A FORAGE YIELD STUDY OF TWENTY TWO SMALL GRAIN VARIETIES AT THREE SEEDING RATES

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Farmers consider small grain pasture an essential asset in the economical production of livestock in Oklahoma. In 1954, there were 6,905,000 (33)[1] acres of small grain planted in the state, of which about 50 to 95% was pastured.

The primary purpose of the small grain crops in Oklahoma has been for grain production, consequently the breeding and selecting has been concentrated on the improvement of grain yields. The value of the small grain forage has been somewhat overlooked. Only a limited amount of research information is available at the present time on the forage yields of varieties which were recommended 10 to 15 years ago. These have largely been replaced by new, superior varieties, but, their ability to produce forage is unknown. It would seem unrealistic to assume that high grain production also indicated high forage yields.

Moreover, the total forage production is not the only criterion used in the evaluation of small grain for pasture purposes. The period of production during the growing season is of prime importance.

The information relative to the rate of seeding small grains for maximum forage production is also very limited and opinions on this vary considerably.

Therefore, a small grain forage and rate of seeding study was planned. Included in this study were winter varieties of wheat, oats, barley and rye. Ryegrass also was included, since it is used in Oklahoma as a winter pasture crop.

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[1] Refers to literature cited page 40.

REVIEW OF LITERATURE

There are few experimental data showing the relative merits of small grains and ryegrass for winter pasture or comparative forage production. Their importance for this purpose however, is being considered more each year as indicated by Holt and Potts (17) in Texas, who report that recent breeding work and selection is placing more emphasis on the forage production of small grains. Varieties now being developed are superior in forage production, disease resistance, and frost tolerance as well as grain yield. They also report that the planting of two different varieties of a crop which will mature at different times will give more grazing.

A report from Texas by Stansel, Dunkle and Jones (39) emphasizes the need for more attention to small grains and ryegrass for pasturage as they produce good yields of highly palatable and nutritious forage. The pasturage is cheap feed, furnishes an excellent source of vitamin A when it is badly needed, gives the permanent pastures a needed rest in the spring or early summer, and excells in preventing winter leaching and soil erosion. Finnell (14) in Oklahoma supports the report of Stansel et. al., with the statement that wheat pasturage supplies a highly palatable forage with a narrow nutritive ratio of 1 to 5.9.

In Morrison's (28) feeding standards he states small grains are very rich in protein at the early stages of growth. Green rye, wheat or oats contain 20 to 25% protein if dried to the same moisture content as hay. Such forage is also very high in carotene and the B complex vitamins.

Chemical analyses and forage yields determined by Staten and Heller (42) in Oklahoma during 1942 to 1947, indicated the pasture value of winter small grains is so high that farmers might profitably use them entirely for pasture, without taking a grain crop. They report the protein content of small grain and annual ryegrass forage, when young, green and succulent, is high, being about 30% or more on a dry matter basis, as compared to around 42% in the usual high protein supplement. The authors state the carotene content is exceedingly abundant. This is an important point, for winter rations in the southwest are often seriously lacking in carotene. The forage is also high in vitamins of the B group. Fiber is low, about the same as in alfalfa leaf meal. They report the forage yield is about tripled if the small grains are completely pastured out instead of taking off the cattle when grazing begins to reduce grain yields. They found forage production of the different varieties of the same crop differed enough to make it worthwhile to choose a variety specifically for pasture. The authors report a good mixture for both early fall and late spring pasture should include either barley or rye, winter oats and annual ryegrass. They state it is more important to have plenty of succulent, rapidly growing forage available to animals than it is to worry about possible differences in the palatibility of pasture crops. Other conclusions drawn were: when clipped all season, ryegrass produced more total forage than small grains, although, most of it is produced in April and May. Barley, oats and rye were about equal in the five year average, but rye was more dependable from year to year because of its greater winter hardiness.

Similar conclusions were reported by Aldous (2) in Kansas who stated that all the grain cereals are very palatable and nutritious

to livestock. Their use makes it possible to extend the pasture season about two months in the fall and make pasturage available a month to six weeks earlier in the spring. Grain cereals planted primarily for pasture will supply grazing until early June. This provides an opportunity for protection of the permanent pasture, which will add greatly to the vigor, yield and density of the desirable forage plants. He advises all grain cereals sown for pasture to be seeded at about twice the rate customary for grain production.

Staten and Elder (43) in Oklahoma studied forage production of several winter annual grasses and found ryegrass to be highest in total production with barley, rye, winter oats, and hard wheat declining in forage yield in this order. Individual varieties of each kind of small grain varied, in some cases, from the order of forage production cited above. When varieties are arranged in order from the greatest to the least in total forage production, ryegrass was highest followed by winter Fulghum oats, Ward barley, Missouri Early Beardless barley, Balbo rye, Wintok oats, Common rye, and Kawvale wheat. Small grain palatability tests conducted in Oklahoma by Staten and others (40,41) indicated cattle preferred winter barley, rye, soft wheat, ryegrass, oats and hard wheat, in this order, for fall grazing. In the spring they preferred soft wheat, hard wheat, oats, barley, rye and ryegrass in that order. Plots which were fertilized with superphosphate were always preferred to the unfertilized areas.

In Kansas, winter barley comes on earlier and makes more winter growth than does wheat according to Shaw and Atkeson (37) however, the hazard of winter killing makes barley less dependable than wheat or rye for pasture. Rye is planted more for pasture purposes only than

any other cereal in Kansas. Its rank growth compared with other small grains, and its ability to withstand severe winters makes rye a dependable, heavy yielding supplementary pasture crop.

Differences of opinion among stockmen regarding the relative palatability of cereals as pasture crops prompted Shaw and Atkeson (37) to study animal preference of small grains, realizing that palatability may not be of paramount importance in pasture crops, particularly when used alone, because cows will often do well on relatively unpalatable forages, if nothing else is available. Palatability would seem worthwhile for high-producing dairy cows when maximum feed intake is important. In this study using barley, wheat, common rye and Balbo rye, cows spent 52% of their grazing time on Balbo rye, 24% on common rye, 18% on wheat, and 6% on barley.

In a study conducted at the U. S. D. A. Southern Great Plains Field Station at Woodward, Oklahoma, Hubbard and Harper (20) found rye produced more forage than any other cereal followed by wheat and then barley. Data obtained by Jones, Smith, Muncrief and Staten (21) and Muncrief (30) also in Oklahoma confirmed the findings of Hubbard and Harper in part, however in this study Italian ryegrass produced the highest total forage yield, but most of the growth occurred in the late spring. Rye produced the highest total yield of forage of any of the small grains followed by oats, hard wheat, barley and soft wheat. They reported the clipping of barley resulted in a more prostrate growth habit and less winter killing.

In Texas, Mortensen (29) indicated that, due to the different peaks of forage production of different varieties of small grain, it would be better from the standpoint of grazing to plant part of the

pasture in an early variety and graze until March and the remainder planted to a later variety and grazed through May. Clipping experiments with small grain varieties were conducted for three years near Crystal City, Texas by Hoveland (18, 19) to obtain information on forage production. He found New Nortex, Victorgrain, Arkwin, Mustang and Alamo oats and Abruzzi rye all gave high forage yield. Arkwin and Alamo oats made excellent early growth and produced well through the winter. Goliad barley made more early growth than any other small grain variety, but the wheat and barley varieties gave considerable less total forage than the better oat varieties. He also found there was no significant difference in forage yield of Mustang oats seeded at $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 bushels per acre.

Cook and Parmer (8) at the Blackland Experiment Station near Temple, Texas studied the forage yields of small grain varieties. Their 1953 results indicated Texas barley to be the top forage producer. In 1954 an experimental oat variety 3770-7 gave the highest yield followed closely by Quanah wheat. Mustang oats produced good forage yield both years. Oats are the most commonly used supplemental winter pasture crop for the Rio Grande Plain, according to Trew (47). Barley will furnish grazing earlier in the season but will not last as long in the spring.

Swanson (45) reported that approximately 65% of the Kansas wheat acreage is pastured to a greater or lesser extent, and if wheat is making a rank growth, moderate winter grazing will not materially reduce the yield of grain and may increase it. In the fall, five to seven acres of green wheat are required to carry an adult animal, whereas in the spring two to four acres may be sufficient, depending

on the vegetative growth. The rate of seeding is sometimes increased one peck to the acre when grazing is planned. He further states winter barley and winter rye are often used for pasturage. Either crop will generally furnish more pasturage than wheat in the fall and early winter.

Pasture experiments conducted by Sandal, Staten and Davis (35) in Arkansas revealed fall seeded small grains produced an abundance of winter grazing and are easily incorporated as a planned source of winter grazing into a year-around grazing program. During the five year period this study was underway, 1946 to 1952, oat pasture produced an average of 236 pounds of beef per acre as compared to 172 pounds produced by Balbo rye. Daily gains were also greater from the oat pasture than from the rye. Oat pasture was superior to rye in carrying capacity. Oats and rye yielded 1,465 and 1,204 pounds of T D N per acre respectively.

Gray and Harper (16) reported winter rye for grazing worked well into a crop rotation for central and eastern Oklahoma. Seeding at one and a half bushels per acre, the Abruzzi rye yielded 4,547 pounds of forage per acre following sweetclover. Under Missouri conditions Ethridge, Helm and Brown (13) report winter barley is the best fall pasturage among the small grains to fit into a all-year pasture system for that state.

In Oklahoma, Chaffin and Graumann (4) report wheat is the most important small grain crop for pasture. This is due mainly to the large acreage of wheat in the western half of the state. Winter barley ranks second in importance to wheat but is adapted more to the fertile soils. They found winter rye furnished more grazing than

winter wheat, barley or oats and is more winter hardy and adapted to poorer soils. Winter oats when seeded early reportedly make good fall and spring grazing.

In agreement with the report of Chaffin and Graumann, McMillen and Langham (26), at the Panhandle Agricultural Experiment Station Goodwell, Oklahoma, found that throughout the Southern High Plains, green wheat is the principal winter pasture, and in favorable years it may be grazed two to five months without decreasing the grain yield. Farmers and ranchers rate it equal, or superior, to the native grasses as a pasture crop. Chemical analyses show it to be an excellent source of protein, calcium, phosphorus, magnesium, and carotene. Before March 25th, the calcium-phosphorus ratio averaged 1.1:1; after March 25th, 0.8:1. When the calcium-phosphorus ratio was about 1:1 calves on wheat pasture chose principally bone meal as a mineral supplement in preference to ground limestone; as the calcium-phosphorus ratio lowered, they ate more ground limestone.

Winter feed is the number one problem facing the cattle industry in the Southeastern United States, according to Burton, Parham, Southwell and Stephens (3). In an extensive study on winter pasture crops for the Georgia Coastal Plain, pastures of Red Rustproof oats, Abruzzi rye, Red Rustproof oats and vetch, and domestic ryegrass were planted. Over an eight year period the per acre production of oats, rye, oats and vetch, and ryegrass was 52, 93, 85, and 49 grazing days, and 68, 124, 154, and 63 pounds of live weight gains respectively. Abruzzi rye produced more forage than any other crop in the test and is worthy of careful consideration where maximum production is sought. Two bushels of rye will give stands equal to 4 bushels of oats. Rye

is less palatable and should not be mixed with other small grains for maximum utilization. Other conclusions were: in clipping tests comparing 29 varieties of winter grain, Abruzzi rye was generally the most productive. Close grazing has reduced the yields of both forage and grain when compared with moderate grazing.

Stephens (44) stressed the importance of temporary winter pasture to furnish feed for cattle at a time when they would otherwise have to be fed from the barn. He includes oats, oats and vetch, Abruzzi rye, and Italian ryegrass as the better temporary winter grazing crops for the Georgia Coastal plains area. He suggests oats or rye seeded at the rate of 1½ to 2 bushels per acre for grain should be doubled for grazing.

In a grazing study of winter small grain at Knoxville, Tennessee, Washko (51) discovered that rye, barley and oats produced approximately equal amounts of forage in the fall, whereas the wheat produced the least fall forage. In the spring, the rye furnished the largest amount of forage, the barley and wheat next largest, and oats the smallest amount. In total forage production, rye out-yielded the other small grains with only minor differences in total forage yields occurring between barley, wheat and oats. He reported wheat and rye produced most of their forage in the spring. When forage yields were related to season of production, it was found the oats and barley varieties produced the greater proportion of their total forage in the fall. This is somewhat contrary to the results obtained in other studies.

Crowder, Sell and Parker (10) conducted several temporary winter grazing experiments at the Georgia Experiment Station. They used small grains alone and in mixtures with vetch, ryegrass and crimson

clover. Oats is the small grain most commonly used for temporary winter pasture, either in a mixture or alone. Up to one ton per acre of dry forage was produced by mid-winter by using locally recommended varieties and following proper management practices. Abruzzi rye produced more fall and winter forage than any other of the grains and grew at lower winter temperatures. Wheat and barley yielded about the same as oats but they were subject to insect and disease damage when seeded early.

Mixtures such as oats, ryegrass and crimson clover and oats with vetch resulted in highest total forage yields, but much of the growth occurred in the spring. The main value of ryegrass and vetch was to extend the spring grazing period. A rate of seeding study showed oats at 5 to 6 bushels per acre alone produced about 200 pounds per acre more fall dry forage than 2 to 3 bushels. Growth during the spring was greater at the lighter rates so that total production for the year was not different. Thus, it would appear that about 4 bushels of oats alone or 2 bushels in a mixture was sufficient. Generally 30 pounds of ryegrass produced no more than the 15 pound seeding rate.

In this study conducted by Crowder et. al., they found that clipping oats through the fall and winter until March 1st reduced the grain yield 25% as compared to no clipping, however the grazing obtained was more than sufficient to repay grain loss. Grazing may be beneficial in some seasons by resulting in increased stooling and reduced lodging, especially if rapid growth is made during the fall.

As a result of the oat forage and grain yield study, Crowder (9) reported that the combination of grazing during fall and winter and removing the animals in time for a grain crop would be of greater value

than sowing oats for grain alone. Also, if the grain is not needed, utilization of the cereal as a grazing crop without harvesting grain would be economical.

In another experiment in Georgia, Crowder, Sell and Parker (11), reported on the effect of clipping on an oat, ryegrass and crimson clover test. They seeded three bushels of Arlington oats, 15 pounds of ryegrass and 15 pounds of crimson clover, and clipped at 2, 4 and 8 week intervals from November to April. The dry matter yields were greatest with the longest interval between clipping, 8 weeks. Little difference in production occurred between the 2 and 4 week intervals during the fall. However, the 4 week intervals resulted in more forage production during the winter and spring than did the 2 week intervals. These results indicated that regulated or rotational grazing should be practiced, particularly in the fall and early winter when growth is largely dependent on rainfall and temperature.

Total pounds of dry matter obtained in this study conducted by Crowder et. al., were 3,340, 4,430 and 6,210 clipped at 2, 4 and 8 week intervals, respectively. Protein content of the forage was relatively high throughout the season, being about 28% on the dry matter basis in the fall and winter and from 10 to 20% in the spring. Delayed clipping had a depressing effect on the nitrogen content of the forage.

Management of small grain for the production of fall and winter pasture is a major item in Arkansas. Thurman (46) found that grazing very young plants and close grazing both reduced the amount of forage produced. He also found the small grain varieties possessing upright growth type produced more early fall forage than prostrate types. The prostrate types produced more regrowth in the winter months than the

upright types. However, there was no significant difference in the total regrowth yield of the two types.

The best chance for early fall grazing in Alabama is with one or more of the small grains, oats, wheat, or rye, according to Langford (24). Results from experiments at substations throughout Alabama indicated oats and rye produced about the same total amount of forage but rye produces more in the early fall than oats.

Reporting on work in southern Mississippi, Gill (15) reported that grazing oats alone or in combination with crimson clover has been very profitable for both dairy farmers and beef producers. Dairy cows practically doubled their production when grazing oats and fed a small amount of concentrate feed. Beef type steers made excellent gains, up to 2 pounds per day when grazing on oats alone. It was found that oats alone produced about as much milk or beef as a combination of oats and crimson clover.

Lush (25) in Louisiana ran a study on seasonal composition of some pasture grasses, including oats, oats and hop clover, Dallisgrass, Bermudagrass and white clover, ryegrass and carpetgrass. He reported there was little difference in chemical composition of grasses from fertilized pastures cut at the same date. He stated that the season of the year or rate of growth is more important than the type of vegetation in influencing the protein and fiber content of monthly clipped pasture grasses.

Testing 4 different varieties of rye for pasture at the Tennessee Experiment Station, Mooers (27) found Balbo to be a high yielding rye which compared favorably with yields of Rosen, Native and Western rye. In a later experiment with ryes in Tennessee, Neel (31) found Abruzzi

rye produced pasture as abundantly as Balbo during mild weather, but suffered much worse from freezing temperatures, therefore was inferior to Balbo as winter pasture. Rosen rye was entirely winter hardy, but not recommended for winter pasture when Balbo was available. The Native southern rye was almost equal to Balbo as pasture but not nearly so productive for grain.

In an experiment conducted at the Georgia Experiment Station in 1899, Redding (34) reported rye and barley were sown almost exclusively for pasturing and green soiling. On a good rich soil, barley was a much more valuable crop than rye, being not only more relished by animals but also more nutritious. On an ordinary soil however, and especially for large acreages, rye is to be preferred.

Chamblee, Woodhouse and Dillard (5), working with rye and barley on different soil types in North Carolina found rye to be better than barley on poor soil. On a Norfolk fine sandy loam with no nitrogen, Sunrise barley yielded 618 pounds dry matter per acre compared with 1,044 pounds of Abruzzi rye. Barley was found to be better than rye on fertile soil.

Coffman (7) summarized results from oat winter hardiness nurseries in 20 of the South-central and Southeastern States. Seventy varieties or selections of oats were grown with Wintok appearing to be the most winter hardy variety, followed by Fulwin.

Wallace and Chapman (50) reported that in Florida 80% of the acreage planted to oats is harvested entirely by grazing. Because of the importance of oats as a grazing crop, more emphasis in the breeding program is being placed on developing a variety to produce more forage. Trotter (48) reported a Nortex x Victoria cross was the highest forage producer in the oat breeding program in Texas.

Vanderford (49) encouraged farmers in the South to use oats alone or in combination for winter grazing to increase livestock profits. As much as 300 pounds of beef per acre were produced on grazing oats alone, as well as protecting the soil from the impact of beating rain drops and soil erosion.

A field study to determine at what stage of plant maturity winter grains seeded alone or with winter vetch should be harvested for hay was conducted by Ahlgren, Pool and Gausman (1) in New Jersey. Winter grains used were wheat, rye, barley and oats. They found when winter vetch was included with small grains the yield of protein per acre was notably increased. The average dry matter yields of the winter grains alone were similar to those obtained from the comparable small grain and vetch mixtures. Thus the addition of vetch did not significantly increase the total dry matter yield per acre. Dry matter yields of winter grains seeded alone were highest when harvests were made during the milk or dough stages. Winter barley seeded with winter vetch was superior to the other small grains seeded alone or with vetch in the production of dry matter and protein when harvested during the dough stage.

The difficulty of providing pasturage when the perennial grasses are unproductive in many parts of Canada can be overcome with cereal grains, according to Kirk, Davidson and Hamilton (23). The cereals used as annual pasture crops were oats, barley, wheat and spring rye. Oats were by far the most important for this purpose. With respect to yield of dry matter per acre and percent of protein, oats was always superior to barley, followed by wheat and spring rye.

Odland, Cox and Moran (32), reporting on studies carried on in Rhode Island, stated that winter rye produced more spring pasturage than winter wheat. Spring sown oats produced an abundance of forage but at a time when permanent pastures were also available. Therefore, its value was not as great.

Winter varieties of small grains provides opportunities for lengthening the grazing season in New Jersey, and for shortening the winter feeding period according to Sprague (38). In a four year study of Wintok oats, Thorn wheat and Balbo rye to determine the potentials of each for meeting fall and spring grazing needs and to establish the best methods of grazing management for greatest return of forage and grain, Sprague found that the rye, wheat and oats yielded forage in approximately a 3:2:1 relationship.

In a study of winter wheat in Nebraska, Kiesselback (22), found pasturing in late March through April not only prevented lodging but provided feed equivalent to 1,600 pounds of alfalfa hay per acre as well as increasing the grain yield from 14 bushels for the ungrazed to 18.7 bushels per acre when grazed for approximately 35 days.

In agreement with the report of Kiesselback, Cutler, Dionisio and Mulvey (12) in Indiana stated that growing conditions during the early spring months may be so favorable as to stimulate a very rapid vegetative growth of the winter wheat crop. The top growth may be so excessive as to lodge and react detrimentally upon yield and quality of the harvested grain crop. Under these conditions clipping from March to April 20th significantly increased the yield and quality of the grain. This forage can be utilized to good advantage by livestock and produce an extra profit.

The use of small grains such as rye, oats, barley and wheat as a winter pasture crops is recommended the country over. Semple, Vinall, Enlow and Woodward (36) advise the use of locally adapted varieties in all cases. Heavy seedings of all these small grains at the rate of at least twice that customary in seeding for grain production is a profitable practice.

Materials and Methods

This experiment was conducted on the Oklahoma Agricultural Experiment Station farm, located near Perkins, Oklahoma. The soil was classified as a Norge, fine sandy loam. Two tons of lime were applied per acre in the summer of 1954 and 250 pounds of superphosphate were applied per acre prior to planting that fall.

In this small grains forage production study 22 varieties or selections were used. These included several varieties commonly grown in this area, as well as new varieties or selections. Annual ryegrass was also included because of its popular use as a winter pasture crop in parts of Oklahoma. The varieties and the rate of seeding of each are as follows:

Crop	Rate of Seeding Bushels Per Acre		
	Common	Double	Triple
Winter Wheat:			
Concho	1	2	3
Triumph	1	2	3
Clarkan	1	2	3
Comanche	1		
Ponca	1		
Winter Barley:			
Harbine	2	4	6
Tenkow	2	4	6
B-400	2		
Colonial "2"	2		
Winter Rye:			
Tetraploid	1	2	3
Balbo	1	2	3
Elbon	1	2	3

Crop	Rate of Seeding Bushels Per Acre		
	Common	Double	Triple
Winter Oats:			
Forkedeer	2	4	6
Traveler	2	4	6
Cimarron	2	4	6
Wintok	2	4	6
Arkwin	2	4	6
Mustang	2		
DeSoto	2		
Arlington	2		
C.I. 6988 (Cimarron X Traveler)	2		
Dubois	2		
Annual Ryegrass	20 Pounds		
Annual Ryegrass	30 Pounds		

The varieties were planted in a randomized block design with 4 replications. Each plot consisted of 5 rows, 7 inches apart and 20 feet long. The plots were planted with a one-row Planet Jr. No. 4 Seeder. Each of the three rates of seeding was treated as a separate study.

The plots were seeded on October 23 and 24, 1954, with the exception of Elbon rye which was seeded November 8. A good stand of each variety was obtained.

When the forage reached grazing height or about 4 to 6 inches, the inside 3 rows of each plot was harvested with a lawn mower equipped with a metal forage catcher. The forage harvested from each plot was placed in a cloth bag, dried at 140 degree F. in a forced air oven, recorded in grams per plot, later being adjusted to pounds of dry forage per acre. A representative sample of the dried tissue of each variety at each seeding rate was ground in a hammer mill and an aliquot taken to the Agriculture Chemistry Department for protein, calcium, phosphorous, and ash analyses. Because of the large number of

samples obtained as growing conditions improved, only protein analyses were determined on the later cuttings.

The total forage yield data of each variety were analyzed by an analysis of variance for a randomized block design. Each rate of seeding was analyzed separately since they were planted in different randomized blocks. A multiple range test was run on the varieties at each rate of seeding.

RESULTS AND DISCUSSIONS

A highly significant difference in total forage yield was obtained between varieties of small grain when planted at the common, double, and triple rate of seeding as shown in tables 1, 2 and 3 respectively. Oats and rye, with the exception of the variety Elbon, were consistently higher in total yield at each seeding rate than barley and wheat. Analysis of variance tables for the 3 rates of seeding are shown in the appendix.

Moisture was a limiting factor during the time this study was conducted, as can be seen in the precipitation record table 4. From the time of planting, until the last harvest was made, only 15.33 inches of precipitation was recorded,/2 with 8.91 inches of this falling in May. This late rainfall may be partially responsible for the high forage yields obtained from oats as compared to the other small grains as they tend to grow later in the spring months.

Some freeze damage occurred on the DeSoto and Arlington oats and Elbon rye when the temperature dropped to 11°F on March the 22 and to 12°F on March 26th (6).

The first forage harvest was made in late February from Elbon rye, following a very dry fall and winter period. Balbo rye gave its first harvest on March 8th. The first barley was harvested on March

/2 Unpublished data. Precipitation Record, Agronomy Farm, Perkins, Okla. Agron. Dept. Okla. A. and M. College. Stillwater, Okla. 1954 and 1955.

Table 1.--Multiple range test of the total forage production of 22 small grain varieties seeded at the common rate.

Entries	Mean	Multiple Range 5%	Multiple Range 1% /x
Triumph	839		
B-400	875		
Comanche	875		
Ponca	888		
Clarkan	904		
Concho	904		
Elbon	925		
Colonial 2	927		
Harbine	948		
Tenkow	972		
Tetraploid	1157		
Arlington	1180		
Dubois	1234		
Arkwin	1251		
DeSoto	1268		
Balbo	1302		
Forkedeer	1343		
C.I. 6988 (C x T)	1369		
Traveler	1379		
Mustang	1401		
Cimarron	1439		
Wintok	1467		

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

Table 2.--Multiple range test of the total forage production of 13 small grain varieties seeded at the double rate.

Entries	Mean	Multiple Range 5%	Multiple Range 1% /x
Triumph	885		
Concho	903		
Clarkan	946		
Harbine	977		
Tenkow	1003		
Elbon	1004		
Arkwin	1134		
Tetraploid	1161		
Cimarron	1170		
Wintok	1228		
Forkedeer	1229		
Traveler	1247		
Balbo	1260		

68

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

Table 3.--Multiple range test of the total forage production of 12 small grain varieties seeded at the triple rate.

Entries	Mean	Multiple Range /x 5%	1%
Tenkow	948		
Concho	969		
Clarkan	971		
Harbine	993		
Triumph	1043		
Arkwin	1159		
Balbo	1164		
Wintok	1167		
Traveler	1203		
Tetraploid	1214		
Cimarron	1237		
Forkedeer	1312		

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

Table 4.--Precipitation Record, Agronomy Farm, Perkins, Oklahoma. July 1954 through June 1955.

Month	Amount
July	1.92
August	2.24
September	.35
October	1.07
November	.25
December	1.46
January	.89
February	1.35
March	1.56
April	.84
May	8.91
June	3.27
Total precipitation for the 12 months	24.11

12th, and wheat three days later on March 15th. Oats were first harvested March 24th with ryegrass yielding its first clipping March 29th. Ability to recover after grazing may be reflected in part by the number of times each variety was clipped as shown in tables 5, 6 and 7 for the common, double and triple rates of seeding respectively. The total production and average percent protein are also given.

The time of forage production is an important factor in the evaluation of small grains. A comparison of the forage produced by these varieties in percent of the total is given in tables 8, 9 and 10. In this study at the common seeding rate on April 15, barley had produced 81% of its total yearly production; Balbo rye 79%; Elbon rye 75%; wheat 74%; Tetraploid rye 67%; oats 36% and ryegrass about 25%. This indicates wheat, barley, Elbon and Balbo rye gave earlier forage production than oats, Tetraploid rye and ryegrass. The latter three producing a higher percent of their total yield later in the spring.

The total accumulated forage yield of all oat varieties at the common seeding rate is presented in Figure 1. Although Wintok, Cimarron, Mustang, Traveler, C.I. 6988 and Forkedeer were the highest forage yielding varieties, only Wintok was significantly higher than the two low yielders Dubois and Arlington. Cimarron was also significantly higher than Arlington.

Figure 2 shows the forage yield of the barley and rye varieties. There was no significant difference between the yield of the barley varieties. Balbo and Tetraploid rye were significantly higher in forage produced than Elbon at the common seeding rate. There was no significant difference obtained between the yield of the wheat varieties shown in Figure 3.

Table 5.--Total forage yield, average percent protein, clipping record of each small grain variety seeded at the common rate.

Crop and Variety	Rate of Seeding	No. of Clippings	Oven Dry Forage lbs./A.	Average % Protein
Wheat:				
Clarkan	1	4	2720	23.19
Ponca	1	3	2512	22.26
Concho	1	3	2486	22.22
Comanche	1	3	2405	22.60
Triumph	1	3	2309	22.76
Average of all wheat varieties			2486	
Oats:				
Wintok	2	4	4032	19.24
Cimarron	2	4	3958	20.42
Mustang	2	4	3853	22.32
Traveler	2	4	3793	21.06
Forkedeer	2	4	3690	19.34
C.I. 6988	2	4	3627	18.53
DeSoto	2	4	3483	19.44
Arkwin	2	4	3439	19.64
Dubois	2	4	3394	19.88
Arlington	2	4	3245	20.61
Average of all oat varieties			3651	
Barley:				
Tenkow	2	4	2674	19.94
Harbine	2	3	2606	23.45
Colonial "2"	2	4	2550	22.14
B-400	2	3	2402	20.78
Average of all barley varieties			2558	
Rye:				
Balbo	1	5	3578	24.50
Tetraploid	1	4	3183	23.99
Elbon	1	4	2542	25.16
Average of all rye varieties			3101	
Annual Ryegrass				
Ryegrass	30 lbs.	4	2702	19.84
Ryegrass	20 lbs.	3	2676	19.32

Table 6.--Total forage yield, average percent protein, clipping record of each small grain variety seeded at the double rate.

Crop and Variety	Rate of Seeding	No. of Clippings	Oven Dry Forage lbs./A.	Average % Protein
Wheat:				
Clarkan	2	3	2600	21.38
Concho	2	3	2481	22.82
Triumph	2	3	2435	22.47
Average			2505	
Oats:				
Traveler	4	3	3426	21.08
Forkedeer	4	3	3378	17.19
Wintok	4	3	3375	18.59
Cimarron	4	3	3215	18.67
Arkwin	4	3	3117	17.86
Average			3302	
Barley:				
Tenkow	4	3	2756	20.23
Harbine	4	3	2688	21.38
Average			2722	
Rye:				
Balbo	2	4	3468	23.82
Tetraploid	2	4	3190	20.48
Elbon	2	4	2749	25.67
Average			3136	

Table 7.--Total forage yield, average percent protein, clipping record of each small grain variety seeded at the triple rate.

Crop and Variety	Rate of Seeding	No. of Clippings	Oven Dry Forage lbs./A.	Average % Protein
Wheat:				
Triumph	3	3	2866	20.17
Clarkan	3	3	2668	20.84
Concho	3	3	2666	19.83
Average			2733	
Oats:				
Forkedeer	6	3	3608	16.55
Cimarron	6	3	3397	19.23
Traveler	6	3	3306	19.48
Wintok	6	3	3207	18.64
Arkwin	6	3	3185	18.38
Average			3341	
Barley:				
Harbine	6	3	2728	16.72
Tenkow	6	3	2605	19.06
Average			2667	
Rye:				
Tetraploid	3	4	3334	19.28
Balbo	3	4	3202	24.16
Average			3268	

Table 8.--Time of forage production, expressed as percent of the total for each variety seeded at the common rate.

Crop and Variety	Feb. 1-14	Feb. 14-28	March 1-15	March 15-31	April 1-15	April 15-30	May 1-15	May 15-31	June 1-15
Wheat:									
Clarkan			31		37	23		9	
Ponca			34		43	23			
Concho			36		38	26			
Comanche			34		41	25			
Triumph			35		39	26			
Oats:									
Wintok				37		32	19		12
Cimarron				43		33	16		8
Mustang				35		31	21		13
Traveler				33		32	22		13
Forkedeer				35.5		30	24.5		10
C.I. 6988 (C x T)				41		26	21		12
DeSoto				35		23	23		19
Arkwin				37		30	22		11
Dubois				35		38	20		7
Arlington				28		27	28		17
Barley:									
Tenkow			41		38	14		7	
Harbine			37		47	16			
Colonial 2			40		38	15		7	
B-400			39		43	18			
Rye:									
Balbo			32	20	27	10		11	
Tetraploid				36	31	15		17	
Elbon		35	27	13		25			

Table 9.--Time of forage production, expressed as percent of the total for each variety seeded at the double rate.

Crop and Variety	Feb. 1-14	Feb. 14-28	March 1-15	March 15-31	April 1-15	April 15-30	May 1-15	May 15-31	June 1-15	June 15-30
Wheat:										
Clarkan			34		47	19				
Concho			35		47	18				
Triumph			35		50	15				
Oats:										
Traveler				35		40		24		
Forkedeer				35		41		24		
Wintok				32		45		23		
Cimarron				39		44		17		
Arkwin				36		41		23		
Barley:										
Tenkow			40		44		16			
Harbine			35		47		18			
Rye:										
Balbo			41	17	26	16				
Tetraploid				42	32	18		8		
Elbon		38	25	14		23				
Ryegrass 30 lbs.				18		34		25	23	
Ryegrass 20 lbs.						65		24	11	

Table 10.--Time of forage production, expressed as percent of the total for each variety seeded at the triple rate.

Crop and Variety	Feb. 1-14	Feb. 14-28	March 1-15	March 15-31	April 1-15	April 15-30	May 1-15	May 15-31	June 1-15	June 15-30
Wheat:										
Triumph			39			44	17			
Clarkan			32			43	25			
Concho			34			45	21			
Oats:										
Forkedeer					45	31		24		
Cimarron					50	34		16		
Traveler					44	35		21		
Wintok					41	38		21		
Arkwin					45	36		19		
Barley:										
Harbine		38				46	16			
Tenkow		37				47	16			
Rye:										
Tetraploid				49	28	18		5		
Balbo		43	17		26	14				

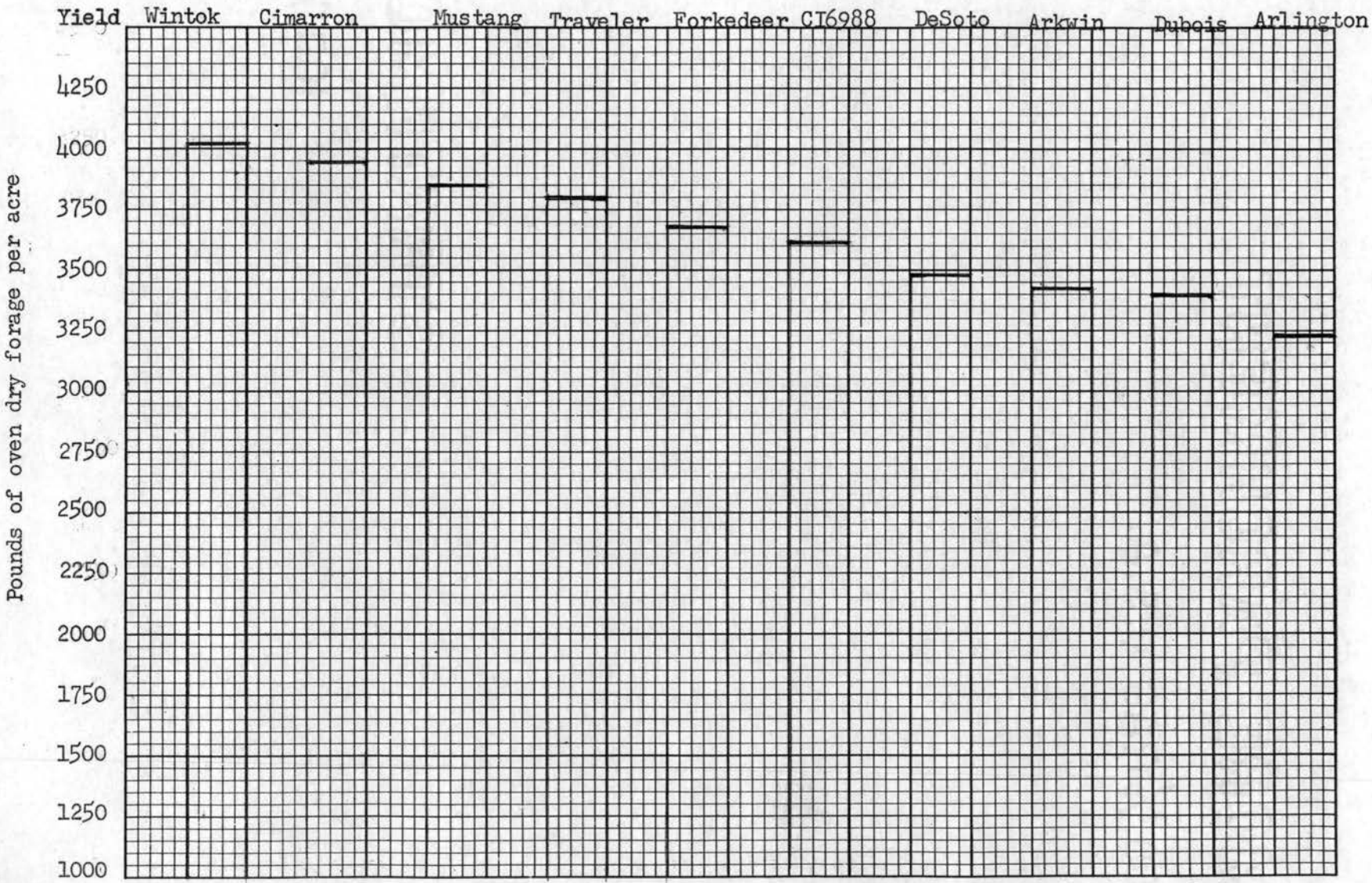

Figure 1. Accumulated Forage Production of All Oat Varieties Seeded at the Common Rate.

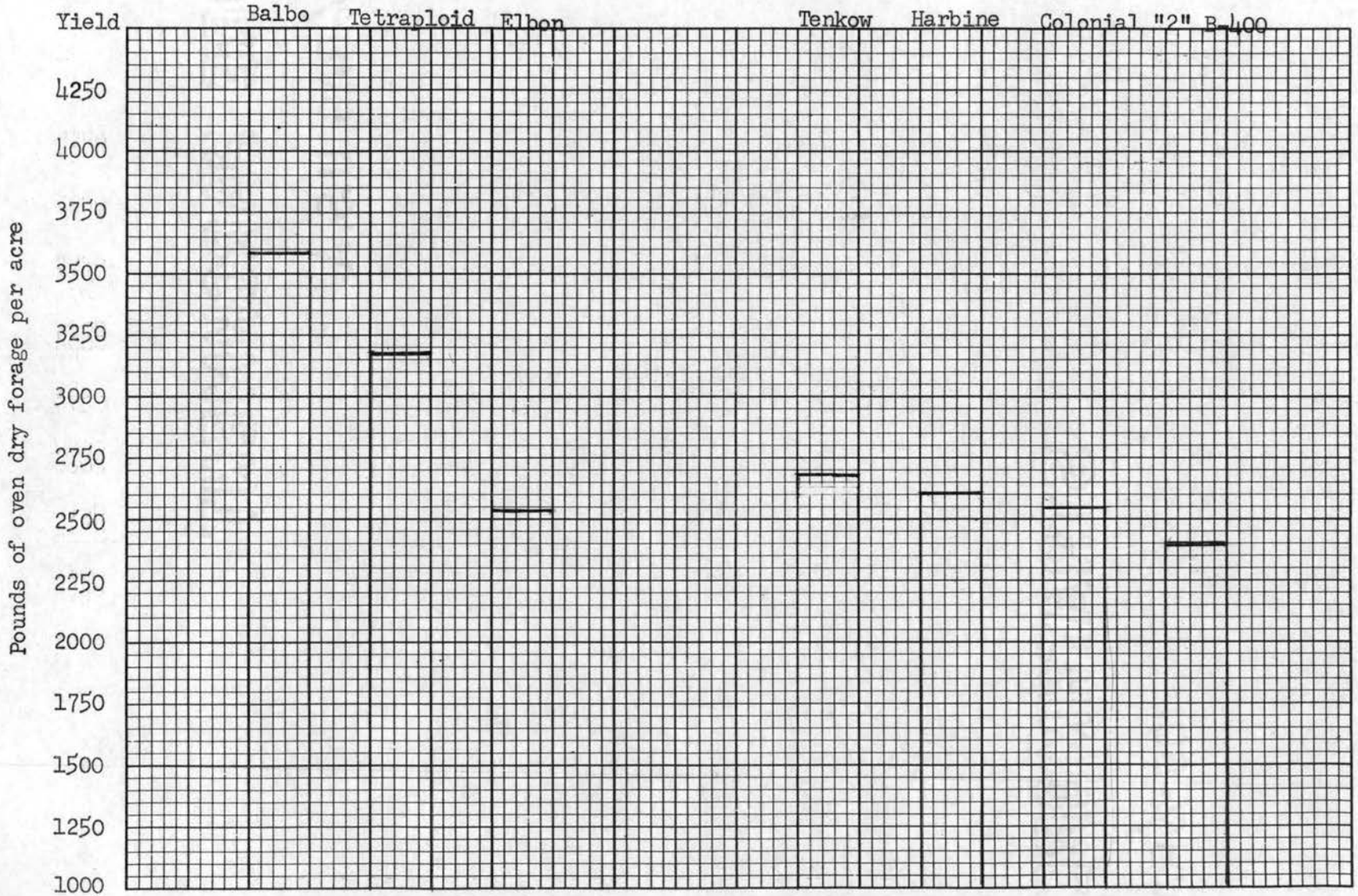

Figure 2. Accumulated Forage Production of All Rye and Barley Varieties Seeded at the Common Rate.

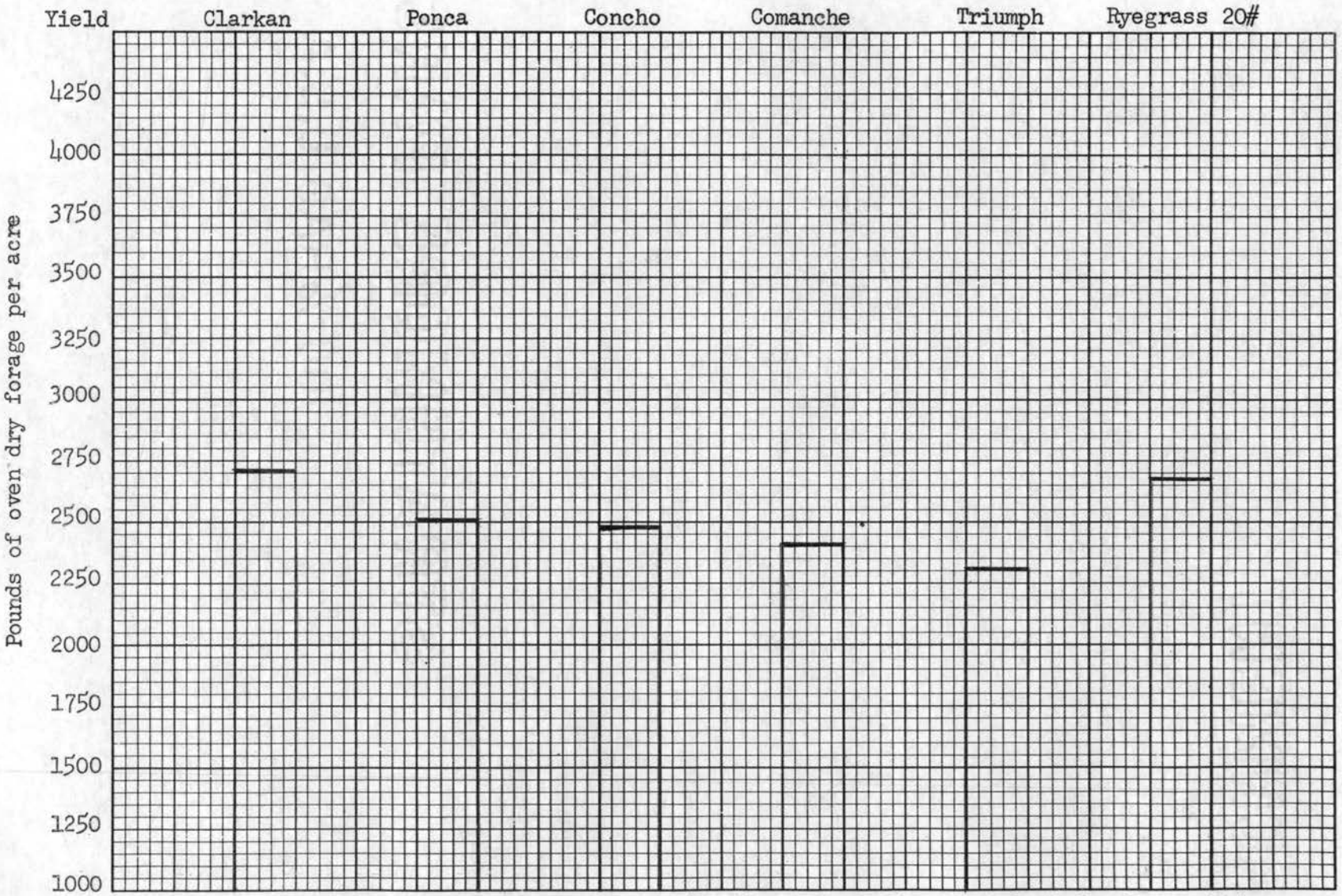

Figure 3. Accumulated Forage Production of All Wheat Varieties Seeded at the Common Rate and Ryegrass at 20 Pounds per Acre.

The average of all varieties of each crop seeded at 3 different rates is presented in Figure 5. Although the rates could not be compared statistically, this study indicated oats at the 2 bushel per acre seeding rate yielded more forage than at the 4 and 6 bushel seeding rate. The rye also gave slightly higher forage yield at the lower seeding rate than at the two increased rates. This probably can be attributed largely to the dry conditions and competition for moisture during this study. Wheat yielded more forage at the 3 bushel per acre rate than at the 1 or 2 bushel rate, but the difference was only slight. The 4 bushel seeding rate per acre of barley gave the highest forage yields, but the difference over the 2 and 6 bushel rates was very small. Ryegrass produced slightly more forage seeded at 30 pounds per acre than at 20 pounds per acre.

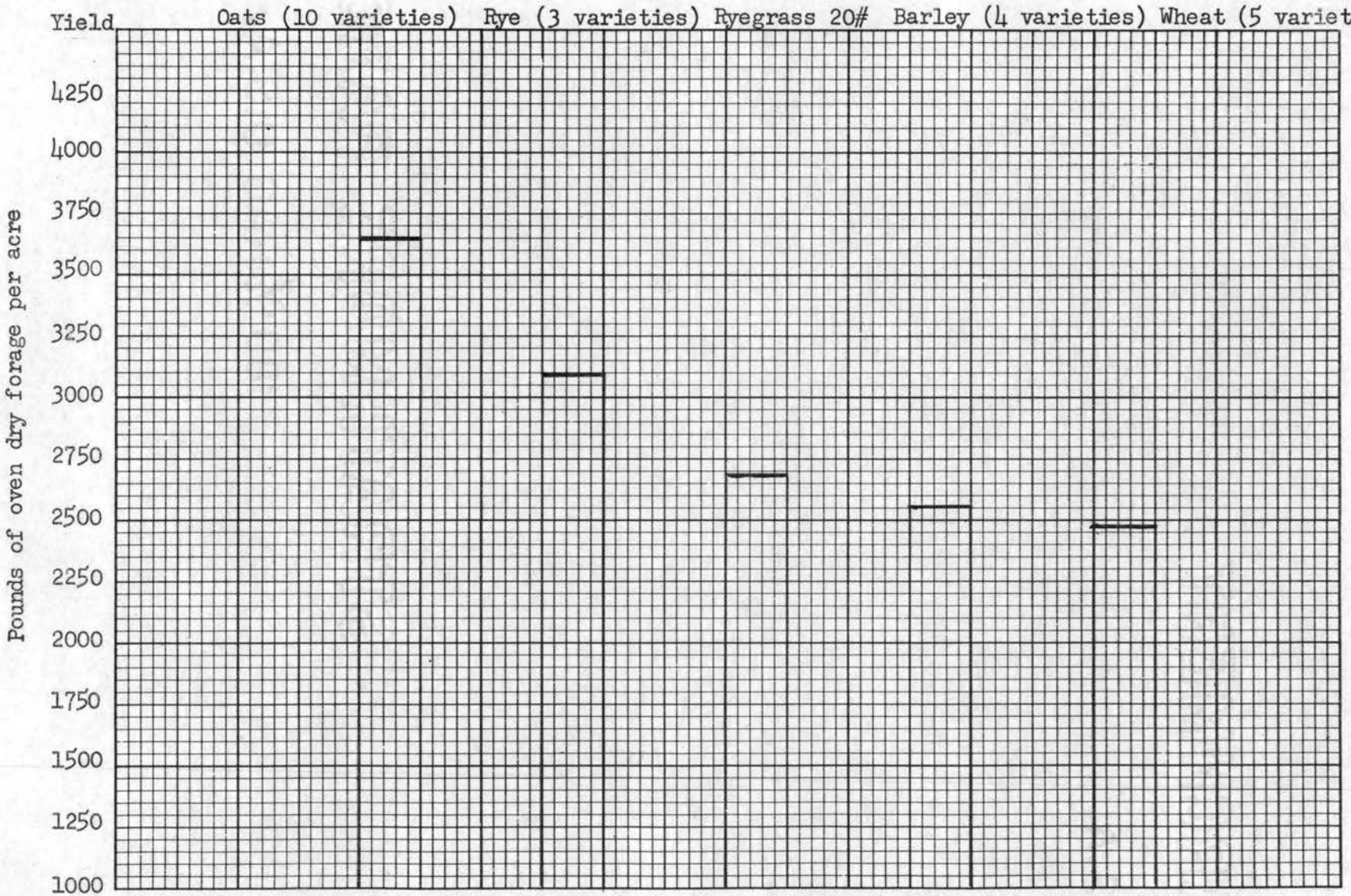

Figure 4. Average Accumulated Forage Production of Crops Seeded at the Common Rate.

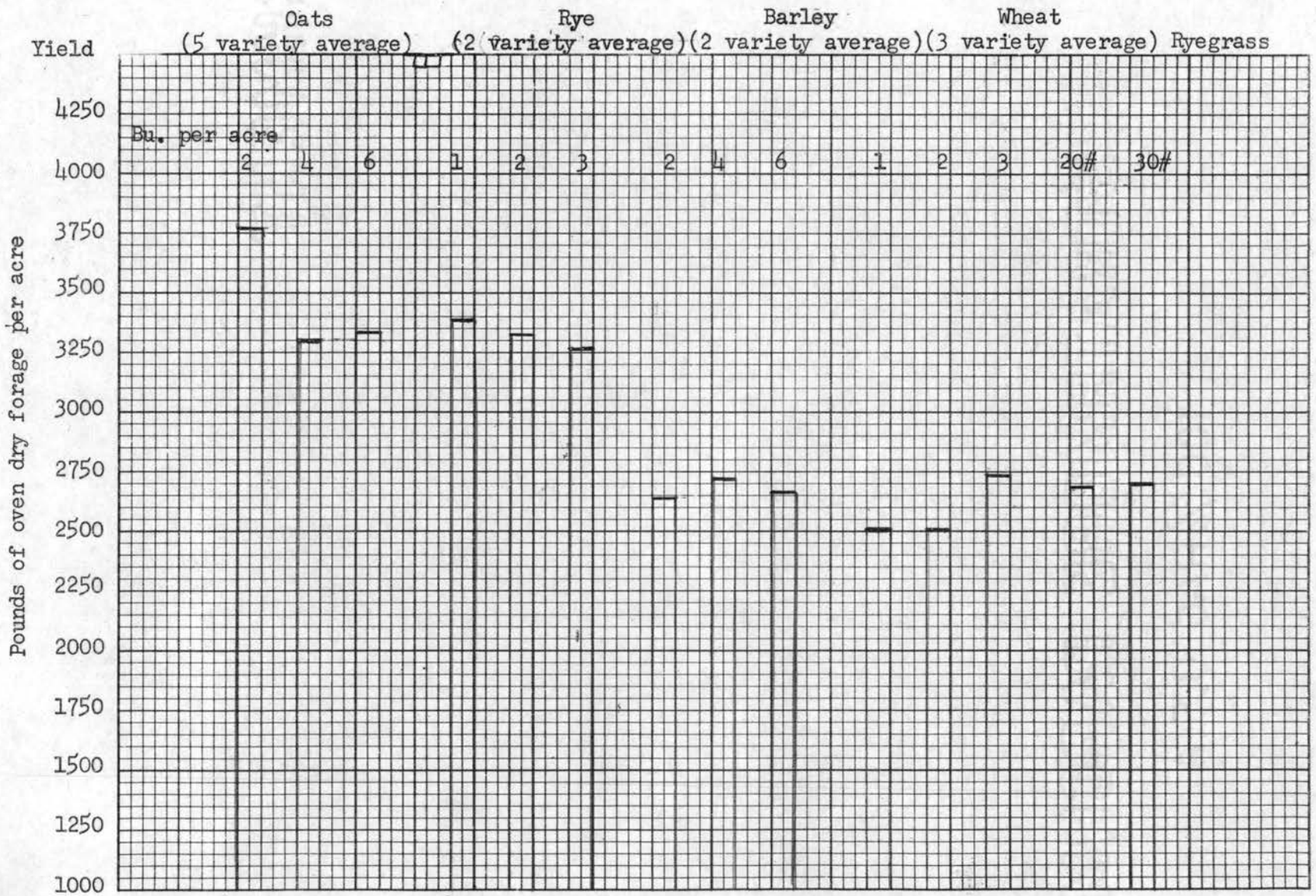

Figure 5. Average Accumulated Forage Production of Crops Seeded at the Three Different Rates.

SUMMARY AND CONCLUSIONS

A small grain forage yield study was conducted in the fall of 1954 and spring of 1955, at the Oklahoma Agricultural Experiment Station farm, located near Perkins, Oklahoma.

In this forage production study 22 varieties of small grains were included at 3 different seeding rates. Annual ryegrass seeded at 2 rates was also included in the study. A randomized block design was used with 4 replications for each rate of seeding. The plots consisted of 5 rows, 7 inches apart, and 20 feet long. The inside 3 rows were harvested with a lawn mower equipped with a metal forage catcher. The plots were harvested when they reached grazing height or from 4 to 6 inches. The harvested forage was placed in a cloth bag and dried in a forced-air oven, recorded in grams per plot, and later converted to pounds of dry forage per acre. The total forage yield of these plots was used for statistical analysis. A representative sample of the dry material was analyzed for protein by the Agricultural Chemistry Department.

Although no conclusive evidence can be determined from only one year's data, several indications are worthy of consideration.

Significant differences were obtained in forage yield between varieties and crops at the common, double and triple seeding rates. Oats and rye, with the exception of the variety Elbon, were significantly higher forage producers than varieties of barley and wheat at each rate of seeding. This would indicate that consideration should be given to the forage yielding ability of a small grain where the crop is to be used for pasture.

Small grain crops and varieties have different forage producing periods. This study indicated barley, wheat, Elbon and Balbo rye produced a higher percentage of their total forage yield earlier than did oats, Tetraploid rye and ryegrass. Therefore, the forage producing period of the small grain should coincide with the desired time of grazing.

Under the conditions that prevailed during this study there was no apparent advantage in increasing seeding rates in order to increase forage yields. In most cases, high rates of seeding of oats and rye were apparently detrimental to forage production, because of more competition for moisture from the greater plant population.

Arlington and DeSoto oats, and Elbon rye suffered some winter injury as a result of severe late March freezes. This might indicate certain varieties of small grain would have an advantage for higher forage yield because of their winter hardiness.

Further research information is needed on small grain forage yields, rate of seeding, and time of production to supplement the data obtained in this study, so that recommendations can be made on crops and varieties of small grains best adapted for forage production in Oklahoma.

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A P P E N D I X

Table 11.--Analysis of variance of the total forage yield data of 22 small grain varieties at the common seeding rate.

Source of variations	Degrees freedom	Sum of squares	Means square	F
Total	87	4,891,403.45		
Reps	3	222,842.70		
Treatments (varieties)	21	4,165,582.20	198,361.10	24.85**
Error	63	502,977.55	7,983.77	

** Indicates significance at the 1% level of confidence.

Table 12.--Analysis of variance of the total forage yield data of 5 oat, 3 wheat, 2 barley and 3 rye varieties seeded at the double rate.

Source of variation	Degrees freedom	Sum of squares	Means square	F.
Total	51	1,121,641.30		
Reps	3	16,103.60		
Treatment (varieties)	12	924,051.80	77,004.32	15.27**
Error	36	181,485.90	5,041.28	

** Indicates significance at the 1% level of confidence.

Table 13.--Analysis of variance of the total forage yield data of 5 oat, 3 wheat, 2 barley and 2 rye varieties seeded at the triple rate.

Source of variation	Degrees freedom	Sum of squares	Means square	F
Total	47	919,523.40		
Reps	3	22,602.81		
Treatments (varieties)	11	673,429.07	61,220.80	9.04**
Error	33	223,491.50	6,772.40	

** Indicates significance at the 1% level of confidence.

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Master of Science

Thesis: A FORAGE YIELD STUDY OF TWENTY TWO SMALL GRAIN VARIETIES AT THREE SEEDING RATES

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Date of Final Examination: April, 1957

THESIS TITLE: A FORAGE YIELD STUDY OF TWENTY TWO SMALL GRAIN VARIETIES AT THREE SEEDING RATES

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