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WINTER PASTURE

for MORE FEED

and BETTER FEED

at LOWER COST

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
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WINTER PASTURE

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Many Oklahoma farmers and ranchers use fall-sown small grains or annual ryegrass for winter pasture. As a result, the Experiment Station gets numerous questions about the best kind of crop or variety for temporary pastures, the best ways of handling them, their value as feed, and the effect of pasturing on grain yield.

This bulletin reports five years of research aimed at answering some of these questions. Annual ryegrass and 20 varieties of six small-grain crops were grown and compared for forage yields, nutrient content, and effect of simulated grazing on grain yield. An effort was also made to compare palatability. The results indicate that **winter pasture crops are even more valuable to Oklahoma than have been suspected.**

Some of the more important conclusions drawn from this research project include:

1. The pasture value of winter small grains is so high that livestock farmers might profitably use them entirely for pasture, without taking a grain crop.

2. The protein content of small-grain and annual ryegrass forage, when young, green, and succulent, is high,—about 30 percent or more (dry matter basis) as compared to around 42 percent in the usual high-protein supplement.

3. The carotene (provitamin A) 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 minerals and in vitamins of the B group. Fiber is low—about the same as in alfalfa leaf meal.

4. Grain yield is not seriously affected by grazing until plants reach the jointing stage of growth.

5. The forage yield is about tripled if grains are completely pastured out instead of taking off the cattle when grazing begins to affect grain yield.

6. Forage production of the different varieties of the same crop differed enough to make it worthwhile to choose a variety specifically for pasture.

7. A good mixture for both early fall and late spring pasture would include either barley or rye, winter oats, and annual ryegrass.

8. On a low-phosphate soil, cows show a definite preference for pasture grown on plots where phosphate fertilizer has been applied.

9. 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 palatability of pasture crops.

10. The protein, vitamin and mineral content of small-grain and annual ryegrass forage cut at the stage of most rapid growth is so high that it apparently would be a valuable supplement for other feeds if dehydrated.

11. Another research project now under way, but not completed, is indicating that at least 90 percent of the protein nitrogen in small-grain forage can be effectively utilized by poultry and swine as well as by ruminants such as cows and sheep.

Some farmers have reported a 50 percent reduction in dry feeding costs by sowing temporary winter pasture. It is not unusual for one acre of good small-grain pasture to produce 2,000 pounds of dry feed. This means about 600 pounds of protein per acre, or the equivalent of approximately 1,200 pounds of cottonseed meal or other similar high-protein supplement.

HOW THE CROPS WERE COMPARED*

The winter pasture crop comparisons reported in this bulletin were made at Stillwater on a soil generally considered to be a good type for wheat production. Planting rates per acre were:

Wheat and rye, 1 bushel.
Barley, 2 bushels.
Oats, 2½ bushels.
Annual ryegrass, 25 pounds.

Date of planting was early, as would be done on a farm to get fall pasture. Dates varied between September 6 to September 15 during the five years.

*More detailed information on methods, and also more complete chemical data, are reported in a publication now in preparation.

Summer fallowing was practiced to conserve moisture.

Forage yields were determined by clipping the plots with a lawn mower to a height of about one inch every time the grass reached a good height for grazing, or about 3 to 5 inches. The tramping and packing of the plots by men operating the lawn mowers is believed to have been very similar to the tramping of pasture by livestock.

Each time a plot was clipped, a sample of the forage was taken to the Station's chemistry laboratory to be analyzed for protein, vitamins, and minerals.

Four plots of each variety were planted so they could be given different clipping treatment. One was clipped all season to get total forage production. Another was not clipped at all, to get normal grain yield. The other two were clipped to the stooling and jointing stages of growth respectively, to find how clipping affected grain yields.

FORAGE PRODUCTION

Green forage yields are shown in Figure 1. All varieties of each crop are averaged so the different crops can be compared.

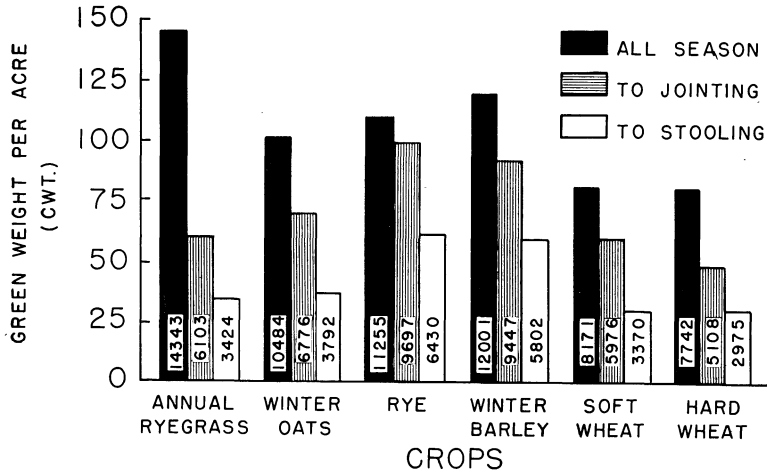

FIG. 1—Green Forage Yields for Three Clipping Treatments; Five-Year Average, 1942-3 to 1946-7.

The yield figures for each crop are averages of the following varieties for the five-year period: Barley: Michigan Winter, Missouri Early Beardless, and Ward. Oats: Winter Fulghum and Wintok. Rye: Abruzzi, Balbo, and Common. Ryegrass: Annual. Wheat (soft): Clarkan, Currell, Fulcaster, and Kawvale. Wheat (hard): Blackhull, Cheyenne, Chiefkan, Comanche, Early Triumph, Pawnee, Tenmarq, and Turkey.

Clipped All Season

Two years out of the five, ryegrass produced as much as 18,000 pounds of forage when clipped the entire season; but it practically froze out during the 1946-47 season and this brought the average down considerably.

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.

Clipped to Stooling or Jointing

Figure 1 also shows the forage yields for crops clipped up to the stooling and the jointing stages of growth. In general, forage production up to stooling stage was about a third of that produced when forage was clipped all season.

Livestock is usually removed from small-grain pasture when the plants begin to stool—that is, to spread out and get ready to send up stems. This usually occurs at Stillwater about March 10 to 15 in the case of rye, March 15 to 25 for barley and wheat; and about April 1 for oats. The dates would be somewhat later in the western part of the state and slightly earlier in the eastern section. About 10 to 12 days after the plants stool out they begin to joint; and this is the dangerous stage of growth for much heavy pasturing if a grain yield is to be taken.

Forage for Fall, Winter and Spring

The growth curves in Figure 2 show how green forage

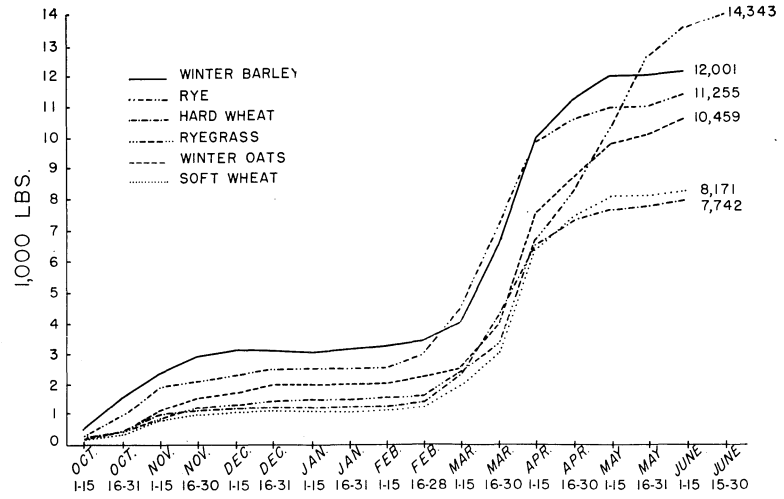

FIG. 2.—Cumulative Green Forage Yield of Different Pasture Crops (Average of Varieties).

yields accumulate throughout the season. These results suggest:

1. Good mixtures for producing pasture through the longest possible season would be either barley or rye with ryegrass, or winter oats with ryegrass.

2. A small acreage of ryegrass, where it is adapted, could be ready for livestock when they are removed from winter grains, to avoid putting animals on the native pastures too early.

As Figure 2 shows, barley starts off quickest in the fall, with rye not far behind. Ordinarily, barley is ready for pasturing ten days to two weeks before wheat, oats, or ryegrass and about one week ahead of rye. Both rye and barley produced much more fall pasture than oats, wheat or ryegrass.

Rye is far more winter hardy than the other crops. It will stay green and sometimes continue to grow throughout the winter, especially if covered with snow.

Rye, barley and wheat become tough and unpalatable about two weeks before winter oats.

Ryegrass often remains green two to four weeks longer than winter oats. The long late-spring growing season accounts for the large total forage yield of ryegrass. About April 15 to May 1, when the other winter pasture crops are slowing up, ryegrass overtakes them in total forage production and makes a tremendous growth in late spring.

EFFECT OF GRAZING ON GRAIN YIELD

Figure 3 shows the effect on grain yields of no clipping and of clipping to the stooling and jointing stages of growth. These results show that grain yields begin to be materially affected if grazing is continued past the jointing stage, which usually occurs 10 to 12 days after stooling. Grazing to the stooling stage did not seriously reduce the grain yields of any of the crops, if the value of the pasture is considered.

The data in Figure 3 suggest two conclusions:

1. The loss of grain caused by grazing up to stooling stage is not serious as compared to the value of the green pasture. As noted above, much more than half the forage is produced **after** stooling stage. Five thousand pounds of green pasture is equal to about 130 pounds of crude protein or 300 pounds of high-protein supplement. And this does not take account of the vitamins and minerals in the forage.

2. If lack of other pasture forces grazing to the jointing stage, it might be more profitable to continue grazing until all the forage is consumed, instead of trying to get some grain, because the grain crop would be small. Oats and barley would stand a better chance of recovering and produc-

ing a grain crop than wheat or rye, if the season were favorable.

Clipping to the jointing stage had the most serious effect on rye and wheat. Yields of barley and oats were less seriously reduced.

Clipping to the stooling stage had no effect on oats or barley. As a matter of fact, grain yields of barley were slightly greater when clipped to stooling stage than when unclipped.

NUTRIENT CONTENT

Table I gives the five-year average analysis of one variety

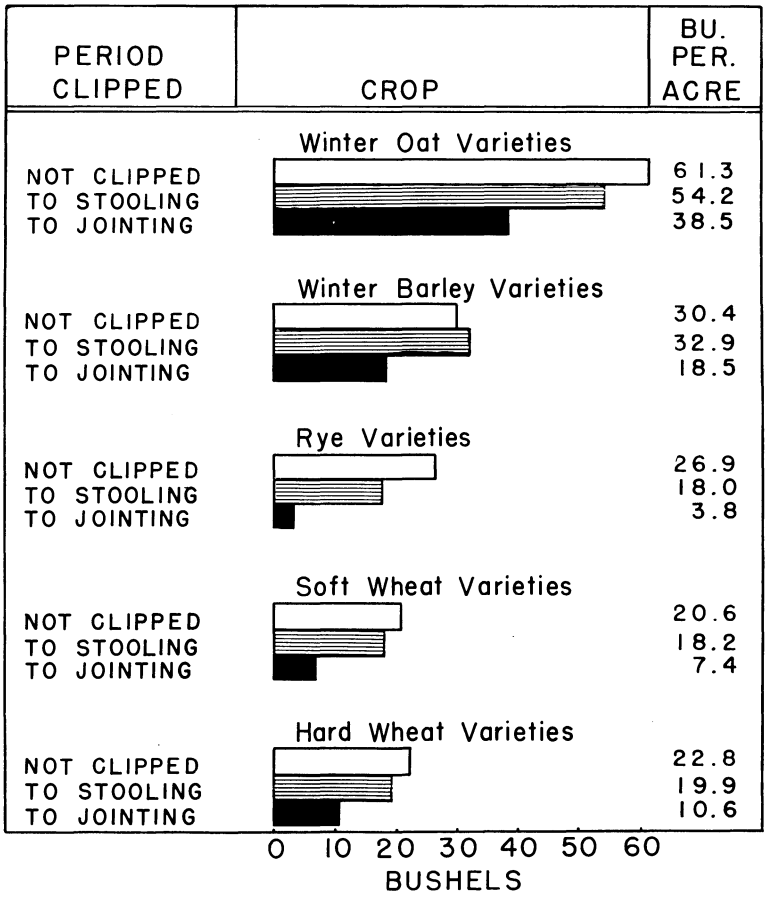

FIG. 3—Grain Yields for Three Clipping Treatments; Five-year Average, 1942-3 to 1946-7. (Varieties averaged are the same as those listed for Figure 1.)

TABLE I.—Chemical Analyses of Hard Wheat (Tenmarq) Forage Clipped at Grazing Height; 1946-47 Season, and Averages 1943-44 to 1947-48.

Sample	No.	H^2O	Ash	Protein	Fat	Fiber	N. F. E.	Ca	P	Niacin	Panto-thenic	Ribo-flavin	Caro-tene
10-17-46	1	72.7	15.58	28.29	6.50	16.82	32.78	.605	.248	44.91	9.26	39.78	395.
11-13-46	2	74.3	12.63	28.08	4.07	15.65	39.52	.442	.475	55.30	37.10	28.40	436.
12-18-46	3	75.6	11.14	31.79	4.56	12.18	40.33	.370	.343	57.80	15.20	30.30	955.
3-21-47	4	66.6	9.55	27.04	3.79	14.60	44.71	.388	.208	55.70	29.30	17.70	466.
3-31-47	5	71.0	10.68	25.17	3.45	16.33	44.37	.420	.220	54.80	21.00	31.40	515.
4-9-47	6	78.2	13.84	26.02	3.04	19.71	37.33	.420	.290	56.00	16.50	21.60	501.
4-21-47	7	81.2	13.95	28.51	4.54	19.59	33.35	.375	.410				503.
5-2-47	8	81.8	14.53	29.09	4.40	19.87	31.95	.450	.390	73.10	19.80	23.60	464.
						ANNUAL AVERAGES							
1943-44		76.3	15.50	28.63	4.47	14.75	36.48	.454	.298				327.
1944-45		77.9	11.51	30.26	4.68	18.13	35.30	.423	.344	31.24	21.80	24.90	520.
1945-46		77.1	14.44	32.69	4.43	15.82	32.77	.441	.287	56.30	16.80	29.57	552.
1946-47		75.2	12.74	28.00	4.29	16.84	38.04	.434	.323	56.80	21.20	27.50	529.
1947-48		77.5	15.02	30.91				.451	.274				598.
Period Average		74.7	13.84	30.10	4.47	16.39	35.65	.441	.303	48.11	19.93	27.32	505.

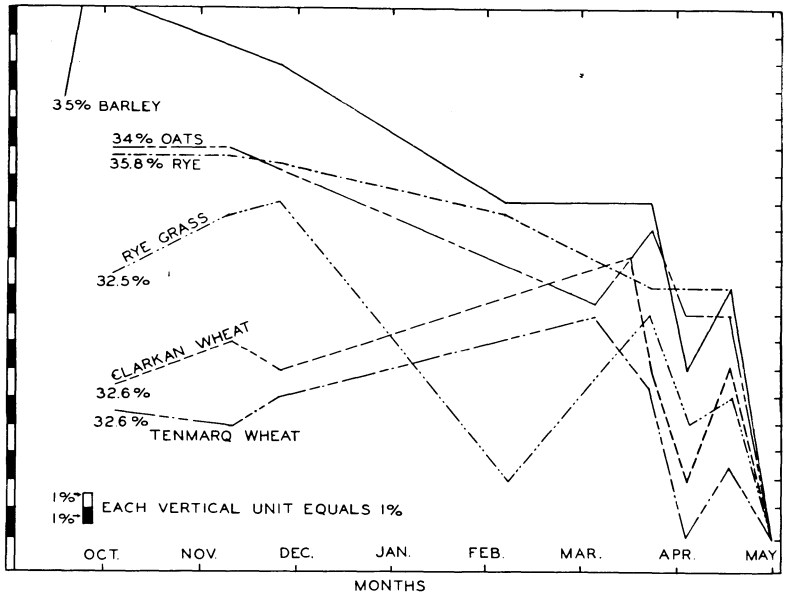

FIG. 4—Protein Levels of Cereal Grasses.

of winter wheat, and the annual averages of the seasonal analyses. Figure 4 presents the typical seasonal changes in protein content.*

Protein

Average protein content of these small grain forages was usually above 30 percent, and when the plants were young and growing rapidly it was higher.

The amount of protein provided by an acre of pasture can be figured out by taking 20 percent of the green forage weight given in Figure 1 and then taking 30 percent of this. (The green forage is about 20 percent dry matter and the dry matter is about 30 percent protein.) For example:

Figure 1 shows that the winter oat varieties averaged a total green forage yield of 10,484 pounds for the five years. Taking 20 percent of this gives 2,097 pounds of dry matter. (.2 x 10,484 = 2,097). Then taking 30 percent of the dry matter gives 629 pounds of protein (.3 x 2,097 = 629). **This is the equivalent of 1,463 pounds of high-protein supplement** containing 43 percent protein.

Another example: Winter oats clipped only to stooling stage averaged 3,792 pounds of green forage. Taking 20 percent of this gives 758 pounds of dry matter. Then taking 30

*More complete data on the chemical analyses made during this research will be found in a publication now in preparation.

percent of the dry matter gives 227½ pounds of protein—the equivalent of 529 pounds of high-protein supplement.

The protein in small-grain pasture is highly digestible, the first year's results of a study of its amino acid content indicates.* Upward of 90 percent of the protein was digestible by poultry and swine. Ruminants, with their multiple stomachs, could digest a still higher proportion.

Vitamins

The high carotene content of small-grain forage, especially when plants are young and growing rapidly, is especially important. Carotene is changed within the animal's body into vitamin A, and lack of this vitamin is one of the most serious shortages of winter rations in the Southwest. Carotene is lost very rapidly from grasses as they mature and become dry. It also disappears rapidly from hays and mixed feeds even when they are stored under better than average farm or ranch conditions.

The small grain forages also contained members of the vitamin B complex—Thiamin, riboflavin, niacin, and pantothenic acid—in generous amounts.

Minerals

Phosphorus was present throughout the clipping season in amounts believed adequate for animal nutrition, despite the fact this forage was grown on land where phosphate fertilizer produced a definite increase in plant growth.

Calcium was somewhat low, but this can be easily supplied in the form of ground limestone. It is also present in most of the roughages usually fed with small-grain pasture.

Fiber

The fiber in the young winter pastures plants was as low as it is in alfalfa leaf meal.

COMPARISON OF CROPS AND VARIETIES

Table II shows the forage yields by varieties of the various crops. In the following list, the crops and varieties which were tested throughout the 5 years are arranged in order of total forage production from highest to lowest:

(a) Ryegrass.

(b) Barley — Ward, Michigan Winter, Missouri Early Beardless, Tenkow, Manchuria.

(c) Rye — Abruzzi, Balbo, Common.

* This project is being conducted by Dr. Robert W. MacVicar of the Station's Department of Agricultural Chemistry Research.

(d) Oats — Winter Fulghum, Wintok, Lee.
(e) Soft wheat — Kawvale, Currell, Clarkan, Fulcaster.
(f) Hard wheat — Turkey, Cheyenne, Tenmarq, Blackhull, Chiefkan.

Traveler oats and Comanche, Early Triumph and Pawnee wheats were added later in the experiment and tested for two years.

TABLE II.—Average Forage Yields, by Varieties; 1942-3 to 1946-7.

(Pounds per acre; green weight)

Crop and Variety	Clip to Stooling	Clip to Jointing	Clip all Season
WINTER BARLEY			
Ward	6006	9790	12450
Michigan Winter	5466	8747	11805
Mo. Early Beardless	5934	9804	11749
Tenkow*	6194	7885	8171
Manchuria*	4856	6169	6707
WINTER OATS			
Wintok	3645	6836	9727
Winter Fulghum	3939	6716	11240
Lee Winter*	3055	4343	6579
Traveler* & **	2014	1897	2100
RYE			
Abruzzi	6800	9880	12001
Balbo	7447	10774	11485
Common	5043	8437	10320
HARD WHEAT			
Tenmarq	2796	4970	7602
Comanche**	3029	4759	8217
Turkey	3024	5530	8143
Blackhull	2579	5729	7700
Cheyenne	3330	5906	7950
Pawnee**	3412	4875	8563
Chiefkan	2424	4689	6350
Early Triumph**	3034	4269	7269
SOFT WHEAT			
Clarkan	3203	4904	7858
Fulcaster	3003	58.6	7337
Kawvale	3537	6383	9211
Currell	3736	6847	8276
ANNUAL RYEGRASS	3424	6103	14343

* Heavy winter damage.
** Two-year average.

In applying the results of this research work done at Stillwater, some allowance must of course be made for soil and climatic differences at other locations. Also, individual judgment must be used about the varying weather conditions from year to year.

Specific management recommendations cannot be made because no two years have the same weather. A dry fall can be partially offset by careful and early preparation of the seedbed. Summer fallowing often will conserve moisture. If particular attention is paid to controlling weeds and compacting the soil, a stand of small grain can usually be obtained.

Some idea of the variation in winter pasture preferences over the State was obtained in a survey made before the research reported in this bulletin was begun. Questionnaires were sent through the Oklahoma Extension Service's county agents to about three hundred farmers in different sections. Their replies can be summarized by sections as follows:

Western. — Wheat was consistently reported as the best crop for winter pasture on the basis of palatability and total forage produced. Rye and barley were placed considerably below wheat, especially on a palatability rating.

Central. — Opinions were divided, but in general farmers in this area liked wheat the best. They were, however, more favorable to rye, barley and oats than were the men reporting from the western section.

Eastern. — Reports from the eastern counties almost reversed those from the western section. Wheat was not considered very worthy; but rye and oats were decided favorites for total pasture, palatability, and general desirability.

Rye

Rye is an excellent pasture crop, especially on sandy soils. It makes a quick fall and early spring growth, produces a large amount of forage in a short time, and is much more winter hardy than ryegrass or any of the other small grains. Rye will remain green and in good pasture condition throughout the winter regardless of cold weather.

The top growth of rye was never frozen back during this five-year test, even when the temperature dropped to 17 below zero in January 1947. Only one time were the tips of the leaves burned slightly by low temperatures.

Balbo and Abruzzi varieties are better than Common. Balbo germinates a little quicker than either of the others, and has more seedling vigor. Both Abruzzi and Balbo make a more rapid growth in the fall than Common and are ready to pasture a few days earlier. These two varieties are also more definitely upright in growth habit, but perhaps are not as winter hardy as Common.

Barley

Barley is not grown very generally for pasture or grain in Oklahoma because of the chinch bug and green bug hazards. However, the results of this research suggest it might be given more consideration as a pasture crop because of the total volume of forage produced and the rapidity of growth.

Barley germinates very rapidly after planting and grows rapidly after emergence. In fact, it makes pasture a few days quicker than rye.

Most varieties are somewhat upright in growth habit until cold weather and then the plants become semi-prostrate. The barley plant produces an abundance of basal leaf growth and the leaves are much thinner and more tender than any of the other crops tested. The lawn mower cuts barley much easier than the other crops.

Several times during the fall months barley was higher than any of the other crops in protein analysis.

Ward, Michigan Winter, and Missouri Early Beardless were very winter hardy; little freezing of these varieties was noticed in the five year period. Several times the entire top growth froze to the ground surface, but little winter killing was observed.

Ward and Michigan Winter varieties were more desirable for pasture because they were hardy, quick growers and produced the most forage. The leaves of these two varieties are narrow for barley and form a dense mat close to the ground. All the other varieties are somewhat coarse in both stem and leaf growth.

Tenkow and Manchuria, although winter types, froze out two years out of the five.

Winter Oats

Winter oats are now being grown quite generally throughout central and eastern Oklahoma, and make an excellent winter pasture. Now many varieties are sufficiently winter hardy to withstand some of the colder winters in Oklahoma.

Wintok came through the five years with only a small percentage of winter killing, but otherwise is not as desirable for pasture as Winter Fulghum or Traveler. The latter two are more upright in growth habit and produce more total forage. The Wintok variety usually is prostrate in growth habit, especially in late fall and early spring.

Lee Winter (a Winter Turf type) and Traveler froze quite heavily and perhaps are not hardy enough for pasture in central Oklahoma, but may be excellent for the eastern part of the state.

Annual Ryegrass

Annual ryegrass is grown generally in eastern Oklahoma, but will do well in the central section. It grows slowly in the seedling stage, is very slow in germination, and has poor seedling vigor. The same is true in early spring; but it makes a rapid growth in April, May, and possibly early June. It is fair in winter hardiness; winter killing was noticed only one year when the temperatures reached 15 degrees below zero. The leaves of ryegrass are dark green and are somewhat thick and leathery. When given free choice in the palatability experiment reported on page 16, cows preferred any of the small grains to ryegrass.

Wheat

None of the wheat varieties, soft or hard, produced as much forage as the other small grains or ryegrass. On the other hand, both soft and hard wheats were noticeably more dependable than the other crops, with the possible exception of rye, except when a rust outbreak occurred. When rust struck, wheat was the first to be seriously affected; and livestock do not like to graze rusted wheat.

HARD WHEAT VARIETIES

All of the hard wheats except Early Triumph were similar in growth habit. Early Triumph was definitely upright in growth. It also showed good seedling vigor. The plant was a light green to greenish yellow in color. Chiefkan was lowest in forage production.

SOFT WHEAT VARIETIES

All of the soft wheat varieties behaved very similarly, but Kawvale was more upright and produced the most forage. In general, all of the soft wheats made a wider leaf than hard wheat, were slightly taller at maturity, and had a more robust vegetation, both stem and leaf.

PALATABILITY TESTS

An effort was made during two seasons to assign palatability ratings to the various crops. Separate plots were planted for this purpose.* Six dairy cows were turned loose in an alley down the middle of the plots and the amount of time the cows spent grazing on each plot was recorded. One year half of each plot was treated with phosphate fertilizer, the plot area in general being on a low-phosphate soil. Two general conclusions were reached:

* The palatability experiment is reported in more detail in Okla. Agri. Exp. Sta. Tech. Bul. No. T-35.

1. It is probably impossible to make true palatability comparisons, because of reasons described below.

2. The cows definitely spent more time on the phosphated plots. This is additional evidence that fertilizer should be used on pasture crops where needed; but there is no conclusive evidence showing that fertilization increased the palatability of the pasture. The cows' preferences may have been due to the fact there was more forage and it was easier to graze.

The first difficulty in making true palatability comparisons came when the crops failed to develop alike in the fall. Despite every effort to bring them all along to reach good grazing condition at the same time, barley and rye were ready to graze several days before wheat, oats, or ryegrass, and the ryegrass was very slow to start. After it was decided the ryegrass would not be ready in time, the cows were turned in without further waiting. The barley and rye soon became tough and stemmy, and by that time wheat and oats were in fine grazing condition; so the cows spent most of their time on the wheat and oats. But the results would likely have been in favor of the barley and rye if the cows had been turned on the plots two weeks earlier.

The second fall another complication arose. The wheat was rusty and the cows did not graze it.

Still another cause of confusion was that the cows, like humans, appeared to have individual likes and dislikes. The data show that variation among individual animals was at least as great as the difference among total time grazed on the various crops. Some cows would not eat ryegrass, others seemed to prefer soft wheat, and still others aparently liked oats better than anything else.

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