAGE PRODUCTION OF TWENTY-ONE SMALL GRAIN COMBINATIONS

By

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INTRODUCTION

Most of the small grains planted in Oklahoma are grazed by livestock sometime during the growing season. The availability of green, succulent forage of high nutritive value during the period when native warm season grasses are dormant would be very advantageous to the livestock producer.

Very little information is available on the forage production of most small grains as breeding work is usually concentrated on the factors which contribute to the grain yield.

Information on the forage production periods and the forage yields of small grains would be very useful to the livestock producer and dairyman in planning a pasture program.

The objective of this study was to determine the period of forage production with varieties or selections most compatible in combinations for sustained high forage yields throughout the growing season.

LITERATURE REVIEW

Some of the earlier workers who reported on forage production by small grains included Dobson (6)[1] in Louisiana who stated that barley sown early made very good pasture and grew as rapidly as oats. It was further stated that rye furnished excellent grazing the entire winter. From Georgia, Redding (17) in 1899 reported that rye and barley were sown almost exclusively for pasture and green manure crops. The practice of early sowing of small grains was recommended for greater forage production.

In Oklahoma, Finnell (10) made the statement that wheat pasture supplied a highly palatable forage with a narrow nutritive ratio of 1 to 5.9 and supported the practice of early sowing in order to secure extra fall pasture.

Semple et. al. (18) advised the use of locally adapted varieties in all forage plantings. They suggested a profitable practice of the heavy seeding of all the small grains at a rate at least twice that in seeding for grain production.

After an extensive study on winter pasture crops for Georgia, Burton et. al. (2) found that winter pasture from small grains could be increased by planting good forage varieties. The practice was also recommended of planting early for early grazing. As a result of an oat forage and grain

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[1] Figures in parenthesis refer to Literature Cited.

yield study, Crowder (4) reported that it was better to plant earlier than the recommended date for grain production to get increased forage yields. Another economical practice recommended was the complete utilization of the cereal grain as a grazing crop if the grain was not needed.

According to Kirk et. al. (15), cereal grains were capable of providing pasturage when the perennial grasses were unproductive in many parts of Canada. Of the small grains, oats were by far the most important. The data submitted supported the view that oats were more valuable for pasture than for hay. Young oat herbage was regarded as a highly concentrated protein feed.

Staten and Heller (23) in Oklahoma stated that in the comparison of total forage yield and protein content of winter small grains pasture, it appeared likely that livestock producers might profitably utilize the crops entirely for pasture without taking a grain crop. Forage production of different varieties of the same crop differed enough to make it worthwhile to choose a variety specifically for pasture when pasture was an important part of the use to be made of the crop.

According to Holt and Potts (12) in 1951, varieties of small grains were being developed for superiority in forage production, disease resistance and frost tolerance as well as grain yield. A trend was developing in the planting of two varieties for production at different times of the year.

Trotter (26) in Texas found some varieties of small grains yielded five times as much green matter when compared to the low variety. He stated the work was "too preliminary" but showed a need for more study on the problem of winter pasture from small grains.

Ethridge et. al. (8) in studying pasture systems for Missouri reported that small grains for pasture should be sown early and thick. Barley was the best in vigor and abundance of fall growth of the small grains studied.

Differences in time for production of winter annual grasses were noted by Gardner and Rogers (11) in Georgia. They observed that certain grasses made maximum growth during fall or early winter while others made peak growth during the spring. These workers recommended that since no single species or variety used in their experiment gave high yields of good quality forage throughout the entire season, combinations with dissimilar growth periods would be a method of obtaining better grazing distribution and higher total yields. They further stated a solution to the winter grazing problem may be in the selection of forages on the basis of the season of their best production.

The period of production of small grains in Oklahoma was cited by Huffine et. al. (13) in some management and evaluation studies. In comparing the different small grain crops, barley produced the highest yields in the fall with rye yielding more in the winter months. The studies also showed that winter oats extended the grazing period later into the spring.

Other work in Oklahoma by Jones et. al. (14) and Mincrief (16) showed barley produced quick growth and high forage yields early in the fall. Rye produced the highest total yield of forage followed in order by oats, hard wheat, barley and soft wheat.

Crowder et. al. (5) found from several grazing experiments conducted in Georgia that various mixtures of small grains produced about

the same as oats or wheat alone. They reported that oats, either in a mixture or alone, was the small grain most commonly used for temporary pasture. Abruzzi rye produced more fall and winter forage than any other small grain and grew at lower winter temperatures.

Experiments conducted on mixtures of oats, rye and barley were conducted by Faires and Dawson (9) in the Sandhill region of the Southeast United States. Rye made rapid growth in late winter and early spring. The oats and barley were later maturing and slower growing than rye in this study.

The results of Stansel et. al. (21) at Angleton, Texas showed that oats and wheat in combination gave a higher forage yield when compared to the pure stand planting of oats, wheat, rye or barley.

The results of four years of studies conducted by Staten and Elder (22) in Oklahoma on the forage production of winter cereal crops showed barley to be the highest producer with rye, winter oats and hard wheat following in that order.

Shaw and Atheson (19) reported rye was planted for pasture more than any other cereal grain in Kansas. The ability to withstand severe winter weather made rye a dependable, high yielding supplementary pasture crop. The hazard of winter killing placed barley in a less favorable position in comparison to wheat or rye for pasture even if it made more and earlier fall growth.

Winter rye and winter barley generally furnished more pasturage than wheat in the fall and early winter in Kansas according to Swanson (24). He further stated there was a varietal difference in forage yield with little information available on this subject.

Trew (25) stated that oats were the most commonly used supplemental winter pasture crop for the Rio Grande Plain. Barley furnished grazing earlier in the season but did not last as long in the spring.

In 1953, Texas barley was the top forage producing small grain in studies at the Blackland Experiment Station near Temple, Texas for Cook and Parmer (3) but in 1954, an experimental oat variety (3770-7) gave the highest yield followed closely by Quanah wheat.

The most recent information on forage production in Oklahoma was by Adams (1) in which Elbon rye was the only small grain giving yields in mid-winter. Wintok and Forkedeer oats gave only three pounds different total seasonal yields at the four bushel seeding rate.

METHODS AND MATERIALS

A forage yield study of several small grain combinations was conducted at the Oklahoma Agricultural Experiment Station Agronomy Farm on a Kirkland silt loam soil in 1957.

The objective of this study was to determine the period of forage production with varieties or selections most compatible in combination for sustained high forage yields throughout the growing season. The small grains used in this investigation were those which appeared to be high forage producers in pure stands in previous studies (1).

Eight varieties or selections of four small grain crops were included in one or more of twenty-one different combinations. Each combination was seeded at the rate of 100 pounds per acre. This rate was obtained through different arrangements of four parts rye, four parts wheat, three parts oats and three parts barley. The varieties and the pounds of each comprising the individual combinations are shown in Table I.

The material was planted in a randomized block design with four replications. The individual plot consisted of five rows, seven inches apart and twenty feet long. The area was fertilized the day prior to planting with 16-20-0 fertilizer at the rate of 250 pounds per acre.

Additional nitrogen was applied with a Gandy spreader in the form of commercial 33% ammonium nitrate at the rate of 38 pounds of actual nitrogen per acre on November 20 and November 30. The last application

TABLE I

THE VARIETY OR SELECTION OF SMALL GRAIN AND POUNDS OF SEED USED IN EACH COMBINATION FOR FORAGE PRODUCTION

Combinations	Pounds of seed per acre
Wintok oats	21
Rogers barley	21
Concho wheat	29
Elbon rye	29
Wintok oats	21
Rogers barley	21
Concho wheat	29
Comp. 222 rye	29
Wintok oats	30
Rogers barley	30
Elbon rye	40
Wintok oats	30
Rogers barley	30
Comp. 222 rye	40
Wintok oats	50
Rogers barley	50
Wintok oats	43
Elbon rye	57
Wintok oats	43
Comp. 222 rye	57
Forkedeer oats	21
Rogers barley	21
Concho wheat	29
Elbon rye	29
Forkedeer oats	21
Rogers barley	21
Concho wheat	29
Comp. 222 rye	29
Forkedeer oats	30
Rogers barley	30
Elbon rye	40

TABLE I (continued)

Combinations	Pounds of seed per acre
Forkedeer oats	30
Rogers barley	30
Comp. 222 rye	40
Forkedeer oats	50
Rogers barley	50
Forkedeer oats	43
Elbon rye	57
Forkedeer oats	43
Comp. 222 rye	57
Bronco oats	21
Rogers barley	21
Concho wheat	29
Elbon rye	29
Bronco oats	21
Rogers barley	21
Concho wheat	29
Comp. 222 rye	29
Bronco oats	30
Rogers barley	30
Elbon rye	40
Bronco oats	30
Rogers barley	30
Comp. 222 rye	40
Bronco oats	50
Rogers barley	50
Bronco oats	43
Elbon rye	57
Bronco oats	43
Comp. 222 rye	57

was 75 pounds actual nitrogen per acre made on March 1.

The plots were planted September 7, 1956 with a one-row Planet Jr. No. 4 seeder. Supplemental water was applied by sprinkler irrigation (Table II) to insure germination of the small grain in the dry seed bed. Additional irrigations were made when necessary to prevent moisture from being a limiting factor in forage yield.

TABLE II

TOTAL QUANTITY OF WATER RECEIVED IN INCHES FROM SPRINKLER IRRIGATION AND RECORDED RAINFALL WITH THE MONTHLY TEMPERATURE MEANS AND EXTREMES BETWEEN JUNE 1, 1956 AND MAY 31, 1957

Month	Inches			Temperature		
	Rainfall	Irrigation	Total	Mean	Highest	Lowest
June	1.27		1.27	79.6	103	52
July	1.03		1.03	85.6	105	63
August	1.27		1.27	88.0	111	--
September	0.16	5.40	5.56	79.2	103	49
October	2.06	5.38	7.44	68.2	94	38
November	1.77	2.10	3.87	48.5	80	14
December	1.68		1.68	42.9	77	17
January	0.84		0.84	33.8	74	9
February	1.71		1.71	45.4	74	21
March	2.40		2.40	49.1	79	26
April	5.10		5.10	57.6	82	24
May	14.91		14.91	67.0	86	41
			47.08			

When the small grain combinations attained approximate grazing height, they were clipped with a Jari mower. The harvest forage from the inside three rows of each plot was oven-dried in a forced air oven at 140 degrees Fahrenheit. After the weights were recorded, a random sample of each combination was taken to the Department of Biochemistry for protein analysis.

Due to a serious infestation of leaf hoppers (Empoasca fabae), the plots were sprayed on October 9 and October 22 with a 5% solution of D.D.T. (dichloro-diphenyl-trichloroethane). Serious damage had occurred to the barley and especially to the ryes before the insecticide applications were made.

The methods for statistical analyses of the data were taken from Snedecor (20) and Duncan (7). The analysis of variance and the multiple range tests were calculated on yields of each harvest and the total accumulated forage production for the season.

RESULTS AND DISCUSSION

When analyzed by statistical methods, each periodic forage clipping showed a highly significant difference between combinations (Tables III through XVI). No single combination was consistantly a high forage producer throughout the entire growing season. The analysis of variance and the multiple range tests are shown in Tables III through XVI.

As shown in Figure 1, Rogers barley with each oat variety was the highest yielding combination for fall production of forage. By far the outstanding combination at this period was Wintok oat and Rogers barley. The lowest forage producer was rye Composite 222 with each basic oat variety. There was a significant difference in forage yield between combinations within each basic oat variety but no significant difference between oat varieties in any given combination as shown by Table III. These yields were reduced considerably by the insect infestation which occurred in early October.

The addition of Elbon rye to any combination increased the forage production during mid-winter as shown in Figure 2. The highest producing combination was Wintok oat with Elbon rye. Bronco in all combinations was lowest in production of the basic oat varieties during mid-winter. Rogers barley did not increase forage production during this period when added to any combination as it did in the fall. Table IV showed a significant difference in forage production between combina-

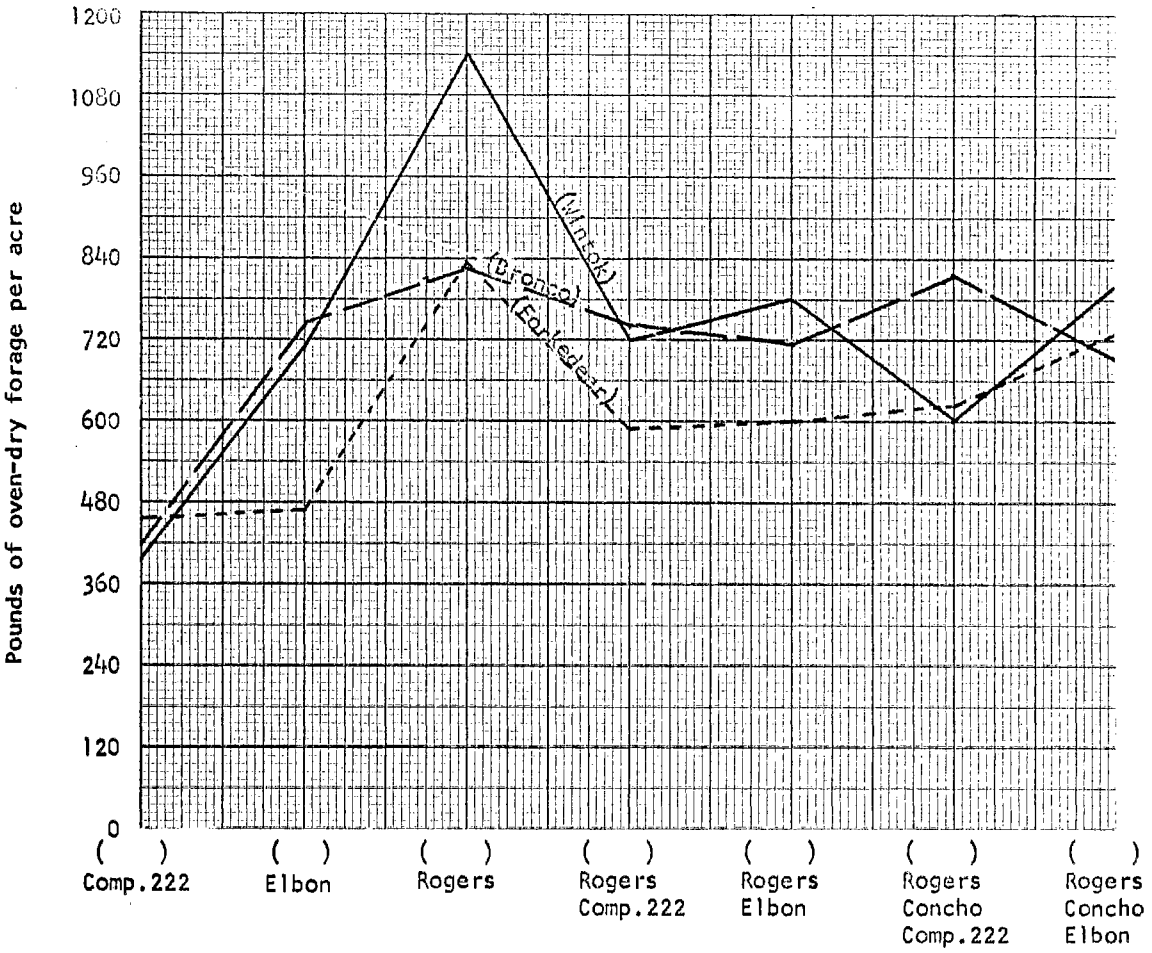

Figure 1. Forage Yields of Twenty-one Small Grain Combinations From the First Harvest of November 16, 1956, in Pounds of Oven-dry Forage per Acre

TABLE III

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FIRST HARVEST OF NOVEMBER 16, 1956

Combinations				Mean	Multiple Range $\not\perp x$ 5%
Wintok	Rogers			1140	
Forkedeer	Rogers			834	
Bronco	Rogers			826	
Bronco	Rogers	Concho	Comp. 222	818	
Wintok	Rogers	Concho	Elbon	800	
Wintok	Rogers	Elbon		784	
Bronco	Elbon			748	
Bronco	Rogers	Comp. 222		739	
Forkedeer	Rogers	Concho	Elbon	729	
Wintok	Rogers	Comp. 222		724	
Bronco	Rogers	Elbon		713	
Wintok	Elbon			713	
Bronco	Rogers	Concho	Elbon	693	
Forkedeer	Rogers	Concho	Comp. 222	628	
Wintok	Rogers	Concho	Comp. 222	598	
Forkedeer	Rogers	Elbon		598	
Forkedeer	Rogers	Comp. 222		589	
Forkedeer	Elbon			472	
Forkedeer	Comp. 222			466	
Bronco	Comp. 222			421	
Wintok	Comp. 222			401	

$\not\perp x$ Any two means underscored by the same line are not significantly different.

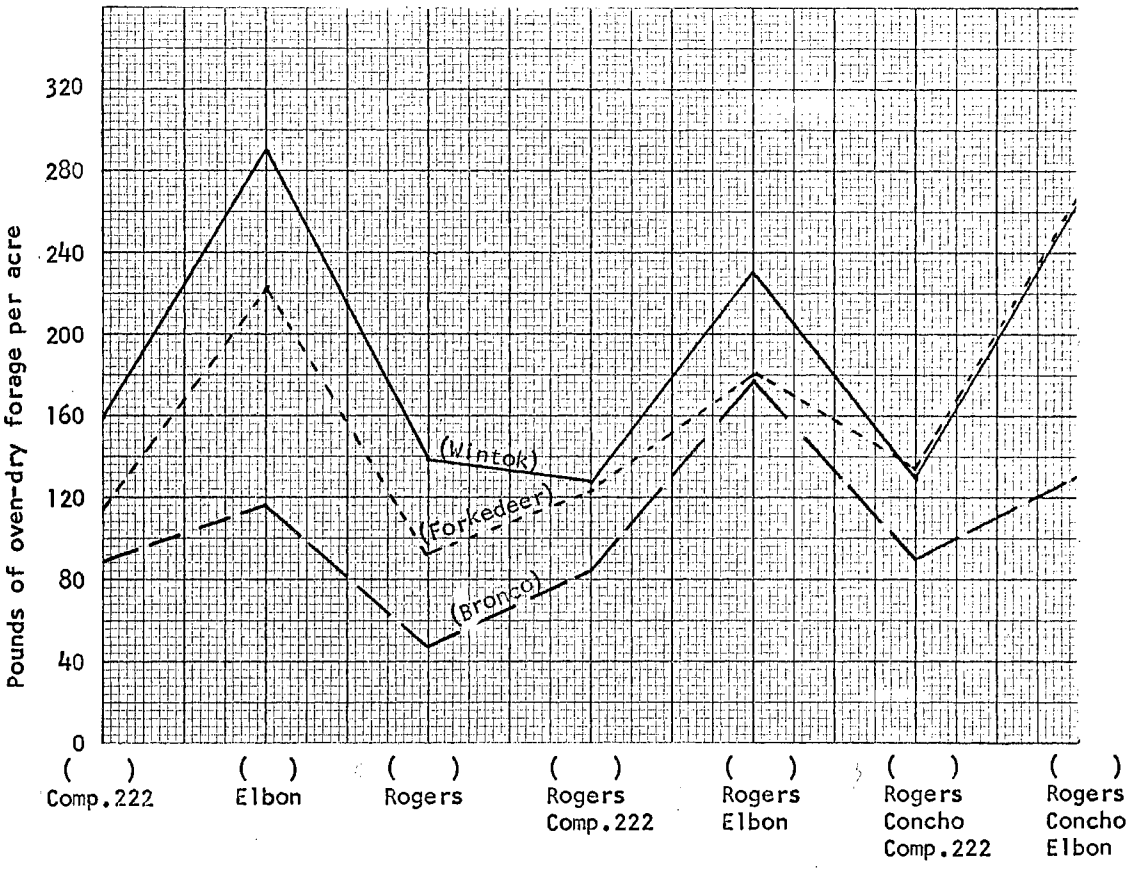

Figure 2. Forage Yields of Twenty-one Small Grain Combinations From the Second Harvest of February 26, 1957, in Pounds of Oven-dry Forage per Acre

TABLE IV

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE SECOND HARVEST OF FEBRUARY 26, 1957

Combinations				Mean	Multiple Range /x 5%
Wintok	Elbon			290	
Forkedeer	Rogers	Concho	Elbon	266	
Wintok	Rogers	Concho	Elbon	264	
Wintok	Rogers	Elbon		229	
Forkedeer	Elbon			222	
Forkedeer	Rogers	Elbon		180	
Bronco	Rogers	Elbon		178	
Wintok	Comp. 222			159	
Wintok	Rogers			137	
Forkedeer	Rogers	Concho	Comp. 222	134	
Wintok	Rogers	Concho	Comp. 222	130	
Bronco	Rogers	Concho	Elbon	129	
Wintok	Rogers	Comp. 222		128	
Forkedeer	Rogers	Comp. 222		124	
Bronco	Elbon			116	
Forkedeer	Comp. 222			114	
Forkedeer	Rogers			93	
Bronco	Rogers	Concho	Comp. 222	90	
Bronco	Comp. 222			89	
Bronco	Rogers	Comp. 222		85	
Bronco	Rogers			47	

/x Any two means underscored by the same line are not significantly different.

TABLE V

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FIRST CLIPPING OF NOVEMBER 16, 1956

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	5,277,760.2		
Reps.	3	666,030.9		
Comb.	20	2,291.760.7	114,588.0	2.9635**
Error	60	2,319,968.6	38,666.1	

** Indicates significance at the 1% level of confidence

TABLE VI

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE SECOND CLIPPING OF FEBRUARY 26, 1957

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	709,556.6		
Reps.	3	63,954.0		
Comb.	20	357,159.6	17,858.0	3.7147**
Error	60	288,443.0	4,807.4	

** Indicates significance at the 1% level of confidence

tions within each basic oat variety. Forage yields of Wintok and Bronco in combination with Elbon were significantly different. In addition, there was a significant difference in production at this time between Wintok or Forkedeer in combination with Concho, Rogers and Elbon when compared to Bronco in this mixture. However, there was no statistical difference in yield between Wintok and Forkedeer in this combination.

The late winter and early spring production was increased by the addition of Concho wheat to the combinations. Mixtures which contained Wintok oats continued to be the leading forage producers. As shown by Table VII, the greater forage production from Wintok was significant statistically over Bronco in every case except the one combination with Rogers barley. Each oat with Rogers combination was consistantly lowest in forage yield again at this period. The outstanding combination was Wintok, Rogers, Concho and Elbon as shown in Figure 3.

In early spring, Wintok, as shown in Figure 4, was still the leading forage producing oat variety. Bronco oats was lowest in forage production except in combination with rye Composite 222. Forkedeer oats was intermediate in yield between Wintok and Bronco. The production of all combinations was more uniform at this time.

The production differences in late April and early May (Figures 5 and 6) were not as great between combinations as previously shown. There was no significant difference between oat varieties (Tables XI and XII). Bronco was making higher forage yields at this period when compared to the other basic oat varieties. The best forage producer this late in the season was Bronco with Elbon which was significantly higher than all other combinations at the May 7 clipping.

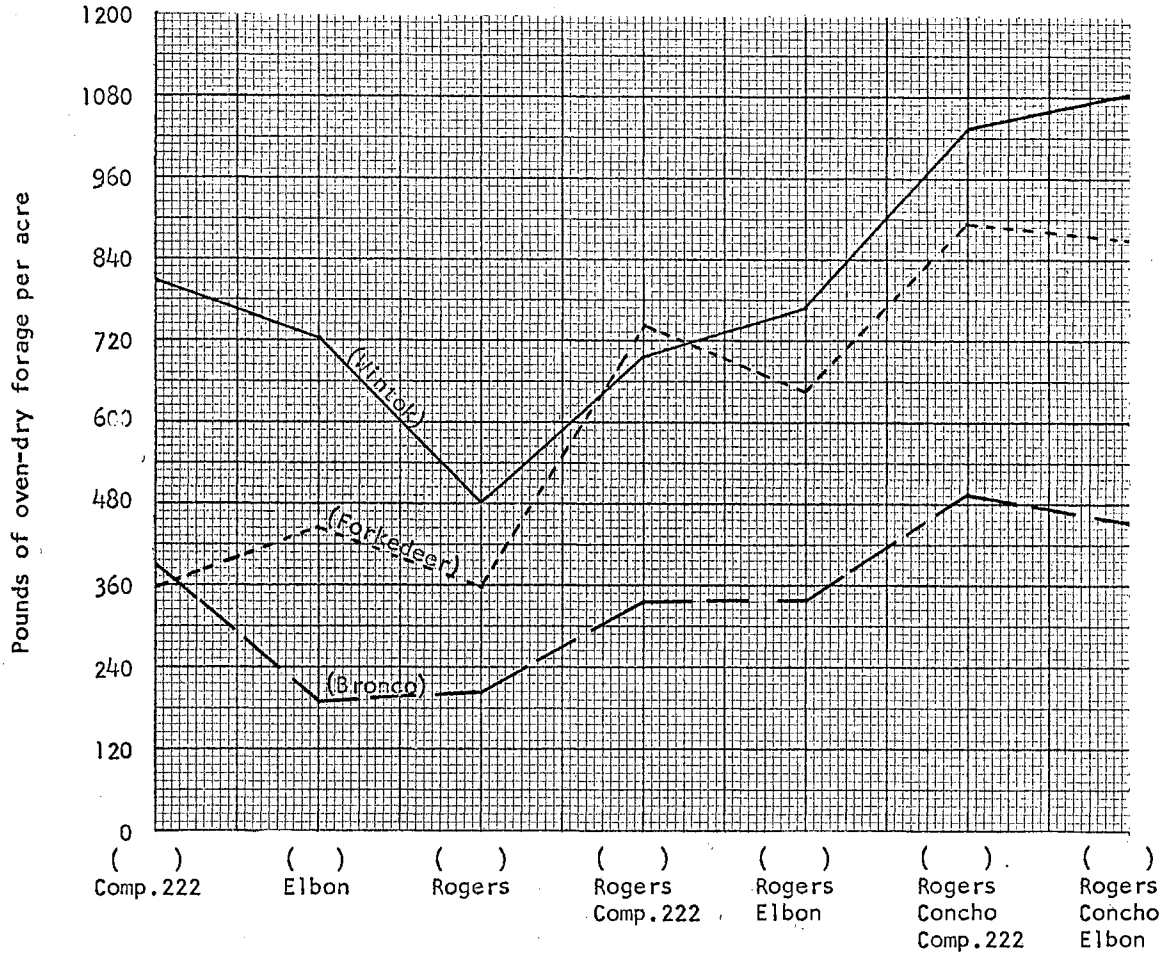

Figure 3. Forage Yields of Twenty-one Small Grain Combinations From the Third Harvest of March 27, 1957, in Pounds of Oven-dry Forage per Acre.

TABLE VII

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE THIRD HARVEST OF MARCH 27, 1957

Combinations				Mean	Multiple Range /x 5%
Wintok	Rogers	Concho	Elbon	1084	
Wintok	Rogers	Concho	Comp. 222	1034	
Forkedeer	Rogers	Concho	Comp. 222	894	
Forkedeer	Rogers	Concho	Elbon	870	
Wintok	Comp. 222			815	
Wintok	Rogers	Elbon		769	
Forkedeer	Rogers	Comp. 222		746	
Wintok	Elbon			721	
Wintok	Rogers	Comp. 222		695	
Forkedeer	Rogers	Elbon		648	
Bronco	Rogers	Concho	Comp. 222	496	
Wintok	Rogers			482	
Bronco	Rogers	Concho	Elbon	455	
Forkedeer	Elbon			448	
Bronco	Comp. 222			391	
Forkedeer	Rogers			360	
Forkedeer	Comp. 222			357	
Bronco	Rogers	Elbon		339	
Bronco	Rogers	Comp. 222		335	
Bronco	Rogers			205	
Bronco	Elbon			193	

/x Any two means underscored by the same line are not significantly different.

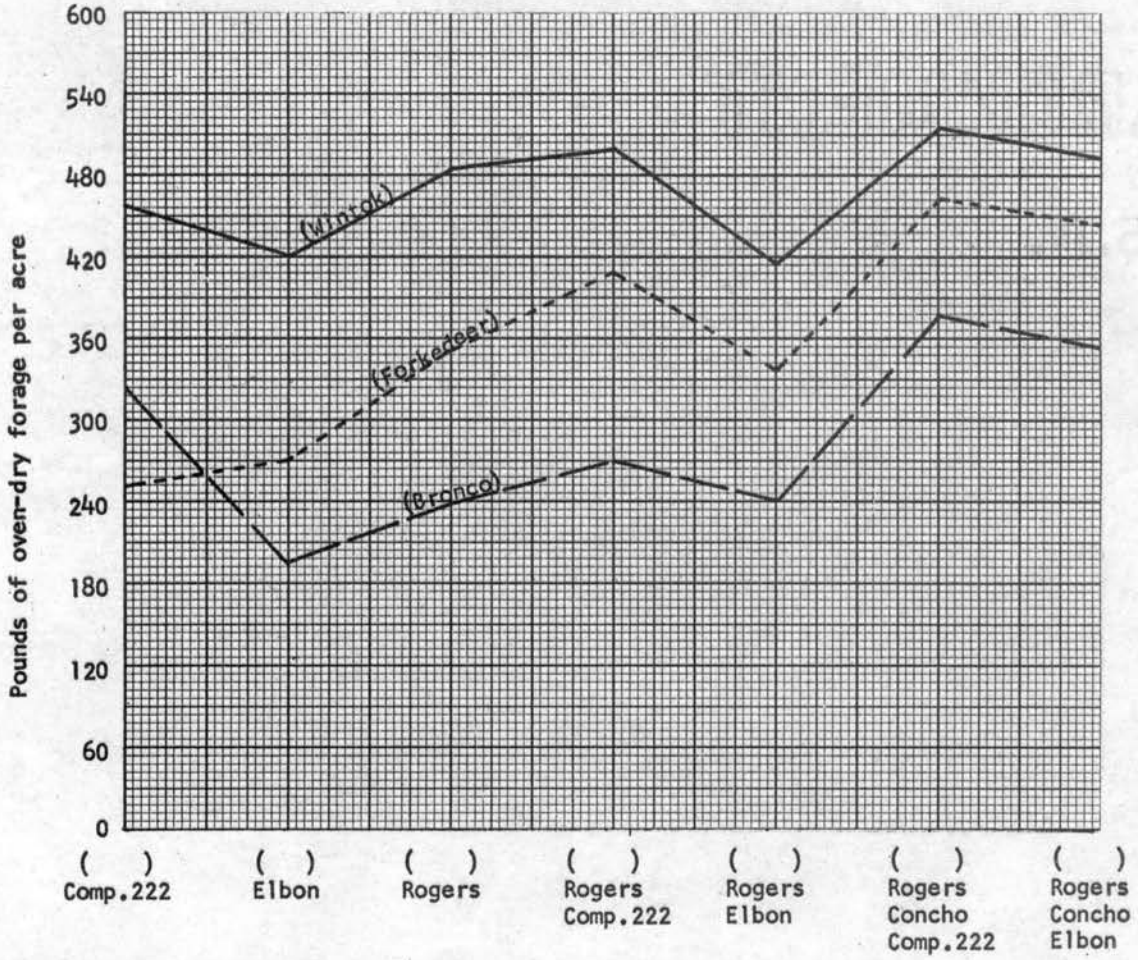

Figure 4. Forage Yields of Twenty-one Small Grain Combinations From the Fourth Harvest of April 9, 1957, in Pounds of Oven-dry Forage per Acre

TABLE VIII

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FOURTH HARVEST OF APRIL 9, 1957

Combinations				Mean	Multiple Range $\angle x$ 5%
Wintok	Rogers	Concho	Comp. 222	513	
Wintok	Rogers	Comp. 222		500	
Wintok	Rogers	Concho	Elbon	493	
Wintok	Rogers			486	
Forkedeer	Rogers	Concho	Comp. 222	460	
Wintok	Comp. 222			456	
Forkedeer	Rogers	Concho	Elbon	444	
Wintok	Elbon			420	
Wintok	Rogers	Elbon		413	
Forkedeer	Rogers	Comp. 222		407	
Bronco	Rogers	Concho	Comp. 222	379	
Bronco	Rogers	Concho	Elbon	355	
Forkedeer	Rogers			351	
Forkedeer	Rogers	Elbon		337	
Bronco	Comp. 222			325	
Forkedeer	Elbon			271	
Bronco	Rogers	Comp. 222		270	
Forkedeer	Comp. 222			254	
Bronco	Rogers	Elbon		241	
Bronco	Rogers			238	
Bronco	Elbon			195	

$\angle x$ Any two means underscored by the same line are not significantly different.

TABLE IX

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE THIRD CLIPPING OF MARCH 27, 1957

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	8,139,819.6		
Reps.	3	209,356.2		
Comb.	20	5,558,111.4	277,905.6	7.0286**
Error	60	2,372,352.0	39,539.2	

** Indicates significance at the 1% level of confidence

TABLE X

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FOURTH CLIPPING OF APRIL 9, 1957

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	1,222,453.8		
Reps.	3	13,778.9		
Comb.	20	777,435.0	38,871.8	5.4084**
Error	60	431,239.9	7,187.3	

** Indicates significance at the 1% level of confidence

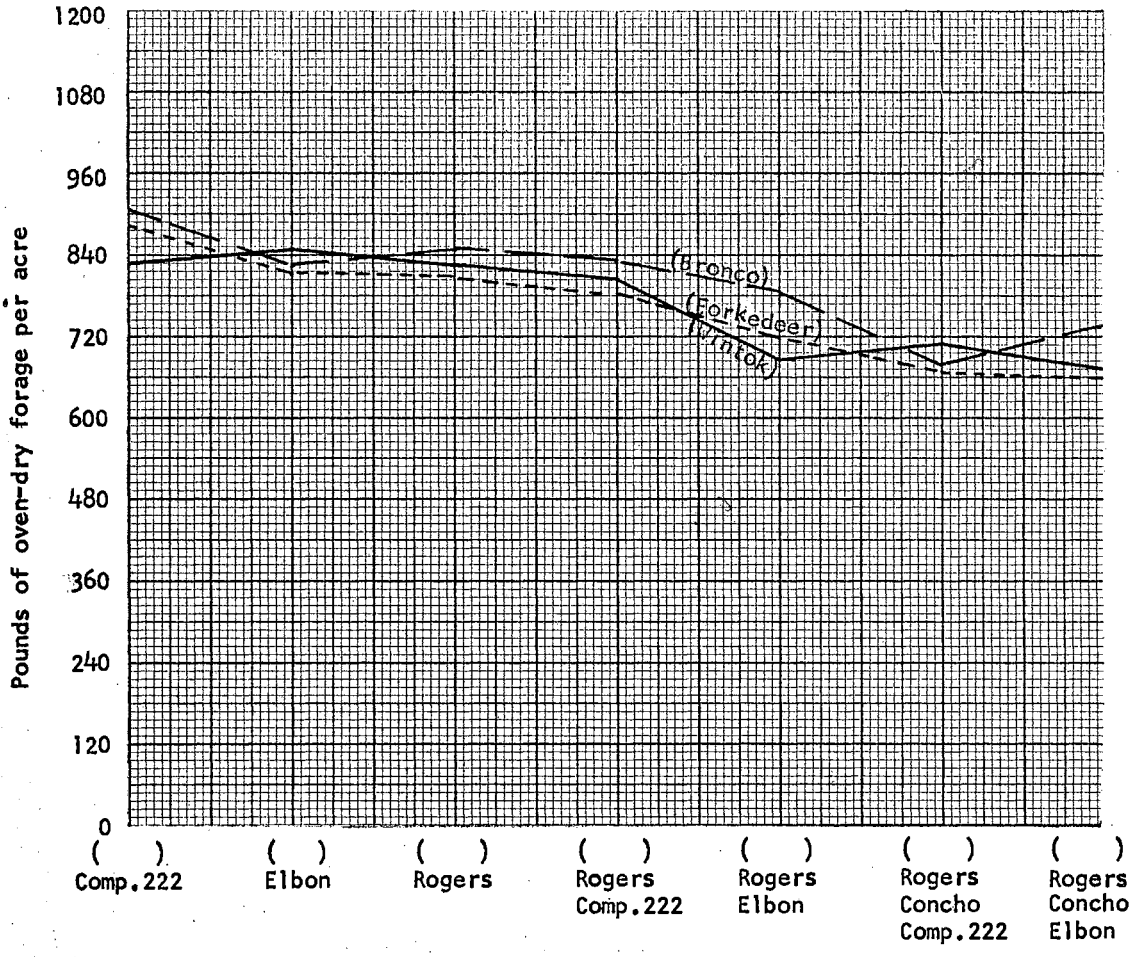

Figure 5. Forage Yields of Twenty-one Small Grain Combinations From the Fifth Harvest of April 26, 1957, in Pounds of Oven-dry Forage per Acre

TABLE XI

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FIFTH HARVEST OF APRIL 26, 1957

Combinations				Mean	Multiple Range $\angle x$ 5%
Bronco	Comp. 222			909	
Forkedeer	Comp. 222			882	
Wintok	Elbon			847	
Bronco	Rogers			846	
Wintok	Comp. 222			833	
Bronco	Rogers	Comp. 222		832	
Wintok	Rogers			825	
Bronco	Elbon			822	
Forkedeer	Rogers			810	
Forkedeer	Elbon			807	
Wintok	Rogers	Comp. 222		805	
Forkedeer	Rogers	Comp. 222		787	
Bronco	Rogers	Elbon		785	
Bronco	Rogers	Concho	Elbon	741	
Forkedeer	Rogers	Elbon		718	
Wintok	Rogers	Concho	Comp. 222	705	
Wintok	Rogers	Elbon		681	
Bronco	Rogers	Concho	Comp. 222	680	
Wintok	Rogers	Concho	Elbon	676	
Forkedeer	Rogers	Concho	Comp. 222	663	
Forkedeer	Rogers	Concho	Elbon	663	

$\angle x$ Any two means underscored by the same line are not significantly different.

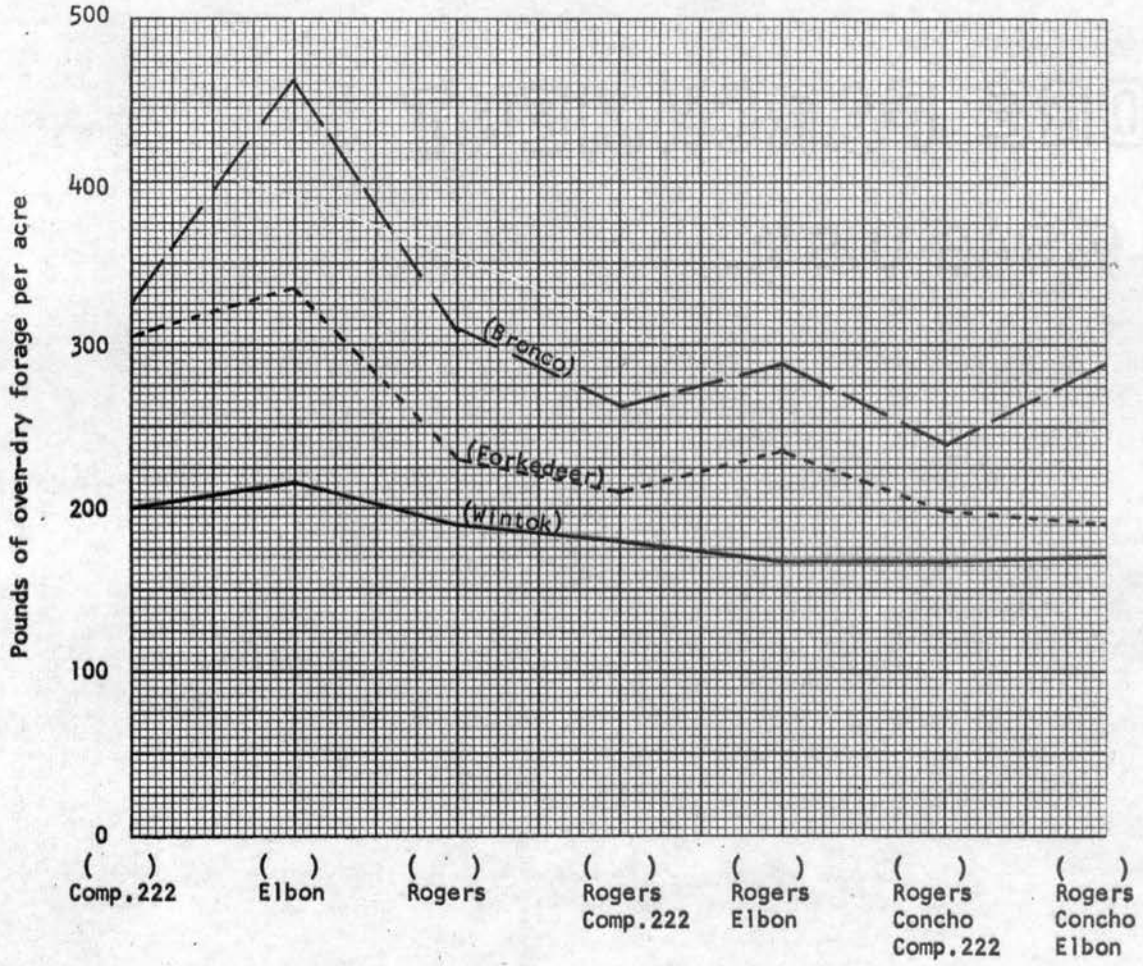

Figure 6. Forage Yields of Twenty-one Small Grain Combinations From the Sixth Harvest of May 7, 1957, in Pounds of Oven-dry Forage per Acre

TABLE XII

MULTIPLE RANGE TEST OF THE FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE SIXTH HARVEST OF MAY 7, 1957

Combinations				Mean	Multiple Range $\angle x$ 5%
Bronco	Elbon			462	
Forkedeer	Elbon			335	
Bronco	Comp. 222			325	
Bronco	Rogers			310	
Forkedeer	Comp. 222			306	
Bronco	Rogers	Elbon		289	
Bronco	Rogers	Concho	Elbon	288	
Bronco	Rogers	Comp. 222		262	
Bronco	Rogers	Concho	Comp. 222	241	
Forkedeer	Rogers	Elbon		234	
Forkedeer	Rogers			230	
Wintok	Elbon			216	
Forkedeer	Rogers	Comp. 222		210	
Wintok	Comp. 222			201	
Forkedeer	Rogers	Concho	Comp. 222	198	
Forkedeer	Rogers	Concho	Elbon	191	
Wintok	Rogers			190	
Wintok	Rogers	Comp. 222		180	
Wintok	Rogers	Concho	Elbon	170	
Wintok	Rogers	Elbon		167	
Wintok	Rogers	Concho	Comp. 222	166	

$\angle x$ Any two means underscored by the same line are not significantly different.

TABLE XIII

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE FIFTH CLIPPING OF APRIL 26, 1957

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	1,183,037.2		
Reps.	3	189,434.2		
Comb.	20	463,286.7	23,164.3	2.6208**
Error	60	530,316.3	8,838.6	

** Indicates significance at the 1% level of confidence

TABLE XIV

ANALYSIS OF VARIANCE OF THE FORAGE PRODUCED BY TWENTY-ONE SMALL GRAIN COMBINATIONS FOR THE SIXTH CLIPPING OF MAY 7, 1957

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	548,844.15		
Reps.	3	12,222.0		
Comb.	20	432,980.15	21,649.0	12.5329**
Error	60	103,642.0	1,727.37	

** Indicates significance at the 1% level of confidence

In total accumulated forage production, Wintok was the leading basic oat variety in every group of combinations as shown in Figure 7. Bronco was the inferior oat with the exception of the oat and Elbon combinations in which Forkedeer was the lowest producer. The outstanding combination was Wintok, Concho, Rogers and Elbon in the total season production.

The average protein per cent was relatively high in all combinations as shown in Figure 8. The lowest combination was Bronco and Rogers with a percentage of 21.5 and 484 pounds per acre of crude protein (Table XVII). The combination with highest protein percentage of 24.9 was unique in being the one with the highest seasonal forage production which was Wintok, Rogers, Concho and Elbon. The highest combination produced 862 pounds per acre of crude protein. This would be the equivalent of approximately 2100 pounds of 41 per cent cottonseed meal per acre.

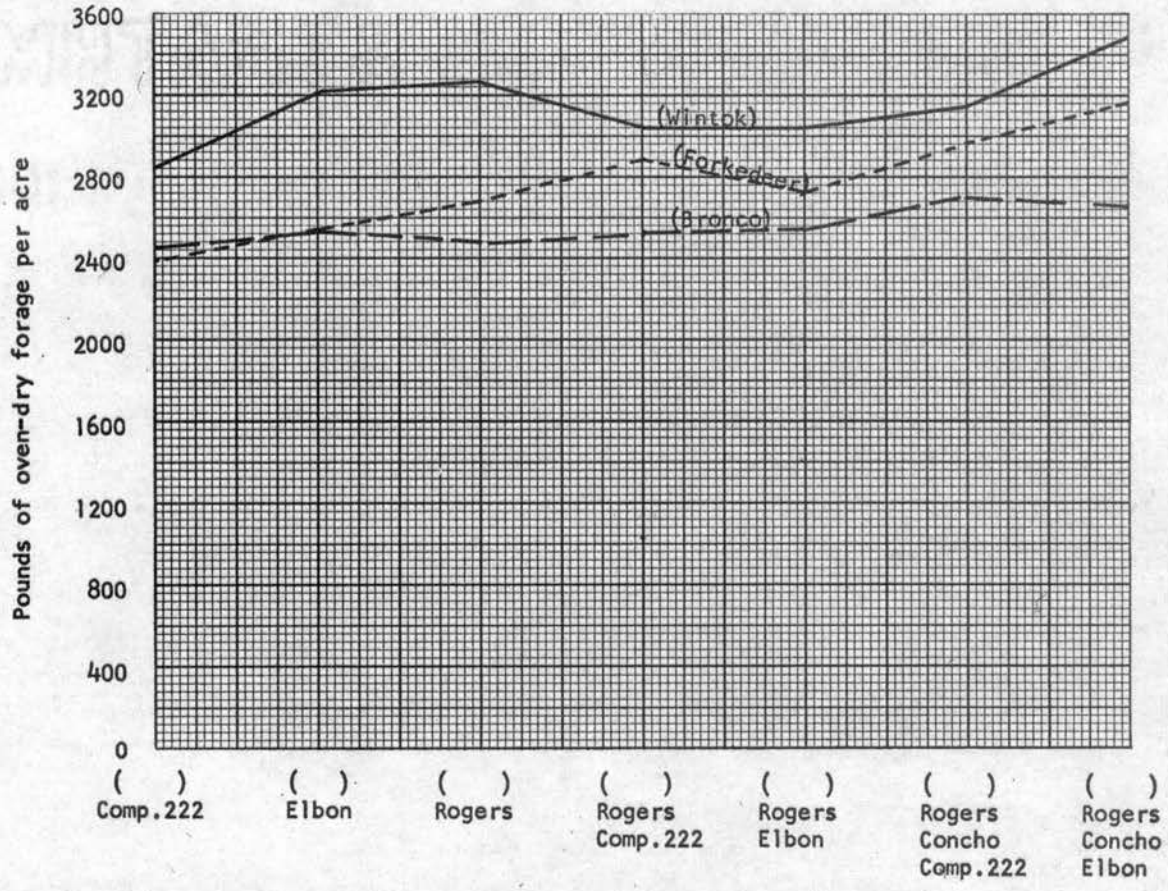

Figure 7. The Total Accumulated Forage Yields of Twenty-one Small Grain Combinations in Pounds of Oven-dry Forage per Acre

TABLE XV

MULTIPLE RANGE TEST OF THE TOTAL ACCUMULATED FORAGE YIELDS OBTAINED FROM TWENTY-ONE SMALL GRAIN COMBINATIONS

Combinations				Mean	Multiple Range $\angle x$ 5%
Wintok	Rogers	Concho	Elbon	3486	
Wintok	Rogers			3258	
Wintok	Elbon			3206	
Forkedeer	Rogers	Concho	Elbon	3163	
Wintok	Rogers	Concho	Comp. 222	3145	
Wintok	Rogers	Elbon		3043	
Wintok	Rogers	Comp. 222		3032	
Forkedeer	Rogers	Concho	Comp. 222	2981	
Wintok	Comp. 222			2864	
Forkedeer	Rogers	Comp. 222		2863	
Forkedeer	Rogers	Elbon		2713	
Bronco	Rogers	Concho	Comp. 222	2703	
Forkedeer	Rogers			2677	
Bronco	Rogers	Concho	Elbon	2660	
Forkedeer	Elbon			2554	
Bronco	Rogers	Elbon		2546	
Bronco	Elbon			2536	
Bronco	Rogers	Comp. 222		2524	
Bronco	Rogers			2471	
Bronco	Comp. 222			2459	
Forkedeer	Comp. 222			2378	

$\angle x$ Any two means underscored by the same line are not significantly different.

TABLE XVI

ANALYSIS OF VARIANCE OF THE TOTAL ACCUMULATED CLIPPED FORAGE YIELD OF TWENTY-ONE SMALL GRAIN COMBINATIONS

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	83	16,752,618		
Reps.	3	1,033,368		
Comb.	20	7,864,205	393,210.2	3.0035**
Error	60	7,855,045	130,917.4	

** Indicates significance at the 1% level of confidence

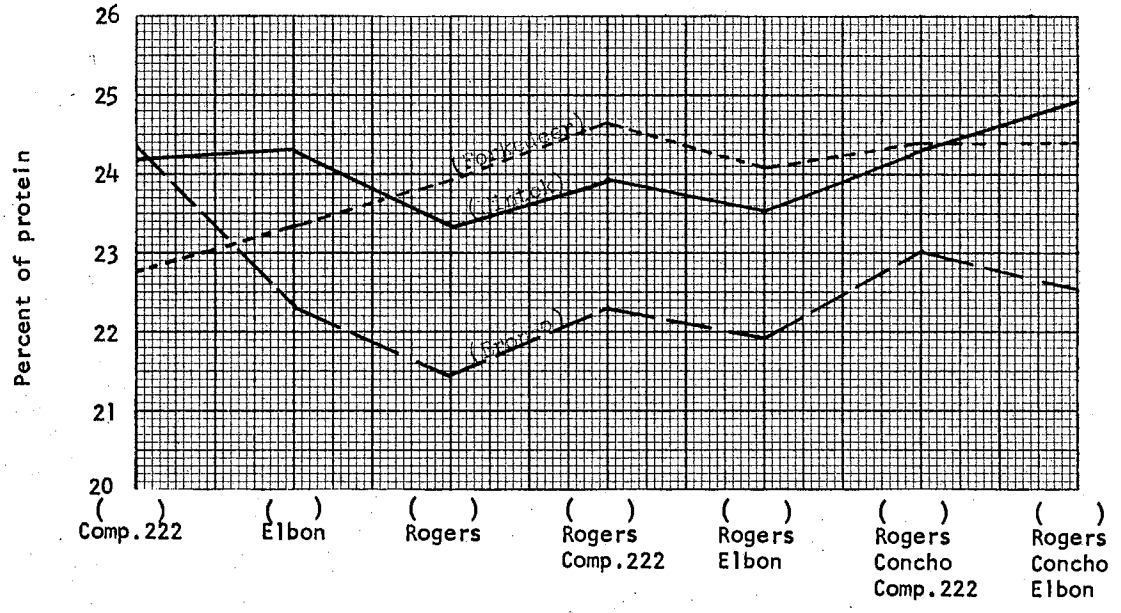

Figure 8. The Average Protein Percentage of Twenty-one Small Grain Combinations

TABLE XVII

THE POUNDS OF CRUDE PROTEIN PRODUCED PER ACRE BY TWENTY-ONE SMALL GRAIN COMBINATIONS BY HARVESTS

Combinations	Harvest Period						
	First	Second	Third	Fourth	Fifth	Sixth	Total
Wintok Rogers Concho Elbon	208	72	291	138	111	42	862
Wintok Rogers Concho Comp. 222	146	37	276	147	108	38	752
Wintok Rogers Elbon	199	58	198	115	103	36	709
Wintok Rogers Comp. 222	181	36	193	132	120	39	701
Wintok Rogers	280	35	130	129	125	40	739
Wintok Elbon	178	80	203	119	130	46	756
Wintok Comp. 222	106	44	226	125	129	41	671
Forkedeer Rogers Concho Elbon	186	75	239	120	102	43	765
Forkedeer Rogers Concho Comp. 222	160	39	234	123	103	44	703
Forkedeer Rogers Elbon	152	49	175	97	107	50	630
Forkedeer Rogers Comp. 222	146	33	212	119	124	47	681
Forkedeer Rogers	208	23	104	100	123	49	607
Forkedeer Elbon	117	56	120	75	115	70	553
Forkedeer Comp. 222	100	30	98	67	136	60	491
Bronco Rogers Concho Elbon	161	31	119	88	115	61	575
Bronco Rogers Concho Comp. 222	247	22	113	94	102	51	629
Bronco Rogers Elbon	154	40	90	63	116	59	522
Bronco Rogers Comp. 222	171	21	81	70	133	54	530
Bronco Rogers	177	11	47	63	124	62	484
Bronco Elbon	161	27	50	53	126	96	513
Bronco Comp. 222	101	25	110	93	143	71	543

SUMMARY AND CONCLUSIONS

A forage yield study of twenty-one small grain combinations was conducted at the Oklahoma Agricultural Experiment Station Agronomy Farm in 1957 on a Kirkland silt loam soil.

The mixtures were planted in a randomized block design with four replications. Each individual plot consisted of five rows, seven inches apart and twenty feet long.

The rainfall was supplemented with sprinkler irrigation as needed to maintain maximum forage production.

Rogers barley in combination with each oat variety was the highest forage producer in the fall. The Elbon rye combinations produced the largest amount of forage in the winter months. The late winter and early spring production was increased when Concho wheat was added to the mixtures. Late spring growth was fairly uniform since all the small grains, except the oats, were apparently declining in production. The best overall combination and most consistant high forage producer was Wintok, Rogers, Concho and Elbon. Wintok was the outstanding basic oat variety with Forkedeer intermediate and Bronco last in total forage production.

No single combination was consistantly high in forage production throughout the growing season. The results of this study indicate that the period of greatest need of the forage will dictate the varietal combination a livestock producer or dairyman should plant for maximum forage production.

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