THE RELATIVE PASTURE VALUE OF WINTER SMALL GRAINS AND RYEGRASS

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BY

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INTRODUCTION

No experiment station data have been published in Oklahoma that give forage yields and other essential information relative to the small grains for pasture. Information is lacking on how intensively the small grains can be grazed without serious injury to the grain yield, the period in the growing season that each provides maximum pasturage, and the varieties and crops furnishing the greatest amount of pasturage with least reduction in grain yield. Farmers consider these pastures as essential assets in the economical production of livestock.

Advantage is taken of wheat pasturage more often than it is neglected so that ordinarily the problem is not one of full utilization but of avoiding abuse. Farmers are constantly asking Extension, Experiment Station and other agricultural workers questions pertinent to the merits of different varieties of the small grain crops for pasture and how late these crops can be pastured and yet harvest a good crop of grain.

In September, 1942, a three year clipping experiment was designed to furnish data that would answer these questions. Varieties of soft and hard wheat, rye, winter oats, and winter barley were used. Ryegrass also was included, since it recently has gained popularity as a winter pasture crop in Oklahoma.

Temporary pastures are especially important on diversified farming units, where they may contribute to a complete conservation and utilization program.

REVIEW OF LITERATURE

Experimental data showing the relative merits of the small grains for winter pasture and forage yields that are produced are somewhat limited; however, there are many references that have a bearing on the problem. Finnell[1] states that in Oklahoma wheat pasturage supplies a highly palatable forage with a narrow nutritive ratio of 1 to 5.9. Staten[2] and others in Oklahoma state that ryegrass and the small grains fit splendidly into a year-round pasture program because these crops give native pastures a needed rest and also furnish a cheap, nutritive and succulent forage to animals during late fall, winter and spring. Kiltz and Cross[3] in Oklahoma say, "Cereals have contributed more to the pasture of Oklahoma than any other temporary pasture crop. They have several advantages, (1) they produce pasture at a time when most other pastures are poor, (2) many of them are adapted over the major part of the state, (3) seed is easily obtained and is relatively cheap, and (4) methods of culture are quite generally known." Stansel[4] and others in Texas

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[1] H. H. Finnell. Grazing of Winter Wheat. Oklahoma Panhandle Station Bulletin 4. 1929.

[2] Hi W. Staten, Bruce R. Taylor, Steen Lemon, and Hubert C. Smith. Oklahoma Vocational Education Bulletin 3. 1942-1943.

[3] C. B. Cross and B. F. Kiltz. Cereals and Annual Legumes for Winter Pasture. Unpublished Data, Agronomy Department, Oklahoma A. & M. College.

[4] R. H. Stansel, P. B. Dunkel, and D. L. Jones. Small Grains and Ryegrass for Winter Pasture. Texas Experiment Station Bulletin 539. 1937.

believe that small grains and ryegrass for winter pasture deserve more attention because, they produce good yields of palatable and nutritive forage; this pasturage is good feed; they furnish an excellent source of Vitamin A; they are excellent for preventing winter leaching or soil erosion; they give the permanent pasture a rest in the spring or early summer; and they produce a crop of grain, if the pasturing is not too severe and is not continued too late. Aldous[5] in Kansas reports that oats, rye, wheat, and barley as temporary pasture crops are especially essential in the improvement of run-down permanent pastures where protection is essential in restoring the normal grazing capacity.

Carleton[6] says, "In the southern states, a mixture of oats and vetch is employed both for pasture and hay." Duggar[7] states that small grains may be pastured with the following precautions: (a) keeping livestock off the land while wet, (b) discontinuing pasturing early enough to afford abundant time for the plants to tiller and head, and (c) avoiding too close pasturing while there is danger of severe freezes. He also states that pasturing early sown oats may be a distinct advantage in preventing too early formation of stems with resultant freeze injury. Rye and barley are chiefly used as

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[5]A. E. Aldous. Management of Kansas Permanent Pastures. Kansas Agricultural Experiment Station Bulletin 272. 1935.

[6]M. A. Carleton. The Small Grains. New York, The Macmillan Company. 1916.

[7]J. F. Duggar. Southern Field Crops. New York, The Macmillan Company. 1912.

pasturing and soiling crops in the South. Redding[8] states that in Georgia barley and rye are sown almost exclusively for pasturing. Barley is more valuable on rich soils, is more nutritious, and is relished more by animals. Rye is better adapted to poor soils. Dodson[9] found in Louisiana that oats furnish winter pasturage from December to the first of March and a good grain crop in May. Rye is the most commonly used small grain as a pasture crop. Barley, if sown in early October, grows rapidly and makes a good winter pasture. Ahlgren[10] and others state that rye, when sown in late August or early September in Wisconsin, will provide the earliest spring pasture. It may be grazed during the fall also. Lloyd[11] working in Mississippi states that turf and winter oats sown in August or September furnished excellent grazing from November until May 15. If a crop of grain is desired the stock should be removed during April. Semple[12] and others state that Italian ryegrass when sown early in the fall makes rapid growth and furnishes grazing in a remarkably

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[8]R. J. Redding. Wheat and Oats; Rye and Barley. Georgia Experiment Station Bulletin 44. 1899.

[9]W. R. Dodson. Forage Crops, Grasses, Alfalfa, Clovers, etc. Louisiana Experiment Station Bulletin 72, 2nd series. 1902.

[10]H. L. Ahlgren, G. M. Briggs, and L. F. Graber. Supplementary Pastures and Hays. Wisconsin Extension Circular 315. 1941.

[11]E. R. Lloyd. Winter and Summer Pasture in Mississippi. Mississippi Experiment Station Bulletin 50. 1898.

[12]A. T. Semple, H. N. Vinall, C. R. Enlow, and T. E. Woodward. A Pasture Handbook. U.S.D.A., Misc. Pub. 194. 1934.

short time. It is tender and palatable to livestock and has excellent carrying capacity. Jacques,[13] in New Zealand, says, "For production late in the season both oats and ryegrass are outstanding. A combination of a cereal with ryegrass from a yield point of view, and where grazing is an important feature, is better than oats and vetches or oats alone, and better than ryegrass alone or with red clover."

Soule and Vanatter[14] in Tennessee report that rye furnishes one of the best pastures for the winter season and that it withstands the effects of tramping. They state that, if rye is sown from the middle of August to the first of September, it furnishes excellent grazing from October until Christmas, or through the entire winter providing the season is mild. They also found that winter cereals prevent the leaching of valuable fertilizing constituents and the washing and eroding of fields by winter rains. Kiltz and Cross[15] in Oklahoma state that when pasture only is desired there is probably no cereal that will consistently produce more pasture on a wider variety of soils than common rye. This crop is winter hardy, and is adapted to both sandy and heavy soils. Neel,[16] of Tennessee, states that Abruzzi rye produces pasture

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[13]W. A. Jacques. Trial of Winter Forage Crops at Messey Agricultural College. New Zealand Journal of Agriculture, Vol. 5, p.25-31. 1935.

[14]A. M. Soule and P. O. Vanatter. Winter Cereals and Legumes. Tennessee Experiment Station Bulletin, Vol. XIV, No. 3. 1901.

[15]Cross and Kiltz, op. cit.

[16]L. R. Neel. Rye for Pasture and Seed in Tennessee. Tennessee Agricultural Experiment Circular 52. 1935.

as abundantly as Balbo during mild weather, but is inferior to Balbo for winter pasture because of its lack of winter hardiness. Rosen and the southern ryes have proven inferior to Balbo, both in vegetative and seed producing qualities. In the experiments by Stansel, Dunkle and Jones[17] conducted in Texas, Italian ryegrass made the highest forage yield; however, most of the growth was made in late spring, while barley made its heaviest growth early in the season. Wheat produced a higher yield of forage than the other small grains. Minkler[18] recommends oats with peas and clover for an early fall pasture for hogs in New Jersey. Rye was a good early spring pasture for brood sows. Dvorachek,[19] et al, found that winter rye has furnished more pasture, both winter and spring, than either winter oats or winter wheat. Finnell[20] in Oklahoma found that winter barley yielded 67 percent more pasture on summer fallow land and 72 percent more on stubble land than wheat in the fall and winter and early spring of 1930-31. Conrey[21] in Oklahoma found that those varieties of oats, barley and wheat making the most rapid growth during

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[17]Stansel, Dunkle, Jones, op. cit.

[18]F. C. Minkler. Field Experiment with Swine. New Jersey Station Report 1916, p.117-118.

[19]Dvorachek, et al. Experiment with swine at the Arkansas Station. Arkansas Experiment Station Annual Report Bulletin 181, p.55. 1922.

[20]Finnell, op. cit.

[21]Edward F. Conrey. The Comparative Growth Rates of some Varieties of Wheat, Oats and Barley. Report submitted to the Department of Agronomy, Oklahoma A. & M. College. 1940.

the fall were more severely retarded by low temperatures. The slower growing varieties produced more dry matter in winter and spring. The non-hardy winter varieties grow more rapidly than hardy varieties during the early stages of development. Anderson[22] reports that in Kansas, wheat is the most widely used pasture crop. Both pasture and grain may be obtained from the wheat, providing the livestock are removed by April 1 to prevent reduced grain yields. He states that winter rye will supply more pasture than any of the other cereal crops. Excellent results have been obtained from Balbo, a new variety that is more erect in its growth habit than common rye. Winter barley is also a popular temporary pasture because it provides pasture quickly after planting and is readily eaten by livestock. Wasson[23] recommends oats for south Louisiana and rye for north Louisiana as the most popular winter and early spring grazing crops in that state. Lush[24] states that oats was found more valuable than Abruzzi rye or winter barley for milk production in north Louisiana in five years' results at Calhoun. Rye was best during cold weather. Kirk[25] and others in Canada found spring oats to

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[22]Kling L. Anderson. Tame Pastures in Kansas. Kansas Agricultural Experiment Station Circular 206. 1941.

[23]R. A. Wasson. Pasture and Forage Crops for Louisiana. Louisiana Extension Circular 140. 1930.

[24]R. H. Lush. Pasture Production and Management. Louisiana Agricultural Experiment Station Circular 15. 1936.

[25]L. L. Kirk, J. G. Davidson, and Stella N. Hamilton. Cereal Grain Crops for Annual Pasture. Sci. Agr. 14:569-579. 1934.

be superior to the other small grains in yield of dry matter per acre, percentage of protein, total yield of protein, and number of cuttings per season where the plants were cut at various stages to simulate grazing. Trotter[26] in Texas tested a number of oat varieties for winter pasture and found great differences between varieties in forage production for a particular period of the grazing season as well as in their total yields.

In Canada, Zavitz[27] found considerable variation in stooling of oats. The Burt and Joanette varieties averaged from 21 to 22 stools per plant, while Tartar King and others averaged only six to eight. Bunch[28] in Tennessee found that clipping at heights of one and three inches and at two different frequencies reduced the number of culms in wheat, oats, rye and barley. Welton and Morris[29] in Ohio found that clipping wheat and oat plants tended to reduce the number and height of culms and prevented lodging, but the effect was largely governed by subsequent seasonal conditions.

Many workers have investigated the effect of pasturing

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[26]Idle P. Trotter. Oat Varieties for Winter Pasture Production. Jour. Amer. Soc. Agron. 34:292-294. 1942.

[27]C. A. Zavitz. Experimental Working Field Husbandry, p.183-200 (230-231). Annual Report Ontario Agricultural College and Experimental Farm, 35.

[28]H. D. Bunch. The Effect of Clipping on Four Winter Grains. Thesis in Department of Agronomy, 1942, University of Tennessee.

[29]F. A. Welton and V. H. Morris. Lodging in Oats and Wheat. Ohio Experiment Station Bulletin 471. 1931.

on the subsequent yield of grain of the cereal crops. Georgeson[30] and others in Kansas found that pasturing wheat to the ground in the first part of April, with no previous pasturage, materially reduced the grain yield. In a later report,[31] it was recorded that grazing wheat in the fall or spring had little effect on the yield of grain; however, the spring grazing in this case was uneven and not so close as in the fall. Shelton,[32] also of Kansas, found that grazing had little effect on the grain yield. Swanson[33] reports that approximately 65 percent 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. Moderate grazing can be continued until the plants show a strong tendency to make erect growth in preparation for jointing which is usually about April 10 at Hays, Kansas. When conditions are unfavorable for vigorous growth and when moisture is a limiting factor, grazing results in a reduction in grain yields. Oklahoma workers[34] report that three years' results show little or no reduction in the yield of grain from

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[30] C. C. Georgeson, F. C. Burtis, and W. Shelton. Experiments with wheat at the Kansas Station. Kansas Experiment Bulletin 33. 1892.

[31] C. C. Georgeson, F. C. Burtis, and D. H. Otis. Experiments with wheat. Kansas Experiment Bulletin 59. 1896.

[32] E. M. Shelton. Experiment with wheat. Kansas Experiment Bulletin 4. 1888.

[33] A. F. Swanson. Pasturing winter Wheat in Kansas. Kansas Experiment Bulletin 271. 1935.

[34] Oklahoma Agricultural Experiment Station 16th Annual Report, 1906-1907. p.21-24.

judicious pasturing of wheat in winter when pasturing ceased by March 1. Heavy or late pasturing reduced the grain yields. When wheat was making a heavy growth, pasturing proved to be beneficial. Kiesselbach[35] in Nebraska found that pasturing rank-growing Turkey red wheat in the spring of 1919, from March 31 to April 30, increased the grain yield 4.7 bushels per acre or 33 percent. Wheat one foot high that was mowed to a height of five inches at that time yielded 2.1 bushels or 15 percent more per acre than unmowed wheat. Lodging was reduced by both the pasturing and the mowing. Pasturing wheat three other years, when no lodging occurred from the time it was nine inches tall until April 30, reduced the average yield of grain 12.9 bushels per acre. Kiesselbach states that April 30 has been arbitarily chosen as the date to cease pasturing in Nebraska in most years. In Indiana, Latta[36] found that the yield of grain was reduced by clipping wheat with a lawn mower when it was six inches high in the spring. In Mississippi,[37] wheat grazed for one month produced 1210 pounds of hay per acre as compared with 1812 pounds where it was not grazed. Hastings[38] at San Antonio,

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[35] T. A. Kiesselbach. Winter Wheat Investigations. Nebraska Experiment Station Research Bulletin 31. 1925.

[36] W. C. Latta. Field Experiments with Wheat. Indiana Experiment Station Bulletin 41. 1892.

W. C. Latta. Indiana Experiment Station Sixth Annual Report for 1893, p.25-31.

[37] Mississippi Station Report, 1905.

[38] S. H. Hastings. The Work of the San Antonio Experiment Farm in 1914. U.S.D.A., Bureau of Plant Industry Work, San Antonio Experiment Farm, 1914.

Texas, reports that pasturing oats in the fall until January does not effect the yield of hay, but several spring pasturings will greatly reduce the hay crop.

In Australia, Perkins and Spafford's[39] data show that (1) hay yields suffered even by judicious pasturing, (2) pasturing was found advisable when there was an "Overrank" growth in order to avoid lodging, and it should be done as rapidly as possible by crowding with sheep, (3) pasturing should not be done in wet weather, late in the season, or in frosty weather, and (4) the percentage of smut in grain was reduced by pasturing. At the McNeill Branch Station in Mississippi,[40] oats and wheat pastured in the winter resulted in a reduced hay yield some years and had little effect in other years. At the Oklahoma Panhandle Station, Finnell[41] found that grazing wheat to April 1 had little effect on the plant or grain yield. Grazing to April 26 and later reduced the grain yield.

In Kansas[42] the custom rate for wheat pasture is based upon the price per head per month and has been approximately

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[39]A. J. Perkins and W. J. Spafford. Experiments bearing on feeding of Cereal Crops with Sheep. Journal of Department of Agriculture, South Australia, Vol. 16, Nos. 9 and 11. 1913.

[40]Report of work at McNeill Branch Experiment Station for 1907 to 1911, inclusive. Mississippi Experiment Station Bulletin 158. 1912.

[41]Finnell, op. cit.

[42]Sanson, op. cit.

$1 for growing cattle since 1929; it was higher previous to that time when higher cattle prices prevailed. The carrying capacity varied greatly, depending on seasonal conditions. During the fall, three to seven acres may be required to carry one adult animal while during the spring, two to four acres are required. Gains of 1.3 to 1.7 pounds per day were obtained from cows pastured on winter wheat, supplemented by a limited supply of dry matter. Marshall and Potts[43] give the number of days of grazing as 309 for wheat and 180 for rye per acre during the year 1919. They state that winter wheat provides better winter and spring pasture for sheep than rye. In Tennesse, Neel[44] reported a three-year average of 169 days pasturing per acre for one steer on Balbo rye, with an average animal gain of over 300 pounds per acre. At San Antonio, Texas in 1917, Letteer[45] obtained a total gain of 243 pounds from two steers pastured on two acres of oats from January 24 to February 23 and from April 11 to June 7. In a later report he states[46] that two steers on one and one-half acres of oats for 34 days made a daily gain of 2.5 pounds each.

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[43] F. R. Marshall and C. G. Potts. Raising sheep on Temporary Pasture. U.S.D.A. Farmers' Bulletin 1181, 1927, revised.

[44] Neel, op. cit.

[45] C. R. Letteer. Experiments in Crop Utilization. U.S.D.A., Bureau of Plant Industry, Work San Antonio Experiment Farm, 1917.

[46] C. R. Letteer. Experiment in Crop Utilization. U.S.D.A., Circular 73. 1920.

Ratliffe[47] at San Antonio, Texas, in 1919 reported that two steers on two acres of oats from November 20 to May 11 made an average daily gain 1.6 pounds each and that the steers were in good finish. Lush[48] reports a comparison of oats, rye and barley, each with vetch, at the North Louisiana Experiment Station. They showed 33, 28, and 22 days grazing, respectively, per animal per acre for an average of four winters with returns of $13.56, $8.91, and $7.15 per acre in butter fat at thirty cents per pound.

There is some objection to rye and wheat as pastures for dairy cows since they have a tendency to flavor the milk. Babcock[49] found that green rye fed after milking has little effect on the flavor or odor of milk produced at the next milking, but when fed before milking, it did affect the flavor and odor of milk. Barley and oats had less effect on milk flavor and odor than wheat or rye.

The cereal grains produce a very nutritive forage, especially during the early stages of growth. McMillen and Langham[50] report that green wheat is an excellent source of calcium, phosphorus, magnesium, and protein, but in order

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[47] G. T. Ratliffe. Experiments in Crop Utilization. U.S.D.A., Circular 209. 1922.

[48] R. H. Lush. Dairy and Pasture Results at North Louisiana Experiment Station. Mimeographed Report, May, 1934.

[49] C. J. Babcock. The Effect of Feeding Green Rye and Green Cowpeas on the Flavor and Odor of Milk. U.S.D.A., Bulletin 1342. 1925.

[50] W. N. McMillen and W. Langham. Grazing Winter Wheat with Special Reference to the Mineral Blood Picture. Journal of Animal Science. Vol. 1, p.14-21. 1942.

to prevent diarrhea and "wheat or protein poisoning," and to make more economical gains, some form of roughage should be supplied. Swanson[51] states that winter cereals during the early stages of growth contain 18 to 30 percent protein and are rich in minerals. Protein and mineral supplements are dispensed with by most stockmen in Kansas as these are considered sufficient for livestock requirements when a heavy growth of green wheat is being pastured. Morrison[52] states that green rye, wheat, or oats 5 inches high contain 20 to 25 percent of protein, if dried to the same moisture content of hay. Odland[53] and others in Rhode Island found that wheat in its early growth may contain as much as 29.56% protein, 6.0% fat, and as low as 15% crude fiber, while in the spring wheat pasture averaged only 19.5% protein. Sotola[54] in Washington states that as barley and wheat plants develop, the ash, protein, and fat decreases on a percentage basis and the fiber increases. Lush[55] reports a gradual decrease in the protein content of suc-

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[51] Swanson, op. cit.

[52] F. B. Morrison. Feeds and Feeding. Ithaca, N.Y., Morrison Pub. Co., 1939.

[53] T. E. Odland, T. R. Cox, and C. H. Moron. Adaptation of Various Crops for Supplementary Pasture. Jour. Amer. Soc. Agron., Vol. 34:229-237. 1942.

[54] Jerry Sotola. The Chemical Composition and Nutritive Value of Certain Cereal Hays as Affected by Plant Maturity. Jour. Agr. Res., Vol. 54:399-415. 1937.

[55] R. H. Lush. Chemical Composition and Yield of Pasture Grasses During 1930. Proc. 32nd Ann. Con. Assn. of Southern Agricultural Workers, pp214-218. 1931.

culent grasses as the season advanced. Lush[56] also found that in the early spring rapidly growing oat plants were similar to clover samples in analysis. Chaffin and Graumann[57] state that small grain pasture is very rich in protein and minerals and the amounts of these nutrients obtained by livestock from the young and tender growth of the small grain plants may be sufficient to meet the needs of the animal. Copeland and Fraps[58] in Texas found that, providing dairy cows have a green pasture during part of the year, silage would furnish enough additional Vitamin A to prevent injury to the animals' health. Fraps[59] and others in Texas state that the feed of dairy cows must be high in Vitamin A potency in order for the animals to produce butter high in Vitamin A. Silage and ordinary hays must be supplemented with green pasture in order to maintain high Vitamin A content in the butter. Fraps and Treichler[60] also in Texas, say "Green pastures are the best sources for supplying animals with Vitamin A. Dry feed high in Vitamin A may lose a great portion of this vitamin during

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[56]R. H. Lush. Seasonal Composition of Pasture Grasses. Journal of Dairy Science, Vol. 16, p149-152. 1933.

[57]Wesley Chaffin, and Hugo Graumann. Small grains for Winter Pasture in Oklahoma. Okla. Extension OP-89.

[58]O. C. Copeland and G. S. Fraps. Sorghum silage as a Source of Vitamin A for Dairy Cows. Texas Experiment Bulletin 473. 1932.

[59]G. S. Fraps, O. C. Copeland, and Ray Treichler. The Vitamin A Requirements of Dairy Cows. Texas Experiment Station Bulletin 495. 1934.

[60]G. S. Fraps and Ray Treichler. Vitamin A Content of Foods and Feeds. Texas Experiment Station Bulletin 477. 1933.

storage. Drying moist foods results in a loss of Vitamin A."

In Kansas, Shaw and Atkesen[61] checked the comparative palatability of Balbo rye, common rye, wheat and barley by using six dairy cows to graze a series of plots of those crops. They report the cows spent 52 percent of their grazing time on Balbo rye; 24 percent on common rye; 18 percent on wheat; and 6 percent on barley.

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[61] A. O. Shaw and F. W. Atkeson. Comparative Palatability of some Cereal Pastures. Journal of Dairy Science, Vol. 25, p503-506. 1942.

METHODS AND MATERIALS

To obtain the relative forage and grain yielding capacities of ryegrass and the small grains, four treatments were employed. One replication of plots in each series was clipped, (1) to March 30th, (2) to April 14th, (3) all season, and (4) one replication was left unclipped. The first three treatments give the forage and grain yields at different clipping periods during the growing season. The fourth treatment gives the normal grain yield when no clipping was practiced. The effect of clipping is determined by comparing the grain yield of the March 30th and April 14th clippings to the grain yield of the non-clipped plots.

Twenty winter small grain varieties and ryegrass were used. The commonly grown Oklahoma varieties of oats (Lee Winter, Winter Fulghum, Wintok), of barley (Ward, Missouri Early Beardless, Michigan Winter, Manchuria, Tenkow), of rye (Balbo, Abruzzi, Common), of soft wheat (Kawvale, Clarkan, Currell, Fulcaster) and hard wheat (Cheyenne, Turkey, Tenmarq, Chiefkan, Blackhull) were used.

On October 6, 1943 four replicated plots of each treatment were planted on level Kirkland silt loam soil on the Oklahoma Agricultural Experiment Station Agronomy Farm--Series 5200. The plots of each variety consisted of four drill rows eight inches apart and sixteen feet long. Two border rows were planted on either side of each crop. The series were separated by three-foot alleys.

One and one-fourth bushels of wheat or rye, two and one-fourth bushels of oats or barley, and thirty-five pounds

of ryegrass were planted per acre. The seed to be planted in each row was weighed previous to planting. A funnel with a long spout was attached to a small Columbia drill and the seeds were dropped by hand through the funnel (Figure 1). This method of planting facilitated rapid planting and even distribution of the seed in the row.

A triple system of randomization was used. The crops and treatments were randomized (Figure 2) and the varieties within each crop were randomized (Pages 24-27).

The plots were clipped with a lawn mower (Figure 3) when the forage reached a height of 3 to 4 inches. Seasonal conditions did not allow regular successive clippings to occur exactly as indicated above. Some investigators contend that clipping is not comparable to grazing in determining forage yields; however, Gardner[62] et al and Robinson[63] found a high correlation between the data obtained by clipping treatments and that obtained by actual grazing trials. Canfield[64] in Arizona states that in clipping, the intensity and frequency of harvesting are always under control, and the weight of the harvest can be accurately determined, with

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[62] F. D. Gardner, et al. Pasture utilization. Pennsylvania Experiment Station Bulletin 323. 1935.

[63] R. R. Robinson. A Comparison of Grazing and Clipping for Determining the Response of Permanent Pastures to Fertilization. Jour. Amer. Soc. Agron. Vol. 29, p.349-359. 1937.

[64] R. H. Canfield. The Effect of Intensity and Frequency of Clipping on Density and Yield of Black Grama and Tabosa Grass. U.S.D.A. Tech. Bul. 681. 1939.

Figure 1. Using a Columbia Drill with a Funnel Attachment to Plant the Seeds.

Figure 2. The Randomization of Crops and Varieties within each Crop.

actual grazing, the cropping of the plant cannot be regulated and only with great difficulty can the volume of forage so utilized from small plots be weighed or otherwise measured. Each time the plots were clipped a composite 500 gram sample of green forage was obtained from each variety (Figure 4). This forage was oven dried at 90°C. and all forage yields were computed on oven-dry forage corrected to a 20 percent moisture basis. A sample of the oven-dry forage was brought to the laboratory where chemical analyses were made.

As the different varieties matured (Figures 5 and 6), they were harvested with a hand sickle. All samples were stored in a screened drying room. A small nursery thresher was used to thresh the grain.

Figure 3. Clipping the Plots with a Lawn Mower.

Figure 4. Weighing the Green Forage in the Field.

Figure 5. The Barley Varieties in the Mature Stage.

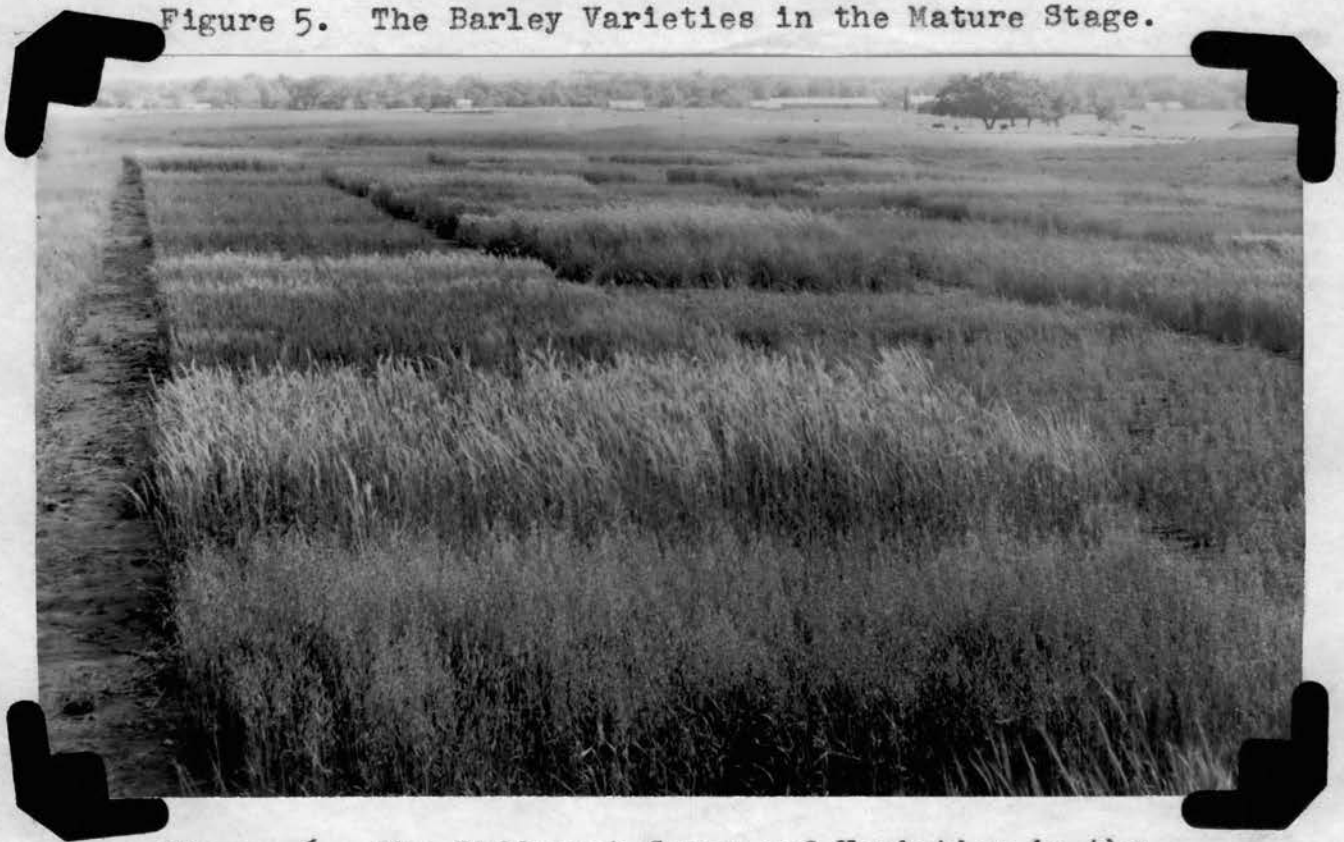


Figure 6. The Different Crops and Varieties in the Mature Stage.

THE ARRANGEMENT OF VARIETIES AND TREATMENT
FOR EACH REPLICATION

First Replication

No Clipping	Clip All Season
1. Tenmarq	43. Balbo
2. Fulcaster	44. Abruzzi
3. Turkey	45. Common
4. Chiefkan	46. Manchuria
5. Kawvale	47. Mo. E. Beardless
6. Currell	48. Tenkow
7. Clarkan	49. Ward
8. Blackhull	50. Michigan Winter
9. Cheyenne	51. Ryegrass
10. Ryegrass	52. Winter Fulghum
11. Ward	53. Wintok
12. Mo. E. Beardless	54. Lee
13. Michigan Winter	55. Currell
14. Tenkow	56. Cheyenne
15. Manchuria	57. Kawvale
16. Wintok	58. Turkey
17. Lee	59. Blackhull
18. Winter Fulghum	60. Tenmarq
19. Abruzzi	61. Fulcaster
20. Common	62. Clarkan
21. Balbo	63. Chiefkan

Clip to April 14	Clip to March 25
22. Manchuria	64. Michigan Winter
23. Tenkow	65. Mo. E. Beardless
24. Mo. E. Beardless	66. Manchuria
25. Michigan Winter	67. Tenkow
26. Ward	68. Ward
27. Ryegrass	69. Fulcaster
28. Balbo	70. Chiefkan
29. Common	71. Turkey
30. Abruzzi	72. Currell
31. Cheyenne	73. Cheyenne
32. Blackhull	74. Kawvale
33. Tenmarq	75. Blackhull
34. Currell	76. Tenmarq
35. Clarkan	77. Clarkan
36. Turkey	78. Ryegrass
37. Kawvale	79. Abruzzi
38. Fulcaster	80. Balbo
39. Chiefkan	81. Common
40. Winter Fulghum	82. Wintok
41. Lee	83. Winter Fulghum
42. Wintok	84. Lee

Second Replication

Clip Entire Season	Clip to March 25
85. Balbo	127. Ryegrass
86. Abruzzi	128. Abruzzi
87. Common	129. Common
88. Winter Fulghum	130. Balbo
89. Wintok	131. Ward
90. Lee	132. Michigan Winter
91. Clarkan	133. Mo. E. Beardless
92. Cheyenne	134. Tenkow
93. Turkey	135. Manchuria
94. Currell	136. Kawvale
95. Kawvale	137. Fulcaster
96. Blackhull	138. Tenmarq
97. Tenmarq	139. Chiefkan
98. Fulcaster	140. Currell
99. Chiefkan	141. Clarkan
100. Ryegrass	142. Turkey
101. Manchuria	143. Blackhull
102. Mo. E. Beardless	144. Cheyenne
103. Tenkow	145. Wintok
104. Ward	146. Lee
105. Michigan Winter	147. Winter Fulghum
No Clipping	**Clip to April 14**
106. Lee	148. Ryegrass
107. Winter Fulghum	149. Currell
108. Wintok	150. Chiefkan
109. Common	151. Tenmarq
110. Balbo	152. Turkey
111. Abruzzi	153. Kawvale
112. Ryegrass	154. Cheyenne
113. Tenkow	155. Blackhull
114. Manchuria	156. Clarkan
115. Michigan Winter	157. Fulcaster
116. Ward	158. Abruzzi
117. Mo. E. Beardless	159. Balbo
118. Blackhull	160. Common
119. Cheyenne	161. Michigan Winter
120. Chiefkan	162. Ward
121. Tenmarq	163. Mo. E. Beardless
122. Kawvale	164. Manchuria
123. Currell	165. Tenkow
124. Fulcaster	166. Wintok
125. Clarkan	167. Winter Fulghum
126. Turkey	168. Lee

Third Replication

Clip to March 25	Clip to April 14
169. Ryegrass	211. Wintok
170. Cheyenne	212. Lee
171. Chiefkan	213. Winter Fulghum
172. Blackhull	214. Mo. E. Beardless
173. Fulcaster	215. Michigan Winter
174. Clarkan	216. Ward
175. Tenmarq	217. Tenkow
176. Kawvale	218. Manchuria
177. Turkey	219. Turkey
178. Currell	220. Clarkan
179. Balbo	221. Kawvale
180. Common	222. Chiefkan
181. Abruzzi	223. Tenmarq
182. Manchuria	224. Fulcaster
183. Michigan Winter	225. Blackhull
184. Tenkow	226. Currell
185. Ward	227. Cheyenne
186. Mo. E. Beardless	228. Ryegrass
187. Winter Fulghum	229. Abruzzi
188. Lee	230. Common
189. Wintok	231. Balbo

Clip All Season	No Clipping
190. Balbo	232. Clarkan
191. Abruzzi	233. Tenmarq
192. Common	234. Fulcaster
193. Ward	235. Cheyenne
194. Michigan Winter	236. Blackhull
195. Manchuria	237. Turkey
196. Mo. E. Beardless	238. Currell
197. Tenkow	239. Chiefkan
198. Ryegrass	240. Kawvale
199. Winter Fulghum	241. Winter Fulghum
200. Wintok	242. Lee
201. Lee	243. Wintok
202. Fulcaster	244. Balbo
203. Tenmarq	245. Common
204. Chiefkan	246. Abruzzi
205. Clarkan	247. Ryegrass
206. Cheyenne	248. Ward
207. Turkey	249. Manchuria
208. Kawvale	250. Tenkow
209. Blackhull	251. Mo. E. Beardless
210. Currell	252. Michigan Winter

Fourth Replication

Clip to April 14	No Clipping
253. Tenmarq	295. Wintok
254. Chiefkan	296. Winter Fulghum
255. Clarkan	297. Lee
256. Cheyenne	298. Michigan Winter
257. Turkey	299. Mo. E. Beardless
258. Blackhull	300. Ward
259. Kawvale	301. Manchuria
260. Fulcaster	302. Tenkow
261. Currell	303. Ryegrass
262. Balbo	304. Abruzzi
263. Abruzzi	305. Balbo
264. Common	306. Common
265. Ward	307. Chiefkan
266. Michigan Winter	308. Turkey
267. Manchuria	309. Tenmarq
268. Mo. E. Beardless	310. Currell
269. Tenkow	311. Fulcaster
270. Winter Fulghum	312. Cheyenne
271. Wintok	313. Clarkan
272. Lee	314. Kawvale
273. Ryegrass	315. Blackhull

Clip to March 25	Clip All Season
274. Tenkow	316. Abruzzi
275. Michigan Winter	317. Common
276. Manchuria	318. Balbo
277. Ward	319. Tenmarq
278. Mo. E. Beardless	320. Chiefkan
279. Lee	321. Fulcaster
280. Winter Fulghum	322. Kawvale
281. Wintok	323. Currell
282. Blackhull	324. Turkey
283. Clarkan	325. Blackhull
284. Fulcaster	326. Clarkan
285. Chiefkan	327. Cheyenne
286. Cheyenne	328. Ryegrass
287. Tenmarq	329. Wintok
288. Kawvale	330. Lee
289. Turkey	331. Winter Fulghum
290. Currell	332. Ward
291. Ryegrass	333. Michigan Winter
292. Common	334. Mo. E. Beardless
293. Balbo	335. Tenkow
294. Abruzzi	336. Manchuria

Table I

Weather Data, July 1943 to June, 1944
Stillwater, Oklahoma (Weather Bureau)

Month	Temperature					Precipitation								
	Mean	High	Date	Low	Date	Total Rain	Dep. from nor'l	High 24 hours	Date	Rain .01"	Clear Days	Partly Cloudy	Cloudy Days	Prev. Winds
July	83.6	107	22,23	59	9	0.60	-2.16	0.31	17	4	17	13	1	S Dry
Aug.	86.4	107	23,10	50	18	1.68	-1.40	1.19	5	3	23	4	4	S Dry
Sept.	72.1	96	12,14	44	7	3.10	-0.60	2.42	29	7	13	11	6	S.E. Med.
Oct.	60.6	85	14	29	27	4.43	+1.34	2.08	22	6	16	9	6	S Wet
Nov.	49.0	80	18	25	10,28	0.10	-2.28	0.10	26	1	18	5	7	N Dry
Dec.	36.3	65	4	4	15	3.23	+1.34	0.75	9	7	6	15	10	N Wet
Jan.	39.0	67	27	1	9	1.13	-0.01	0.56	27	6	13	8	10	S Med.
Feb.	44.5	80	24	14	11	1.13	-0.19	0.33	10	6	8	12	9	S Med.
Mar.	49.0	77	13,31	16	29	2.13	-0.18	1.05	15	5	14	7	10	N Med.
April	58.6	83	8,22	32	5	4.68	+0.71	1.66	9,10	6	9	8	13	S Med.
May	69.8	91	15	33	6	2.22	-2.73	0.62	2	8	5	15	11	S Dry
June	79.1	96	23	55	6	3.54	-0.45	1.57	13	6	12	15	3	S Med.

RESULTS AND DISCUSSION

Climatic Conditions

The climatic conditions at Stillwater, Oklahoma are characterized by moderate rainfall (35 inches annually), which is somewhat erratic in distribution. The winters are usually moderate with occasional severe freezes. The meteorological data for the period July, 1943 to July, 1944 are presented in Table I. The rainfall was below normal during July, August, November, and May. September, January, February, March, April, and June were characterized by moderate rainfall, while October and December were fairly wet months. The temperature was moderate throughout the winter with the exception of 1 degree above zero on January 9th and 16 degrees above zero the 29th of March. The latter was also accompanied by a 2 inch snow. All of the varieties recovered, however, with the exception of Lee Winter oats which froze out completely. Excluding the freeze of March 29th, the spring growing season was very favorable for small grains. The chemical analyses were greatly altered by this late freeze as shown in Table VII. The percent of dry matter of the varieties was affected by the rainfall.

Yields of Forage - 1944

All varieties planted on Oct. 6, 1943, emerged to a good stand. The total acre yields of green and air-dry forage (corrected 20 percent moisture basis) are presented in Tables II and III. Ryegrass made the highest total yield followed in order by oats, barley, soft wheat, hard wheat,

and rye. Barley made the most abundant early fall pasture. A clipping of forage was removed from the barley varieties 30 days after planting. Barley, oats, and ryegrass produced the heaviest yields in early winter. In early spring, barley made the heaviest forage yields followed by oats and soft wheat. Ryegrass made the greatest yield in late spring and early summer. The yield of rye was consistently low throughout the growing season. Ward barley was the leading small grain variety for forage production followed closely by Missouri Early Beardless. Of the oats, rye and soft wheat varieties, Winter Fulghum, Balbo, and Currell led in forage production, but were low in grain yields. Of the hard wheat, Cheyenne made the greatest forage yield, while Tenmarq produced the most grain.

Effect of Length of Grazing Period on the Production of Grain

Since small grains in Oklahoma are grown primarily for grain, the question of when to stop grazing in the spring is of considerable importance. Opinions on this question among stock farmers vary considerably, some believing that pasturing after March 1 will lower production, while others believe that pasturing up to March 15 or April 1 does not reduce yields. Most farmers agree that pasturing small grains during the fall and winter reduces winter-killing and increases the production of grain.

Grain yields of Wintok oats, Michigan Winter, Ward, Missouri Early Beardless, and Manchuria barleys were slightly

increased by the March 30 clipping. All others were slightly reduced. All small grain varieties were drastically reduced by the April 14 clipping. The seed yields of ryegrass were greater on the later clipped plots.

Average of Two Years Data

During the two year period ryegrass made the highest total forage yield, (Tables IV and V) followed in order by oats, rye, barley, soft wheat, and hard wheat. Winter Fulghum oats was the leading small grain variety for forage production, however, Wintok oats was high in grain yield. Balbo was the leading rye variety in forage but was lowest in grain yield. Of the soft wheat Kawvale was high in both grain and forage yields. Of the hard wheats Turkey and Tenmarq were high in forage, but Blackhull was high in grain yield. Ward made the highest total yield of the barley varieties, but was surpassed by Michigan Winter in grain yield.

Table II

Yields of Grain and Forage* of Each Crop
(Ave. of Varieties) Under Each Clipping Treatment
1944

Crop and Terminal Clipping Dates	Seasonal Clipping Dates Nov. 5	Dec. 8	Feb. 24	Mar. 30	Apr. 14	Apr. 25	May 9	May 31	Tot. for. dry wt. per acre	Tot. for. green wt. per acre	Grain in bu. per acre
Soft wh.											
no clip											32.8
Mar. 30		80	265	793					1138	4009	26.5
Apr. 14		82	275	912	762				2031	7722	15.4
All seas.		73	260	859	746	456	298		2695	10640	
Hard wh.											
no clip											29.1
Mar. 30		35	194	758					987	3435	24.1
Apr. 14		49	229	817	693				1788	6722	11.3
All seas.		32	205	787	695	392	315		2426	9411	
Ryegrass											
no clip											372**
Mar. 30		124	272	471					867	2910	405
Apr. 14		160	376	608	714				1858	6884	492
All seas.		135	308	381	681	667	752	1519	4443	18153	
Barley											
no clip											39.3
Mar. 30	48	81	418	973					1520	5518	41.8
Apr. 14	52	81	463	980	899				2475	9813	22.3
All seas.	48	81	439	952	972	531	316		3339	13935	
Oats											
no clip											72.9
Mar. 30		62	277	521					860	2844	70.2
Apr. 14		68	274	553	767				1662	6222	50.9
All seas.		65	353	618	845	718	583	586	3768	14280	
Rye											
no clip											21.0
Mar. 30		42	249	615					906	3542	10.5
Apr. 14		83	372	700	312				1467	5819	4.1
All seas.		49	269	575	298	188	174		1553	6312	

*Dry wt. corrected to 20% moisture. **Ryegrass in pounds per acre.

Graph I
Accumulative Forage Production of All Crops
Used in the Pasture Clipping Study

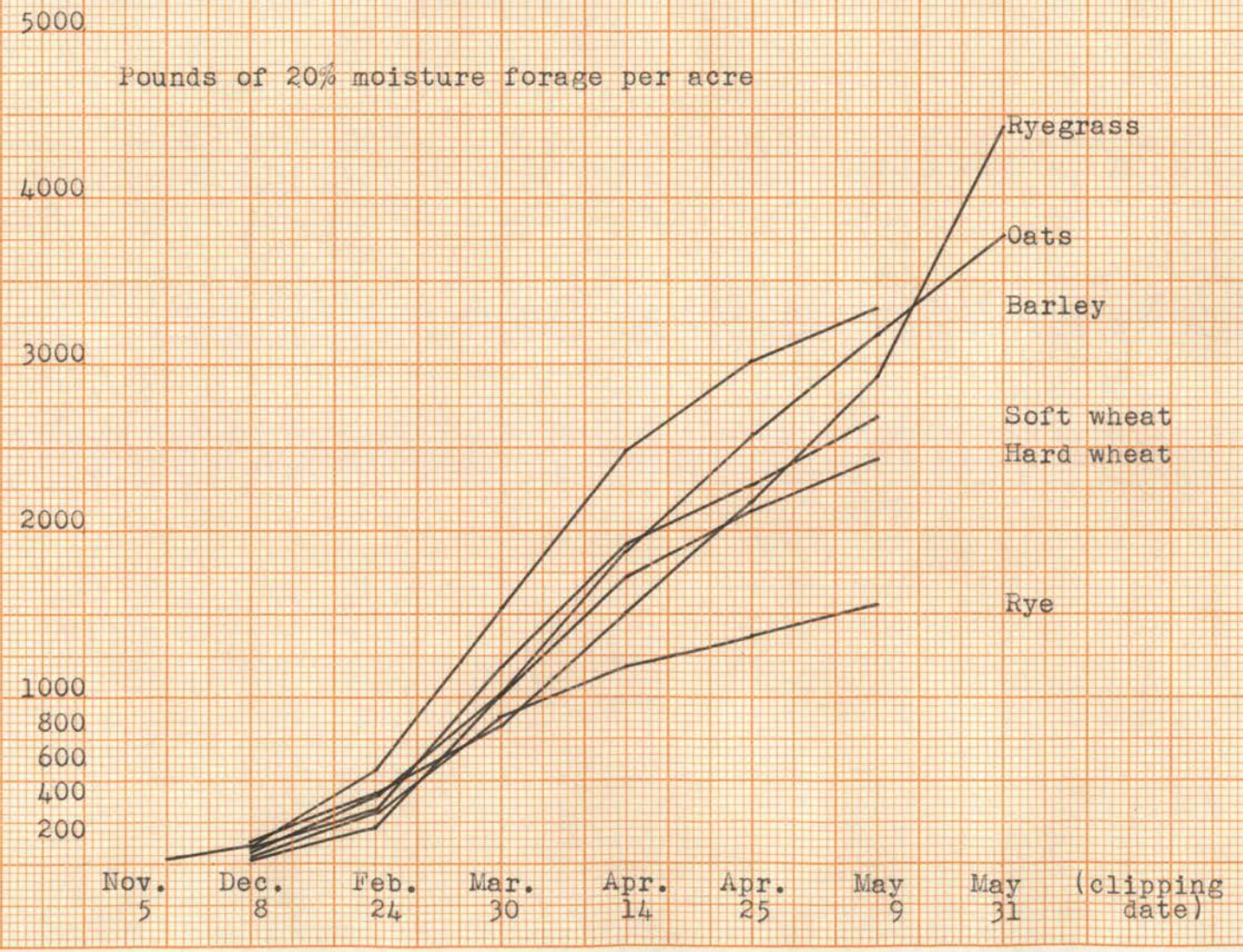
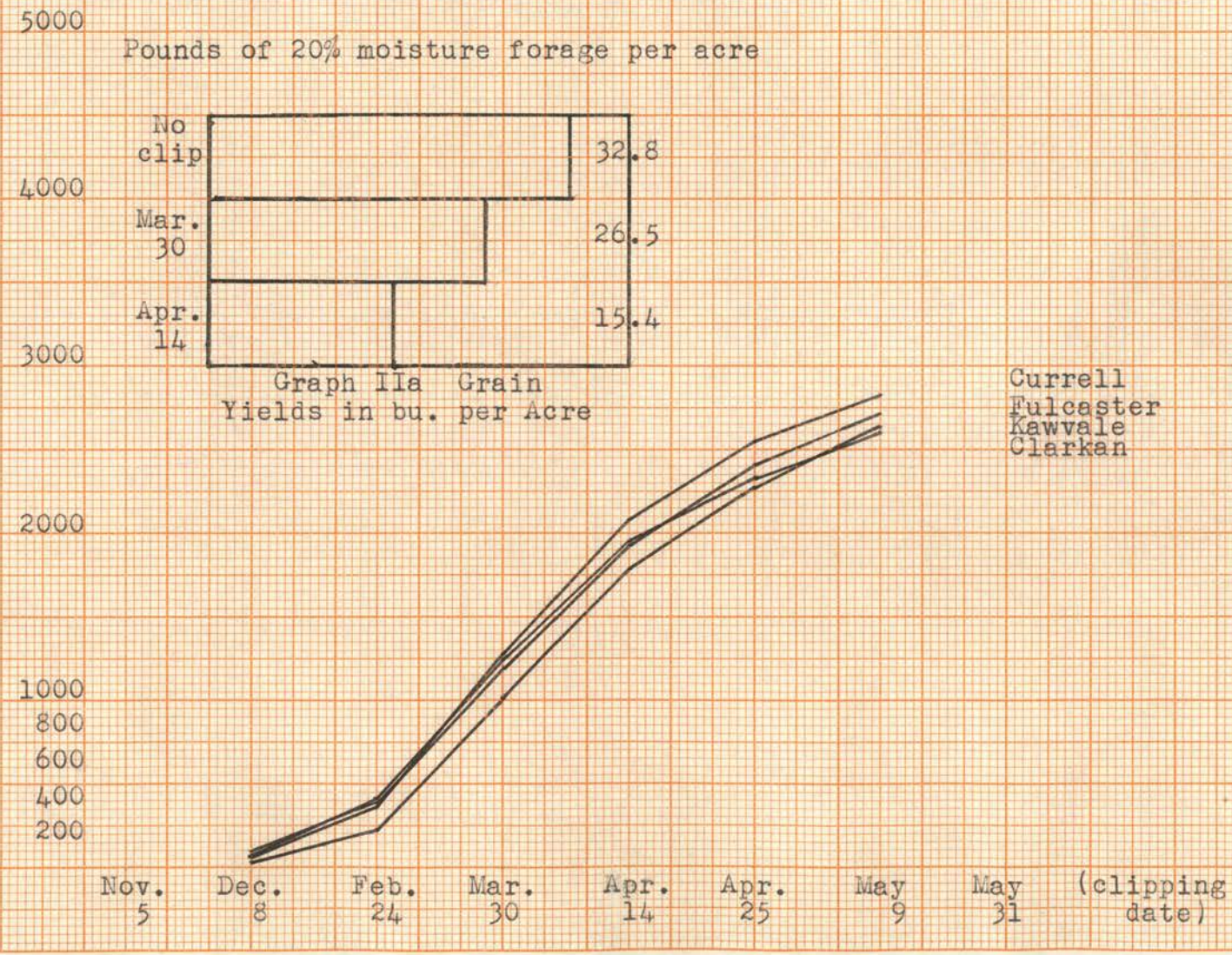


Table III
Yield of Forage* Under Different Clipping Treatments
For Each Variety by Crops
1944

Crop and Terminal Clipping Dates	Seasonal Clipping Dates Nov. 5	Dec. 8	Feb. 24	Mar. 30	Apr. 14	Apr. 25	May 9	May 31	Tot. for. dry wt. per acre	Tot. for. green wt. per acre	Grain in bu. per acre
Soft wheat											
Currell											
no clip											29.0
Mar. 30		81	327	887					1295	4594	24.7
Apr. 14		104	312	991	824				2231	8513	13.5
All seas.		58	305	935	791	461	292		2842	11113	
Fulcaster											
no clip											30.7
Mar. 30		102	304	769					1175	4085	25.0
Apr. 14		105	280	847	739				1971	7471	12.7
All seas.		100	274	824	739	475	306		2718	10763	
Clarkan											
no clip											33.0
Mar. 30		87	236	786					1109	3890	25.3
Apr. 14		63	262	855	658				1838	6968	14.5
All seas.		85	282	898	677	403	259		2604	10273	
Kawvale											
no clip											38.5
Mar. 30		51	191	728					970	3471	30.8
Apr. 14		57	244	956	826				2083	7936	20.7
All seas.		50	179	779	790	484	335		2617	10413	
Hard wheat											
Tenmarq											
no clip											34.1
Mar. 30		35	137	725					897	3015	26.9
Apr. 14		41	177	839	673				1730	6415	11.1
All seas.		32	144	786	678	379	344		2363	9007	

*Dry wt. corrected to 20% moisture.

Graph II
Soft Wheat Varieties
Accumulative Forage Yield for Entire Season



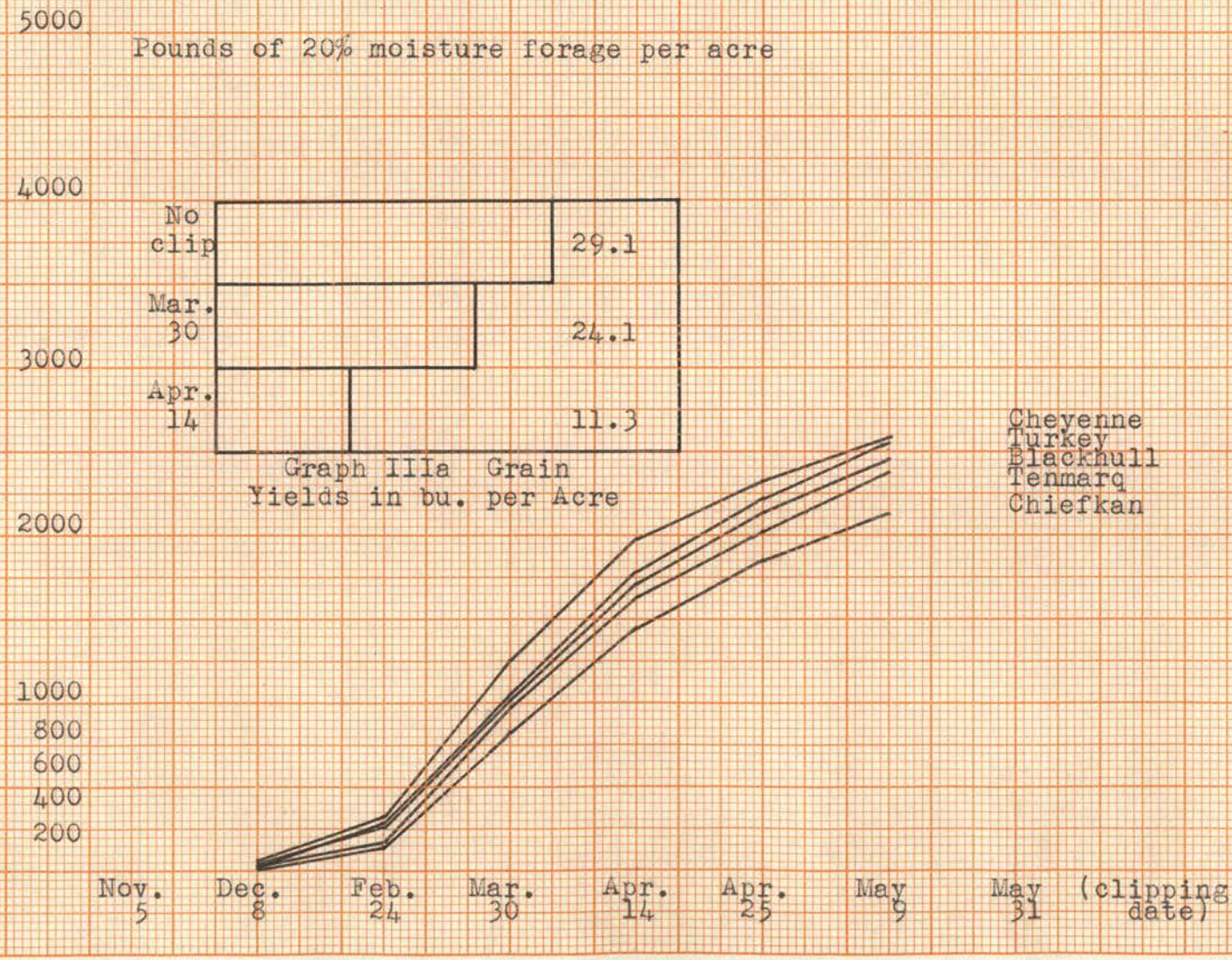
Graph IIa Grain
Yields in bu. per Acre

Table III
(continued)

Crop and Terminal Clipping Dates	Nov. 5	Seasonal Clipping Dates: Dec. 8	Feb. 24	Mar. 30	Apr. 14	Apr. 25	May 9	May 31	Tot. for. dry wt. per acre	Tot. for. green wt. per acre	Grain in bu. per acre
Hard wheat											
Blackhull											
no clip											30.7
Mar. 30		47	262	890					1199	4129	25.2
Apr. 14		70	288	840	739				1937	7201	12.7
All seas.		35	220	774	703	416	304		2452	9502	
Cheyenne											
no clip											28.9
Mar. 30		40	245	835					1120	3981	23.9
Apr. 14		59	317	967	711				2054	7795	10.3
All seas.		42	300	911	723	338	282		2596	10303	
Turkey											
no clip											26.3
Mar. 30		35	213	756					1004	3538	23.5
Apr. 14		51	245	849	758				1903	7158	11.5
All seas.		32	227	779	752	427	367		2584	9847	
Chiefkan											
no clip											25.6
Mar. 30		18	113	586					717	2514	21.1
Apr. 14		26	119	592	585				1322	5044	10.8
All seas.		18	132	683	617	402	276		2128	8398	
Ryegrass*											
no clip											371.5
Mar. 30		124	272	471					867	2910	405.0
Apr. 14		160	376	608	714				1858	6884	492.0
All seas.		135	308	381	681	667	752	1519	4443	18153	

*Ryegrass in pounds per acre.

Graph III
Hard Wheat Varieties
Accumulative Forage Yield for Entire Season

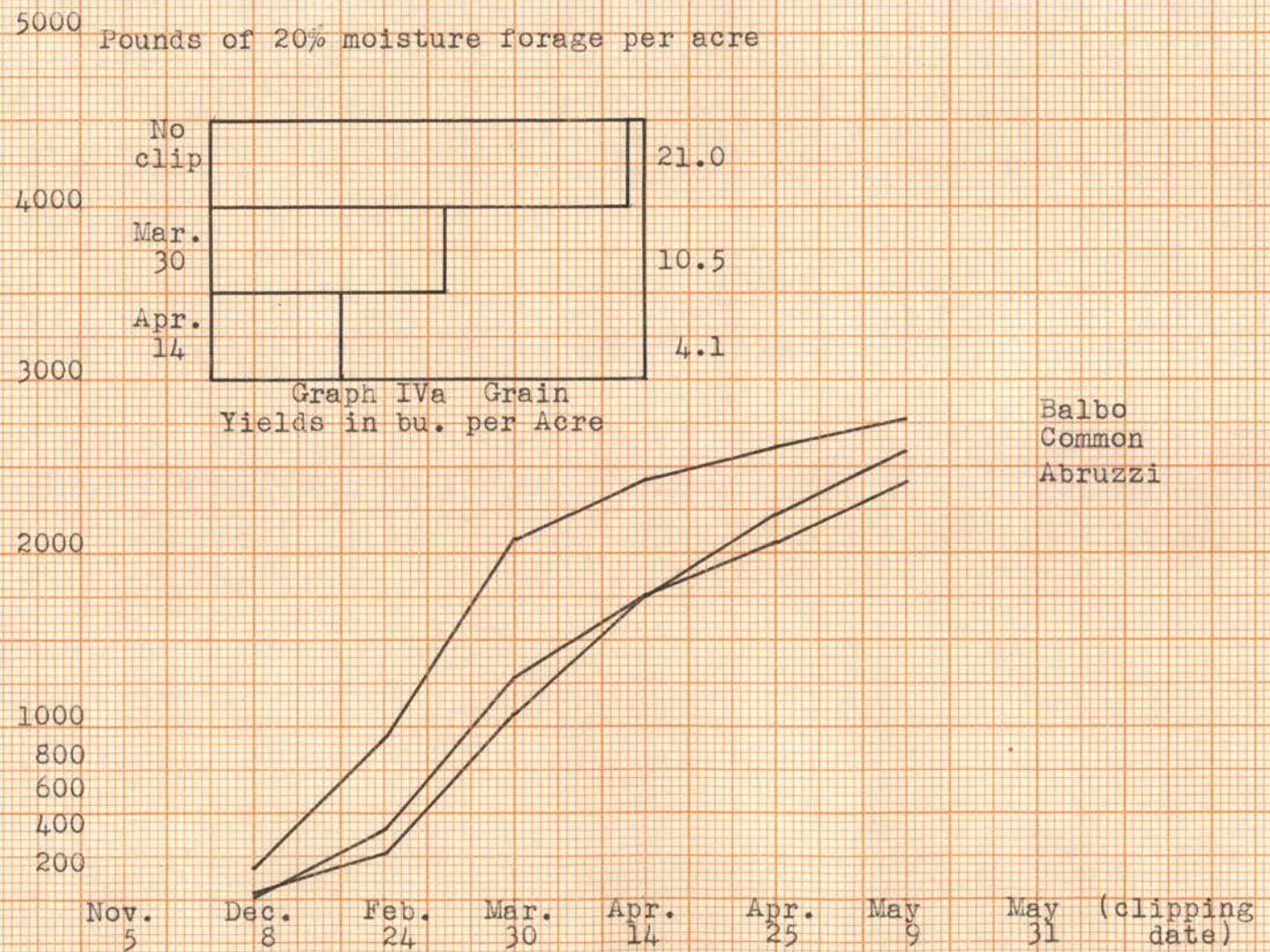


Graph IIIa Grain
Yields in bu. per Acre

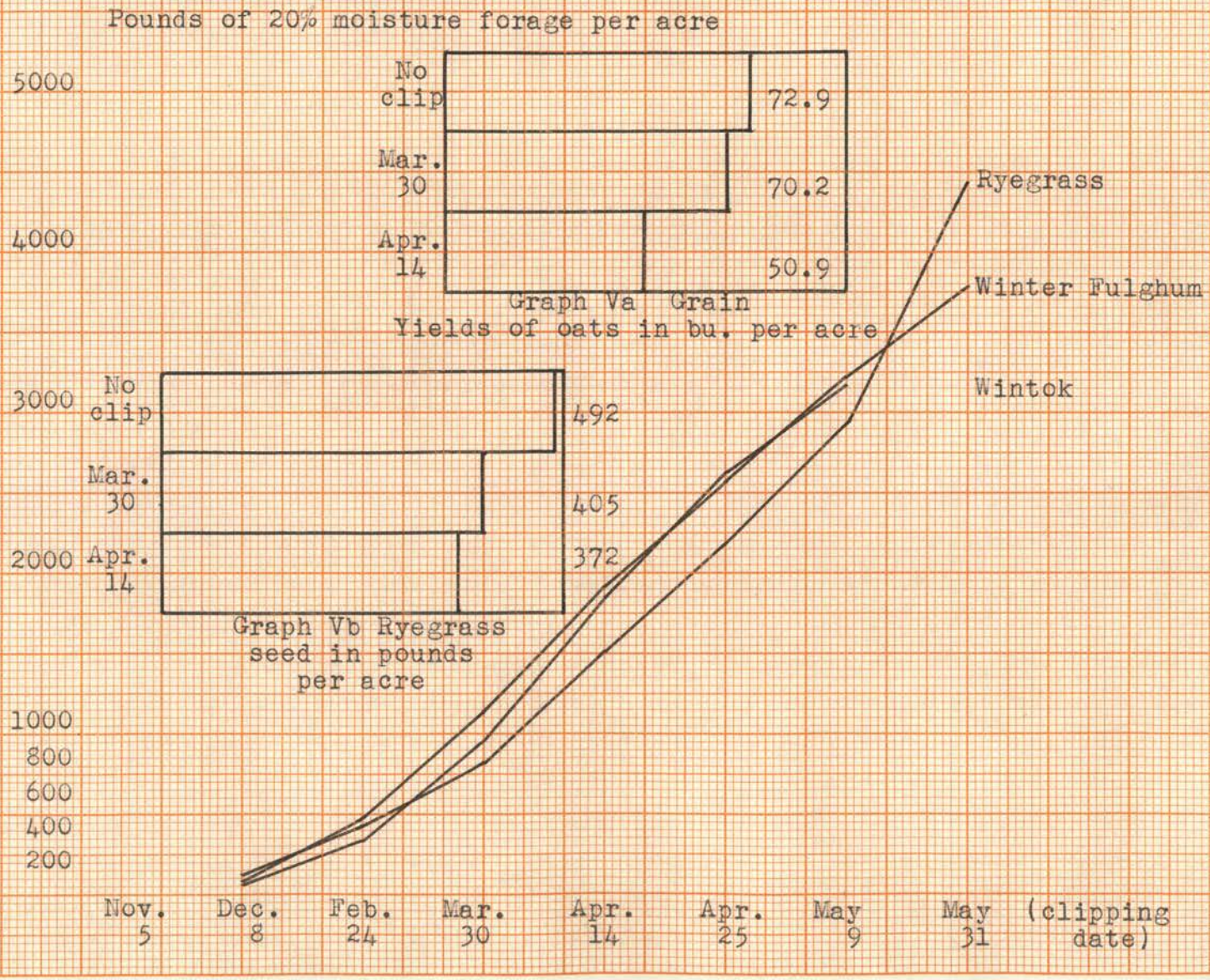
Table III
(continued)

Crop and Terminal Clipping Dates	Seasonal Clipping Dates: Nov. 5	Dec. 8	Feb. 24	Mar. 30	Apr. 14	Apr. 25	May 9	May 31	Tot. for. dry wt. per acre	Tot. for. green wt. per acre	Grain in bu. per acre
Rye											
Abruzzi											
no clip											36.5
Mar. 30		28	359	1007					1394	5696	20.7
Apr. 14		56	616	1078	526				2276	8949	9.7
All seas.		30	373	895	459	297	358		2412	9850	
Common											
no clip											35.4
Mar. 30		36	199	818					1053	3920	19.6
Apr. 14		58	316	1026	674				2074	8281	6.3
All seas.		38	221	816	677	477	364		2593	10513	
Balbo											
no clip											33.1
Mar. 30		147	685	1251					2083	8096	12.4
Apr. 14		300	930	1395	359				2984	11865	4.4
All seas.		179	749	1166	353	168	146		2761	11197	
Oats											
Wintok											
no clip											76.3
Mar. 30		56	247	472					775	2607	76.9
Apr. 14		51	235	519	804				1609	6087	54.7
All seas.		53	293	605	899	769	543		3162	12945	
Wint. Fulghum											
no clip											69.6
Mar. 30		68	307	570					945	3082	63.5
Apr. 14		86	314	588	731				1719	6357	47.2
All seas.		77	414	632	792	667	623	586	3791	15615	

Graph IV
Rye Varieties
Accumulative Forage Yield for Entire Season



Graph V
Oat Varieties and Ryegrass
Accumulative Forage Yield for Entire Season



Graph Va Grain
Yields of oats in bu. per acre

Graph Vb Ryegrass
seed in pounds
per acre

Table III
(continued)

Crop and Terminal Clipping Dates	Seasonal Clipping Dates: Nov. 5	Dec. 8	Feb. 24	Mar. 30	Apr. 14	Apr. 25	May 9	May 31	Tot. for. dry wt. per acre	Tot. for. green wt. per acre	Grain in bu. per acre
Barley											
Tenkow											
no clip											45.3
Mar. 30	54	77	500	990					1621	5998	45.0
Apr. 14	54	84	485	973	815				2411	9606	21.9
All seas.	51	75	483	957	855	338	232		2991	12450	
Mich. Winter											
no clip											42.2
Mar. 30	43	79	332	711					1165	4130	44.4
Apr. 14	47	68	406	712	1000				2233	8776	27.4
All seas.	44	99	380	771	1029	744	379		3446	14543	
Ward											
no clip											41.1
Mar. 30	55	103	470	1102					1730	5959	45.8
Apr. 14	69	107	548	1180	997				2901	11228	31.5
All seas.	55	105	502	1121	1077	609	338		3807	15714	
M.E. Beardless											
no clip											27.9
Mar. 30	41	78	413	1273					1805	6497	31.2
Apr. 14	44	75	461	1132	935				2647	10344	19.2
All seas.	42	72	399	1105	1053	511	333		3515	14329	
Manchuria											
no clip											39.9
Mar. 30	47	67	376	791					1281	5007	42.4
Apr. 14	48	71	415	904	750				2188	9113	11.4
All seas.	48	54	429	805	846	453	298		2933	12640	

Graph VI
Barley Varieties
Accumulative Forage Yield for Entire Season

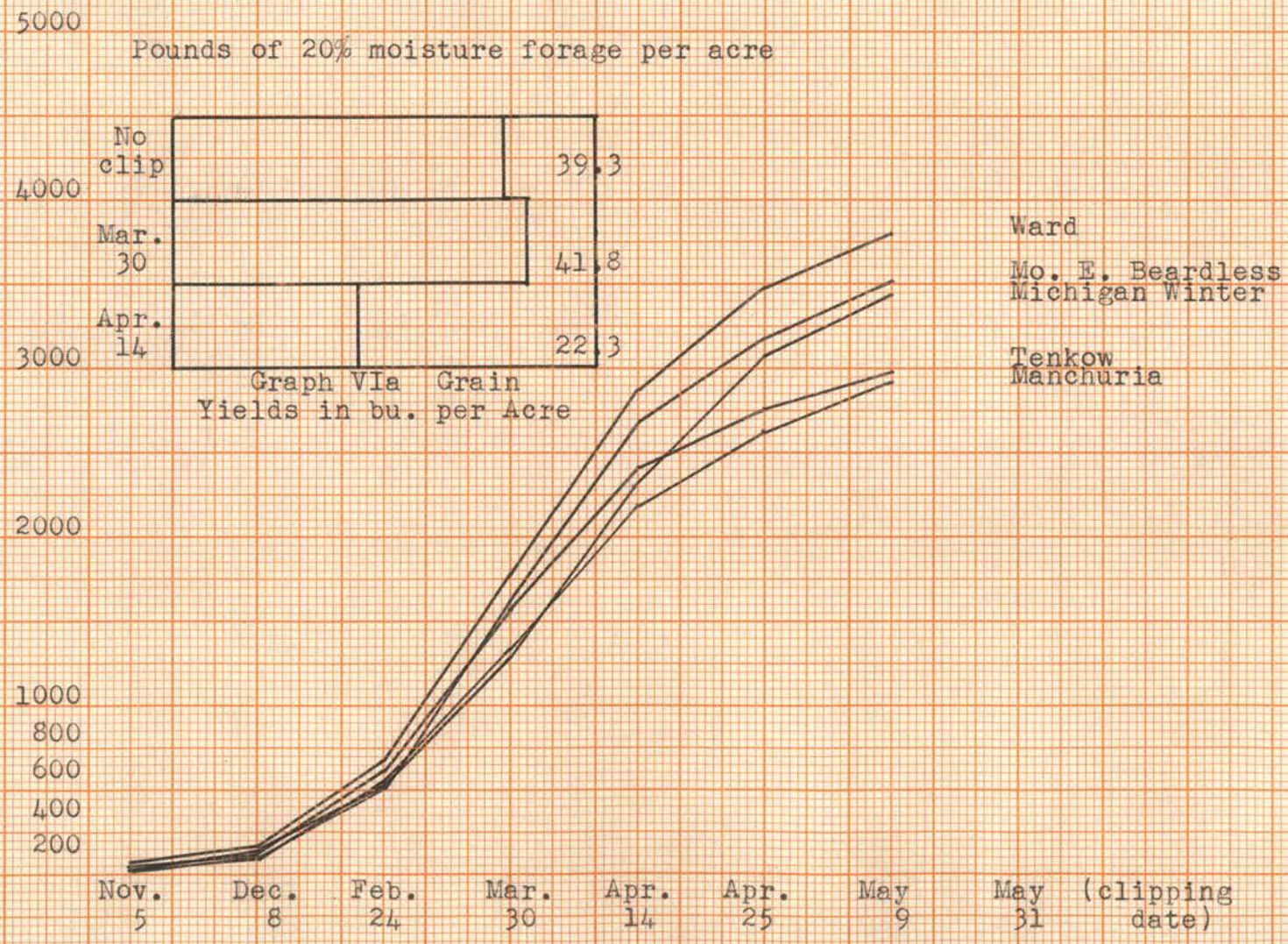


Table IV
Yields of Grain and Forage* Made by Each Crop
(Average of 2 years 1943-44)

Crop and Terminal Clipping Dates	Total forage dry wt. per acre			Total forage gr. wt. per acre			Grain in bushels per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Soft wheat									
no clip							7.8	32.8	20.3
Mar. 30	419	1138	778	1396	4009	2702	6.6	26.5	16.5
Apr. 14	1309	2031	1670	4465	7722	6093	1.2	15.4	8.3
All seas.	1574	2695	2134	5204	10640	7922			
Hard wheat									
no clip							8.7	29.1	18.9
Mar. 30	402	987	694	1468	3435	2451	6.8	24.1	15.4
Apr. 14	1322	1788	1555	4396	6722	5554	0.8	11.3	6.0
All seas.	1722	2426	2074	5453	9411	7432			
Ryegrass									
no clip							899**	372	635
Mar. 30	486	867	676	1689	2910	2299	940	405	672
Apr. 14	1211	1858	1534	4648	6884	5766	981	492	736
All seas.	4568	4443	4505	18095	18153	18124			
Barley									
no clip							16.6	39.3	27.9
Mar. 30	810	1520	1165	3733	5518	4630	11.3	41.8	26.5
Apr. 14	1873	2475	2174	8150	9813	8981	1.0	22.3	11.6
All seas.	1579	3339	2459	6516	13935	10225			
Oats									
no clip							15.5	72.9	44.2
Mar. 30	746	860	803	2984	2844	2914	28.0	72.0	50.0
Apr. 14	1631	1662	1646	6433	6222	6327	14.2	50.9	32.5
All seas.	2666	3768	3216	9615	14280	11947			
Rye									
no clip							23.6	21.0	22.3
Mar. 30	1150	906	1028	4180	3542	3861	15.8	10.5	13.1
Apr. 14	3551	1467	2509	13211	5819	9515	0.1	4.1	2.1
All seas.	3688	1553	2620	13222	6312	9767			

* Dry weight corrected to 20% moisture. ** Ryegrass in pounds per acre.

Graph VII
Accumulative Forage Production of All
Crops Used in Pasture Clipping Study
(Ave. of 2 yrs. 1943-44)

Table V
Yield of Grain and Forage Produced Under
Different Clipping Treatments
Average of 2 years 1943-44

Crop and Terminal Clipping Dates	Total forage dry wt. in pounds per acre*			Total forage gr. wt. in pounds per acre			Grain in bu. per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Soft wheat									
Currell									
no clip							7.2	29.0	18.1
Mar. 30	376	1295	836	1254	4594	2924	6.2	24.7	15.4
Apr. 14	1117	2231	1674	3831	8513	6172	1.1	13.5	7.3
All seas.	1443	2842	2127	4708	11113	7910			
Fulcaster									
no clip							5.2	30.7	17.9
Mar. 30	283	1175	729	876	4085	2480	5.5	25.0	15.2
Apr. 14	1022	1971	1496	3418	7471	5444	1.0	12.7	6.8
All seas.	1324	2718	2021	4233	10763	7498			
Clarkan									
no clip							9.2	33.0	21.1
Mar. 30	425	1109	767	1429	3890	2659	6.9	25.3	16.1
Apr. 14	1185	1838	1511	4099	6968	5533	1.6	14.5	8.0
All seas.	1461	2604	2032	4931	10273	7602			
Kawvale									
no clip							9.5	38.5	24.0
Mar. 30	594	970	782	2025	3471	2748	7.7	30.8	19.2
Apr. 14	1911	2083	1997	6512	7936	7224	1.0	20.7	10.8
All seas.	2107	2617	2362	6944	10413	8678			

* Dry weight corrected to 20% moisture hay.

Table V
(continued)

Crop and Terminal Clipping Dates	Total forage dry wt. in pounds per acre			Total forage gr. wt. in pounds per acre			Grain in bu. per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Hard wheat									
Tenmarq									
no clip							7.4	34.1	19.2
Mar. 30	458	897	677	1628	3015	2321	6.3	26.9	16.6
Apr. 14	1312	1730	2521	4539	6415	5477	0.4	11.1	5.7
All seas.	1981	2363	2172	6433	9007	7720			
Blackhull									
no clip							11.6	30.7	21.1
Mar. 30	512	1199	855	1722	4129	2925	7.9	25.2	16.5
Apr. 14	1355	1937	1646	4414	7201	5807	0.6	12.7	6.6
All seas.	1560	2452	2006	4965	9502	7233			
Cheyenne									
no clip							9.7	28.9	19.3
Mar. 30	383	1120	751	1382	3981	2681	7.9	23.9	15.9
Apr. 14	1195	2054	1624	4006	7795	5900	1.6	10.3	5.9
All seas.	1554	2596	2075	4825	10303	7564			
Turkey									
no clip							6.2	26.3	16.2
Mar. 30	341	1004	672	1088	3538	2313	5.2	23.5	14.3
Apr. 14	1424	1903	1663	4624	7158	5891	0.6	11.5	6.0
All seas.	1787	2584	2185	5590	9847	7718			
Chiefkan									
no clip							4.6	25.6	15.1
Mar. 30	85	717	406	243	2514	1378	5.5	21.1	13.3
Apr. 14	630	1322	976	2084	5044	3564	1.5	10.8	6.1
All seas.	1111	2128	1619	3525	8398	5961			

Graph VIII
Wheat Varieties
Accumulative Forage Yield for Entire Season
(Ave. of 2 years, 1943-44)

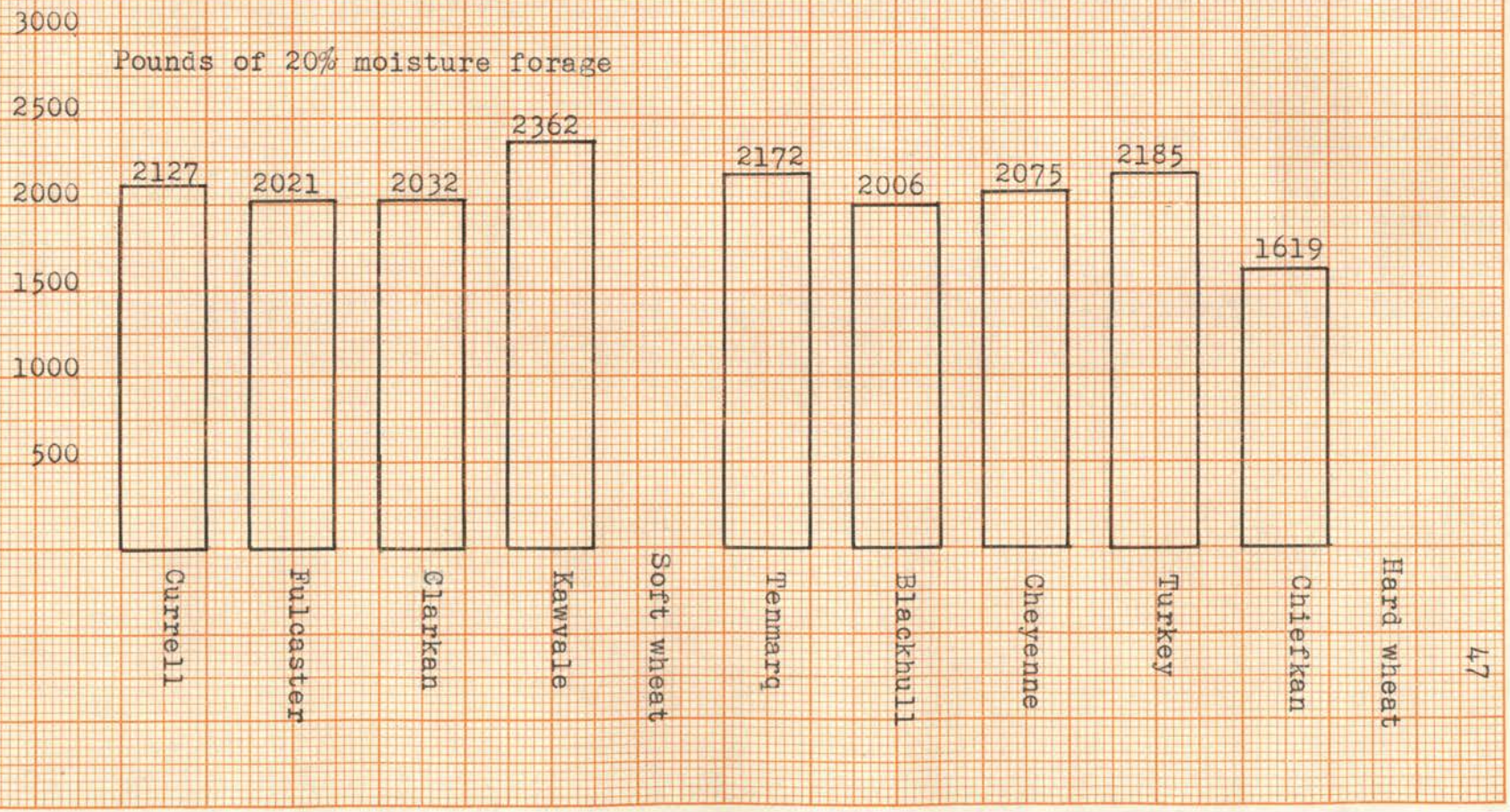


Table V
(continued)

Crop and Terminal Clipping Dates	Total forage dry wt. in pounds per acre			Total forage gr. wt. in pounds per acre			Grain in bu. per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Rye									
Abruzzi									
no clip							27.0	36.5	31.7
Mar. 30	1259	1394	1326	4699	5696	5197	16.3	20.7	18.5
Apr. 14	3530	2276	2903	13858	8949	11403	0.6	9.7	5.1
All seas.	3866	2412	3139	14489	9850	12169			
Common									
no clip							24.5	35.4	29.9
Mar. 30	771	1053	912	2555	3920	3237	18.2	19.6	18.9
Apr. 14	2892	2074	2483	11264	8281	9772	1.2	6.3	3.7
All seas.	3334	2593	2963	11686	10513	11099			
Balbo									
no clip							19.3	33.1	26.2
Mar. 30	1419	2083	1751	5286	8096	6692	13.0	12.4	12.7
Apr. 14	4230	2984	3607	14512	11865	13188	0.4	4.4	2.4
All seas.	3863	2761	3312	13490	11197	12343			

Graph IX
Barley and Rye Varieties
Accumulative Forage Yield for Entire Season
(Ave. of 2 years, 1943-44)

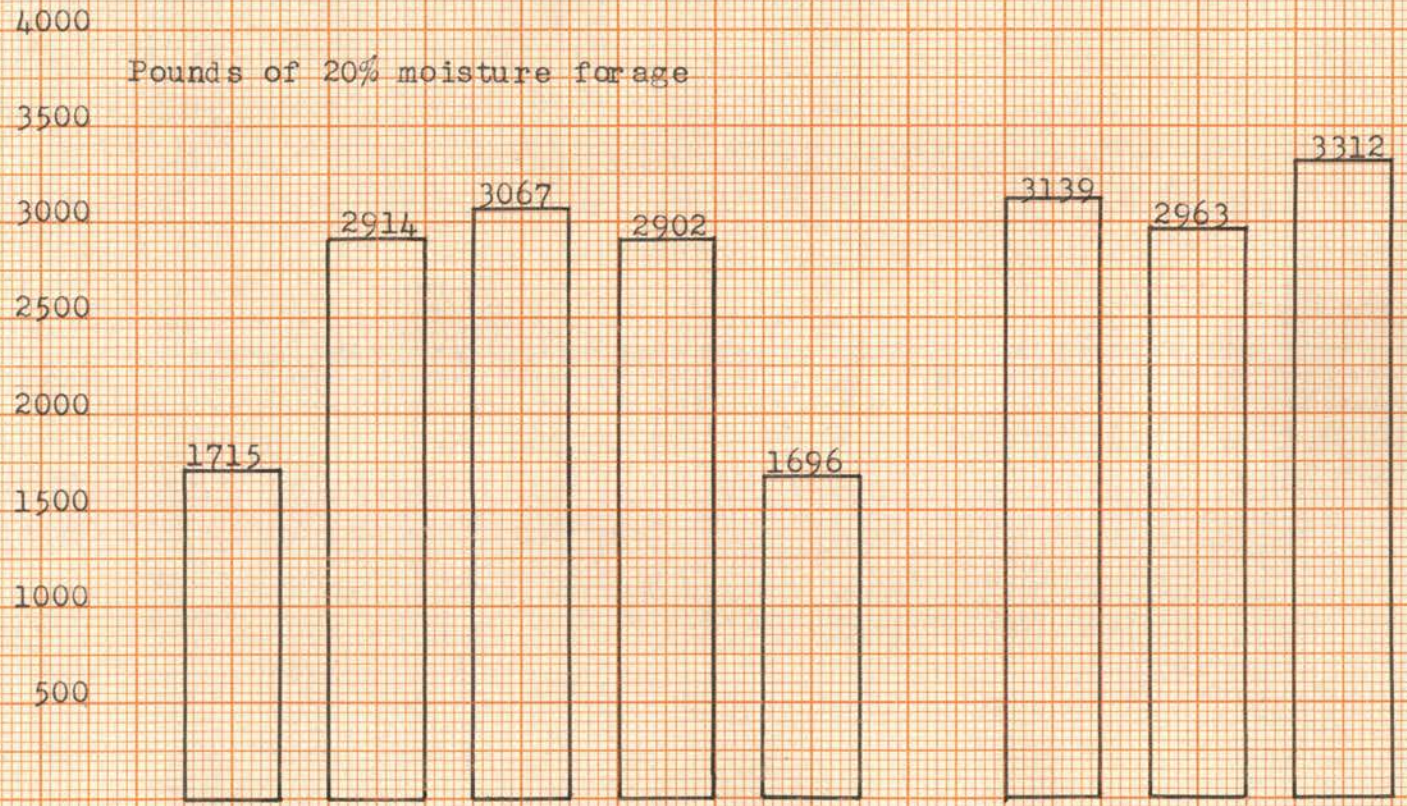


Table V
(continued)

Crop and Terminal Clipping Dates	Total forage dry wt. in pounds per acre			Total forage gr. wt. in pounds per acre			Grain in bu. per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Barley									
Tenkow									
no clip							0*	45.3	22.6
Mar. 30	462	1621	1441	2315	5998	4156	0	45.0	22.5
Apr. 14	637	2411	1524	3231	9606	6418	0	21.9	10.9
All seas.	440	2991	1715	2207	12450	7328			
Mich. Wint.									
no clip							24.7	42.2	33.4
Mar. 30	1109	1165	1137	4850	4130	4490	27.6	44.4	36.0
Apr. 14	2738	2233	2485	11385	8776	10080	1.9	27.4	14.6
All seas.	2382	3446	2914	9590	14543	12067			
Ward									
no clip							22.0	41.1	31.5
Mar. 30	1046	1730	1388	4462	5959	5210	20.2	45.8	33.0
Apr. 14	2750	2901	2825	11113	11228	11170	2.2	31.5	16.8
All seas.	2328	3807	3067	9011	15714	12362			
M.E. Beardless									
no clip							11.1	27.9	19.5
Mar. 30	914	1805	1359	4175	6497	5334	8.8	31.2	20.0
Apr. 14	2706	2647	2676	11481	10344	10912	1.0	19.2	10.1
All seas.	2289	3515	2902	9182	14329	11755			
Manchuria									
no clip							0*	39.9	19.9
Mar. 30	514	1281	897	2864	5007	3935	0	42.4	21.2
Apr. 14	628	2188	1408	3540	9113	6326	0	11.4	5.7
All seas.	460	2933	1696	2590	12640	7615			

* Winter killed.

Table V
(continued)

Crop and Terminal Clipping Dates	Total forage dry wt. in pounds per acre			Total forage gr. wt. in pounds per acre			Grain in bu. per acre		
	1943	1944	Average	1943	1944	Average	1943	1944	Average
Oats									
Wintok									
no clip							17.7	76.3	47.0
Mar. 30	764	775	769	2633	2607	2620	24.4	76.9	50.6
Apr. 14	2132	1609	1870	7886	6087	6986	6.4	54.7	30.5
All seas.	2638	3162	2900	9122	12945	11033			
Wint. Fulghum									
no clip							22.5	69.6	46.0
Mar. 30	872	945	908	3347	3082	3214	38.3	63.5	50.9
Apr. 14	1943	1719	1831	7525	6357	6941	19.0	47.2	33.1
All seas.	2990	3791	3390	10793	15615	13204			
Ryegrass									
no clip							899*	372	635
Mar. 30	486	867	676	1689	2910	2299	940	305	672
Apr. 14	1211	1858	1534	4648	6884	5766	981	492	736
All seas.	4568	4443	4505	18095	18153	18124			

* Ryegrass in pounds per acre.

Graph X
Oat Varieties and Ryegrass
Accumulative Forage Yield for Entire Season
(Ave. of 2 years, 1943-44)

Table VI
Test Weight (Pounds per Bushel) for the Individual Crop Varieties under Different Clipping Treatments - 1944

Clipping Period	Soft Wheat Varieties				Hard Wheat Varieties				
	Currell	Fulcaster	Clarkan	Kawvale	Tenmarq	Blackhull	Cheyenne	Turkey	Chiefkan
no clipping	59.0	56.9	61.0	58.6	58.5	60.0	58.9	57.4	58.2
March 30	56.8	55.5	58.7	57.3	57.0	58.7	57.2	56.1	57.4
April 14	53.2	52.1	57.1	54.6	52.2	57.3	55.1	54.3	54.8

Clipping Period	Rye Varieties			Oat Varieties		Ryegrass
	Abruzzi	Common	Balbo	Wintok	Winter Fulghum	
no clipping	54.4	53.5	51.1	32.6	29.4	19.1
March 30	52.4	51.3	49.1	31.3	29.4	18.7
April 14	49.8	49.6	47.5	30.2	26.4	18.9

Clipping Period	Barley Varieties				
	Tenkow	Mich. Winter	Ward	Mo. E. Beardless	Manchuria
no clipping	43.0	40.5	41.4	38.7	40.2
March 30	46.1	42.1	41.1	36.3	41.1
April 14	42.5	42.8	43.6	37.6	38.6

Quality of Grain Produced under Different Treatments 1944

The test weight of all varieties in the non-clipped plots, with the exception of Ward and Michigan Winter barley, was higher than either of the clipping dates. These two varieties were heavier in the later clippings. Of the wheats, Clarkan (soft wheat) and Blackhull (hard wheat) produced the best quality of grain and higher test weight in all treatments. The April 14th treatment showed a slight increase of test weight in ryegrass. Of the rye varieties, Abruzzi and Common showed better quality of grain than Balbo. The test weight of the oat varieties was slightly reduced by clipping, but was less affected than most of the other crops. Because of an exceptional amount of straw the non-clipped plots of barley lodged rather severely. All of the barley varieties were higher in test weight on the March 25th treatment with the exception of Ward and Michigan Winter.

Type of Growth Study of the Small Grains and Ryegrass

Little information is available on the type of growth made by varieties of each of the small grain crops, and the effect of clipping on winter hardiness. Some farmers contend that the erect growing plants furnish more forage and can more easily be grazed by livestock but are less winter hardy. Cross[65] in Oklahoma states that the more prostrate

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[65] C. B. Cross. Unpublished Data on the Type of Growth of Small Grains. Oklahoma A. and M. College, Stillwater, 1933-35.

wheat varieties had a higher percent survival than the erect growing varieties during the fall and winter of 1934-35. It has been found that growth habit may be changed by moving a plant from one region to another. Dodson[66] reports that rye from the North, when planted in Louisiana in the fall, will spread close to the ground, the leaves lying too flat to afford grazing, while rye from the South stands more erect and furnishes excellent grazing all season for all classes of livestock.

Jones[67] of Oklahoma in 1943 concluded that clipping had a tendency to produce a more prostrate growth and a higher percent survival in all the crops. The growth habit assumed by most varieties was erect in the early fall stage, semi-prostrate during the winter, and erect during the spring, as well as during the tillering period. Two oat varieties (Winter Fulghum and Lee), and two barley varieties (Manchuria and Tenkow) of the erect type showed heavy winter killing; however, Michigan Winter, Missouri Early Beardless, and Ward barleys of the erect type showed very little winter killing. Balbo and Abruzzi rye were approximately of the same growth type as Winter Fulghum and Lee, but no winter killing was

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[66] W. R. Dodson. Forage Crops, Grasses, Alfalfa, Clovers, etc. Louisiana Experiment Station Bulletin 72, 2nd Series.

[67] Melvin D. Jones. The Relative Forage Production of Twenty Winter Small Grain Varieties and Italian Ryegrass (Loluim multiflorum), and How Forage and Grain Yields are Affected by Dates of Clipping. Submitted to the Agronomy Department, Oklahoma A. & M. College as part of Requirement for M.S. Degree, 1943.

observed. This is an indication that type of growth is not the only factor in survival of the winter small grains. However, when varieties of the same crop are compared, there tends to be a higher survival in the more prostrate types. Turkey wheat, Ward barley, Wintok oats, and Common rye were the most prostrate varieties of each crop in this study, and less winter killing was observed.

The writer observed practically the same thing. However, the winter of 1943-44 was considerably milder than the previous year, and fortunately only one variety winter killed. This variety was Lee Winter Oats.

Chemical Analyses of the Pasture Crops

After each clipping an oven-dried sample of the material was analysed for water content, ash, fat, fiber, protein, nitrogen-free-extract, and in some cases calcium and phosphorus (Tables VII, VIII, and IX).

In the early fall, while the crops were young and tender, a high protein, fat, nitrogen-free-extract, and low fiber content was found. As the season advanced and the crops matured there was a decrease in protein, fat, nitrogen-free-extract, and an increase in fiber. The ash content varied throughout the season, but a slight increase was noticeable as the crops matured. The percentage of calcium and phosphorus seemed to be considerably higher in the spring than in the fall.

After the freeze of March 29, 1944, a definite decrease in the percentage of ash, fat, protein, calcium, and phos-

phorus, along with an increase in fiber occurred. Throughout the season, Kawvale soft wheat was high in protein percentage. It was also high in fiber. Fulcaster was high in fat and nitrogen-free-extract, while Clarkan led in the percentage of ash. Of the hard wheats, Tenmarq was high in protein and fiber, Chiefkan high in ash, fat, and nitrogen-free-extract. In the rye varieties, Common was high in protein and Balbo high in ash, fat, nitrogen-free-extract, and fiber. Of the barley varieties, Tenkow was high in protein, and fiber, Michigan Winter in fat, Ward in ash, and Missouri Early Beardless in nitrogen-free-extract. Of the oat varieties, Wintok was high in protein, fat, and lowest in fiber, but was surpassed by Winter Fulghum in ash and nitrogen-free-extract.

An average of all varieties within the crop showed rye to be the outstanding crop as far as chemical analyses were concerned. Rye was high in protein, fat, calcium, and phosphorus, but was also high in fiber. Barley was low in fiber, and oats was high in nitrogen-free-extract. Ryegrass compared very favorably with the small grains, but was lowest in percentage of protein.

Table VII
Chemical Analysis Expressed in Percentage

Missouri Early Beardless Barley

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	82.8	14.38	5.85	11.64	28.10	40.00
Dec. 8	80.9	15.66	5.97	10.55	32.55	35.24
Feb. 24	75.0	13.63	3.00	12.41	34.47	36.58
Mar. 30	76.9	9.46	4.49	16.40	27.27	42.42
Apr. 14	81.4	11.83	5.48	20.54	25.94	36.18
Apr. 25	82.1	18.09	4.11	19.74	24.75	33.20
May 9	82.5	19.11	3.57	17.44	29.56	30.18
May 31	----	-----	----	-----	-----	-----
Ave.	80.2	14.59	4.64	15.53	28.95	36.26

Tenkow Barley

Nov. 5	83.7	13.83	5.77	12.13	35.04	33.25
Dec. 8	80.8	16.07	5.17	12.75	31.70	34.27
Feb. 24	75.0	13.15	2.87	15.16	34.49	34.30
Mar. 30	77.9	9.26	4.20	23.19	28.52	34.87
Apr. 14	81.6	12.53	5.26	20.69	27.01	34.49
Apr. 25	83.3	20.10	3.43	20.41	26.73	29.26
May 9	80.5	19.71	4.75	19.21	30.73	25.57
May 31	----	-----	----	-----	-----	-----
Ave.	80.4	14.95	4.49	17.65	30.60	32.29

Table VII
(continued)

Manchuria Barley

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	84.4	12.39	6.28	11.40	35.13	34.79
Dec. 8	81.4	19.06	5.60	10.81	31.29	33.27
Feb. 24	77.6	14.09	3.61	14.09	33.02	35.24
Mar. 30	78.1	9.74	4.13	17.84	28.11	40.18
Apr. 14	82.2	11.85	5.32	20.36	26.07	35.85
Apr. 25	83.2	17.73	3.05	20.88	24.63	33.69
May 9	81.3	19.62	4.10	19.73	29.70	26.79
May 31	----	-----	----	-----	-----	-----
Ave.	81.2	14.93	4.58	16.44	29.71	34.26

Ward Barley

Nov. 5	83.4	14.41	6.67	11.00	35.88	23.03
Dec. 8	80.6	14.36	5.99	11.38	32.94	35.30
Feb. 24	75.0	15.81	3.02	13.09	33.36	34.73
Mar. 30	75.0	10.44	4.34	16.92	29.57	38.72
Apr. 14	82.3	12.39	6.00	13.63	26.05	41.95
Apr. 25	82.3	19.24	3.91	18.31	27.30	30.91
May 9	83.5	23.10	4.71	17.99	28.64	25.88
May 31	----	-----	----	-----	-----	-----
Ave.	80.3	15.68	4.95	14.62	30.53	34.22

Table VII
(continued)

Michigan Winter Barley

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	84.0	14.30	5.89	9.46	35.31	23.93
Dec. 8	80.8	15.89	5.66	11.08	32.15	35.59
Feb. 24	75.0	14.73	5.10	13.39	32.18	34.61
Mar. 30	75.9	7.76	3.28	14.04	20.49	54.40
Apr. 14	81.3	11.71	6.10	19.82	25.17	37.24
Apr. 25	82.6	16.68	5.44	19.90	25.73	33.21
May 9	82.9	19.24	5.27	19.56	27.92	28.00
May 31	----	-----	----	-----	-----	-----
Ave.	80.4	14.33	5.25	15.32	28.42	35.28

Ryegrass

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	76.9	15.23	3.72	9.87	26.52	44.64
Feb. 24	70.0	20.92	4.82	14.90	31.00	28.39
Mar. 30	76.6	11.39	3.05	13.42	21.56	50.54
Apr. 14	80.7	13.60	5.83	17.30	26.89	36.41
Apr. 25	81.9	16.78	6.13	17.81	26.98	32.34
May 9	80.3	18.55	3.74	17.94	23.43	34.02
May 31	79.9	15.70	4.00	23.00	18.40	39.26
Ave.	78.0	15.80	4.47	16.32	24.97	37.94

Table VII
(continued)

Wintok Oats

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	78.79	15.12	5.63	11.19	32.95	35.01
Feb. 24	70.4	15.79	3.50	13.98	29.21	37.51
Mar. 30	75.9	8.80	4.37	15.31	31.04	40.50
Apr. 14	80.2	10.72	5.78	19.17	28.74	35.59
Apr. 25	82.4	15.15	5.13	20.43	29.27	30.10
May 9	80.7	17.78	3.76	20.72	27.35	30.35
May 31	----	-----	----	-----	-----	-----
Ave.	78.1	13.89	4.70	16.80	29.76	34.84

Winter Fulghum Oats

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	80.4	14.65	4.94	11.82	30.82	37.78
Feb. 24	70.4	14.94	4.53	14.70	28.13	37.69
Mar. 30	74.6	7.78	3.24	14.78	22.62	51.57
Apr. 14	80.4	13.28	5.42	16.72	30.66	33.93
Apr. 25	82.6	15.13	4.69	21.05	27.97	31.14
May 9	82.7	18.19	4.02	19.57	25.89	32.27
May 31	79.9	15.70	4.00	23.00	18.40	39.26
Ave.	78.7	14.24	4.41	17.38	26.36	37.66

Table VII
(continued)

Balbo Rye

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	80.8	11.78	4.77	10.79	31.13	41.63
Feb. 24	79.0	14.15	6.43	14.28	32.41	32.71
Mar. 30	78.1	9.63	3.02	18.36	21.77	47.21
Apr. 14	81.3	16.25	6.14	17.09	31.38	29.10
Apr. 25	82.3	17.96	5.58	15.80	29.90	30.72
May 9	82.3	17.96	3.96	27.70	32.95	29.30
May 31	----	-----	----	-----	-----	-----
Ave.	80.6	14.62	4.98	17.34	29.92	35.11

Abruzzi Rye

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	78.2	12.97	5.80	9.53	31.63	40.10
Feb. 24	77.7	14.13	3.19	13.49	33.00	36.33
Mar. 30	81.3	10.12	4.05	20.91	27.24	37.67
Apr. 14	81.8	12.12	6.20	19.57	28.60	33.47
Apr. 25	82.5	16.41	4.56	18.37	28.80	31.84
May 9	74.7	17.14	5.67	22.01	27.04	28.10
May 31	----	-----	----	-----	-----	-----
Ave.	79.4	13.82	4.91	17.31	29.39	34.59

Table VII
(continued)

Common Rye

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	76.5	11.54	5.93	8.92	30.85	42.73
Feb. 24	73.4	12.45	4.03	11.81	34.06	37.60
Mar. 30	78.5	10.04	4.24	18.55	28.16	39.03
Apr. 14	80.7	13.29	5.73	18.83	30.94	31.33
Apr. 25	81.5	17.94	4.15	20.30	28.42	29.14
May 9	79.7	15.48	5.45	23.79	28.45	26.79
May 31	----	-----	----	-----	-----	-----
Ave.	78.4	13.46	4.92	17.03	30.15	34.44

Tenmarq Wheat

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	74.3	14.63	5.43	10.84	29.70	39.39
Feb. 24	73.0	15.67	2.76	12.35	33.81	35.39
Mar. 30	75.2	9.13	3.54	16.34	22.78	48.21
Apr. 14	80.5	13.84	6.24	18.93	29.80	31.23
Apr. 25	82.2	17.97	4.18	18.89	27.81	31.10
May 9	74.5	22.23	3.65	18.31	27.52	27.98
May 31	----	-----	----	-----	-----	-----
Ave.	76.2	15.58	4.30	15.94	28.57	35.55

Table VII
(continued)

Chiefkan Wheat

Date	Field H_2O	Ash	Fat	Dry Basis Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	73.0	14.82	4.47	9.89	27.98	42.82
Feb. 24	75.6	24.16	3.60	12.61	30.09	29.56
Mar. 30	76.6	11.54	4.18	16.03	27.38	52.29
Apr. 14	80.3	15.55	4.71	18.59	27.58	33.52
Apr. 25	80.7	20.20	6.51	14.31	27.27	32.66
May 9	80.3	19.60	3.97	20.67	29.13	26.62
May 31	----	-----	----	-----	-----	-----
Ave.	77.8	17.65	4.57	15.35	28.24	46.25

Cheyenne Wheat

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	75.5	14.12	4.73	10.15	28.32	42.27
Feb. 24	74.8	13.49	4.49	14.16	34.70	33.15
Mar. 30	77.1	10.77	3.87	17.00	26.68	41.67
Apr. 14	80.7	14.72	5.01	18.31	27.91	34.07
Apr. 25	82.3	21.16	3.61	20.22	28.10	26.91
May 9	80.5	18.30	4.64	18.11	30.25	26.62
May 31	----	-----	----	-----	-----	-----
Ave.	78.5	15.43	4.39	16.33	29.33	34.12

Table VII
(continued)

Turkey Wheat

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	73.4	14.60	4.22	10.30	27.31	43.49
Feb. 24	74.6	13.38	4.06	14.33	32.56	35.47
Mar. 30	76.8	11.35	4.31	17.06	26.82	40.48
Apr. 14	79.9	13.25	4.72	19.38	28.60	34.02
Apr. 25	81.4	17.12	4.68	18.56	30.29	29.29
May 9	73.7	20.51	3.56	18.64	27.96	29.27
May 31	----	-----	----	-----	-----	-----
Ave.	76.6	15.04	4.26	16.38	28.92	35.34

Blackhull Wheat

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	75.3	14.70	4.54	10.54	28.16	42.12
Feb. 24	74.0	12.50	4.49	14.23	34.30	34.50
Mar. 30	76.30	10.52	3.87	18.03	28.35	39.26
Apr. 14	80.0	13.70	5.17	19.35	28.53	33.28
Apr. 25	80.7	20.64	5.06	17.54	27.40	29.31
May 9	79.7	17.84	3.68	20.38	29.51	27.43
May 31	----	-----	----	-----	-----	-----
Ave.	77.7	14.98	4.47	16.68	29.38	34.32

Table VII
(continued)

Fulcaster Wheat

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	75.6	12.27	4.35	11.78	25.03	46.59
Feb. 24	74.2	9.45	4.36	14.82	31.79	39.57
Mar. 30	76.9	10.84	4.64	17.53	27.79	39.19
Apr. 14	80.7	12.71	6.17	19.52	29.95	31.69
Apr. 25	81.4	17.34	6.22	19.80	29.86	26.70
May 9	80.3	18.87	3.99	19.52	28.38	29.06
May 31	----	-----	----	-----	-----	-----
Ave.	78.2	13.58	4.96	17.16	28.80	35.47

Currell Wheat

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	76.0	13.91	4.55	11.49	26.26	43.79
Feb. 24	74.4	15.80	4.40	14.51	31.48	33.84
Mar. 30	77.3	11.60	4.59	18.06	26.61	39.19
Apr. 14	80.5	14.35	5.86	18.51	28.81	32.47
Apr. 25	80.7	17.91	6.11	19.50	28.25	28.13
May 9	78.9	20.86	3.57	18.15	27.81	29.53
May 31	----	-----	----	-----	-----	-----
Ave.	78.0	15.74	4.85	16.70	28.20	34.49

Table VII
(continued)

Clarkan Wheat

Date	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	74.0	13.36	4.70	10.63	27.07	44.26
Feb. 24	75.2	16.00	6.15	14.58	33.70	29.78
Mar. 30	76.6	9.07	3.03	15.69	22.21	49.97
Apr. 14	80.7	14.40	5.02	19.15	28.80	32.64
Apr. 25	81.3	20.98	4.88	19.58	27.66	26.87
May 9	81.3	22.93	3.31	18.40	26.49	27.65
May 31	----	-----	----	-----	-----	-----
Ave.	78.2	16.12	4.52	16.34	27.66	35.20

Kawvale Wheat

Nov. 5	----	-----	----	-----	-----	-----
Dec. 8	75.3	15.77	4.86	11.35	27.76	40.55
Feb. 24	74.2	14.68	4.13	13.34	33.61	34.21
Mar. 30	77.2	10.45	3.63	16.88	27.70	41.35
Apr. 14	80.0	13.93	5.34	21.10	28.49	31.12
Apr. 25	81.4	16.49	4.90	19.27	31.14	29.08
May 9	79.3	16.16	3.71	21.06	29.89	29.18
May 31	----	-----	----	-----	-----	-----
Ave.	77.9	14.58	4.43	17.17	29.77	34.25

Table VIII
Chemical Analysis
Expressed in Percentage (Ave. for entire growing season - 1943-44)

Crop	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Soft wheat						
Fulcaster	78.2	13.58	4.96	17.16	28.80	35.47
Currell	78.0	15.74	4.85	16.70	28.20	34.49
Clarkan	78.2	16.12	4.52	16.34	27.66	35.20
Kawvale	77.9	14.58	4.43	17.17	29.77	34.25
Hard wheat						
Tenmarq	76.2	15.58	4.30	15.94	28.57	35.55
Chiefkan	77.8	17.65	4.57	15.35	28.24	36.25
Cheyenne	78.5	15.43	4.39	16.33	29.33	34.12
Turkey	76.6	15.04	4.26	16.38	28.92	35.34
Blackhull	77.7	14.98	4.47	16.68	29.38	34.32
Rye						
Balbo	80.6	14.62	4.98	17.34	29.92	35.11
Abruzzi	79.4	13.82	4.91	17.31	29.39	34.59
Common	78.4	13.46	4.92	17.03	30.15	34.44

Table VIII
(continued)

Crop	Field H_2O	Dry Basis Ash	Fat	Fiber	Protein	N.F.E.
Barley						
Mich. Winter	80.4	14.33	5.25	15.32	28.42	35.28
Manchuria	81.2	14.93	4.58	16.44	29.71	34.26
Ward	80.3	15.68	4.95	14.62	30.53	34.22
Tenkow	80.4	14.95	4.49	17.65	30.60	32.29
Mo. E. Beardless	80.2	14.59	4.64	15.53	28.95	36.26
Oats						
Wintok	78.1	13.89	4.70	16.80	29.76	34.84
Winter Fulghum	78.7	14.24	4.41	17.38	26.36	37.66
Ryegrass	78.0	15.80	4.47	16.32	24.97	37.95

Table IX
Chemical Analysis of Each Crop*
Expressed in Percentage (Ave. of All Varieties)

Crop	Field H_2O	Dry Basis						
		Ash	Fat	Fiber	Protein	N.F.E.	Ca.	P.
Soft wheat	78.1	15.01	4.69	16.84	28.61	34.85	.397	.310
Hard wheat	77.4	15.74	4.40	16.13	28.88	35.12	.335	.247
Rye	79.5	13.97	4.94	17.23	29.82	34.71	.561	.317
Barley	80.5	14.90	4.78	15.91	29.64	34.46	.475	.229
Oats	78.4	14.07	4.56	17.09	28.06	36.25	.434	.264
Ryegrass	78.0	15.80	4.47	16.32	24.97	37.94	.533	.274

* The Calcium and Phosphorus contents are from Clarkan Soft Wheat, Tenmarq Hard Wheat, Balbo Rye, Michigan Winter Barley, Winter Fulghum Oats, and ryegrass respectively.

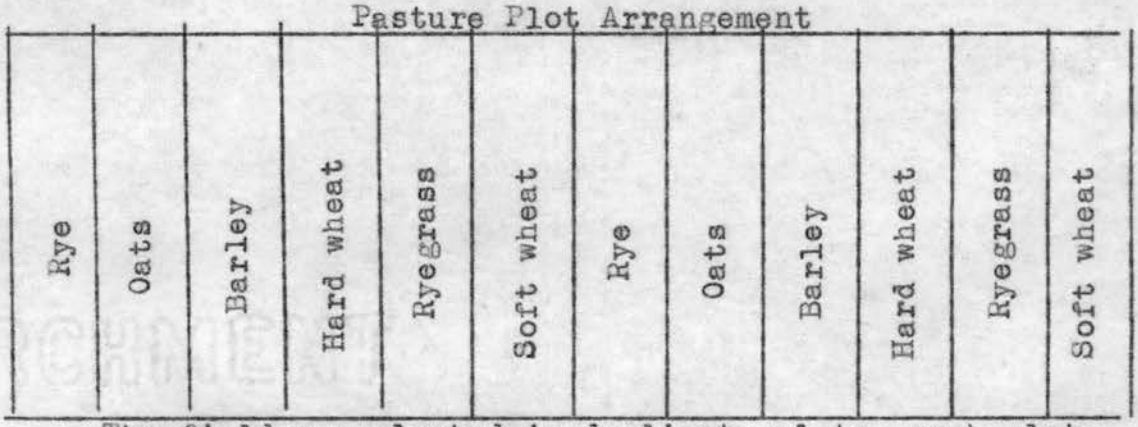
Determination of Palatability of Winter Small Grains and Ryegrass by Actual Grazing Trials, November 20, 1943 to May 15, 1944[68]

Series 5400 was planted to the following winter pasture crops October 12, 1943 for the purpose of making palatability trials. The area was planted to green mung beans in the spring of 1943. After the mung beans were harvested for seed the land was disked twice, harrowed, drilled to the pasture crops and rolled with a cultipacker. The pasture crops came up readily and made a very rapid growth.

The Varieties and Planting Rates Were

Crop	Variety	Planting Rate (Per Acre)
Rye	Balbo	1 1/4 bu.
Oats	Winter Fulghum	2 1/2 bu.
Barley	Michigan Winter	2 1/2 bu.
Soft wheat	Clarkan	1 1/2 bu.
Ryegrass		25 lbs.
Hard wheat	Tenmarq	1 1/4 bu.

Pasture Plot Arrangement



The field was planted in duplicate plots, each plot measuring approximately 48 feet by 300 feet.

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[68] Hi W. Staten. Palatability test of Winter Pasture Crops. Oklahoma Experiment Station Mimeographed Circular 115. 1944.

An electric fence was constructed on the east and north end and to divide the replications into two separate fields. The Dairy Department supplied heifers and milk cows used in grazing (Figure 7). Each cow was clocked to actual time spent on each plot, as shown in Table X.

Fall Grazing Record

A 4 1/2-inch rain occurred late in October. The month of November was warm and practically no rain occurred. Grazing started November 20th, using four two-year-old heifers (two Holsteins, one Guernsey, one Jersey) and one Jersey cow. The forage at the time grazing started was not sufficient to support many animals. The animals spent more time on barley, probably because it was larger and more easily grazed. Rye was second except in the south replication. The cows moved from plot to plot very frequently. The amount of forage seemingly was the cause for moving. No conclusions could be drawn from the fall grazing period because of the limited amount of forage.

Spring Grazing Record

The spring grazing was conducted very much like the fall grazing except mature Holstein and Guernsey cows were used. The clocking period did not start until a good growth of small grain had developed. The various crops did not develop at the same rate; therefore, some crops were ahead of others in amount of forage. The rye was perhaps too far along, while

the ryegrass was slow in starting growth. The cows could not keep ahead of the crops. However, more time was spent on soft wheat followed by oats, hard wheat, barley, ryegrass, and rye.

The crops rank as follows in the fall grazing record:

Fall

Rank	Total for all cows
1. Barley	915 minutes
2. Rye	680 "
3. Soft wheat	675 "
4. Ryegrass	644 "
5. Oats	610 "
6. Hard wheat	576 "

Spring

Rank	Total for all cows
1. Soft wheat	2678 minutes
2. Oats	2125 "
3. Hard wheat	2025 "
4. Barley	1777 "
5. Ryegrass	1371 "
6. Rye	1063 "

Entire Grazing Period

Rank	Total for all cows
1. Soft wheat	3353 minutes
2. Oats	2735 "
3. Barley	2692 "
4. Hard wheat	2601 "
5. Ryegrass	2015 "
6. Rye	1743 "

The cows showed a decided preference for barley, rye and soft wheat during the fall grazing period. The maturity factor of the rye particularly caused a short grazing period in the spring. Earlier spring grazing of the rye perhaps would have shown a different picture.

The cows, in the spring, showed a preference for the wheats, especially soft wheat, and oats, and did not select

Figure 7. Dairy Cows Grazing on the Pasture Crops.

Table X

Summary of Grazing Record - Fall and Spring

Fall Grazing - November 20 to December 2, 1943

	Rye		Oats		Barley		Hard wheat		Ryegrass		Soft wheat		Total Time
Cow	* Time	No.** Times	Time	No. Times	Time	No. Times	Time	No. Times	Time	No. Times	Time	No. Times	Total Time***
Blackey	58	7	34	11	161	21	109	26	360	40	118	19	840
Spot	107	25	234	41	265	49	104	29	68	20	62	15	840
Guernsey	109	24	162	40	228	56	194	47	66	26	71	13	840
Jersey H.	313	30	115	38	129	40	62	28	95	36	126	21	840
Jersey C.	93	14	65	26	232	44	97	31	55	23	298	27	840
TOTAL	680	100	610	156	915	210	576	161	644	145	675	95	4200

Spring Grazing - April 7 to May 15, 1944

Blackey	211	19	459	55	501	76	340	63	246	39	424	39	2181
Whitey	181	16	313	47	228	44	505	67	253	34	726	49	2206
Guernsey	361	25	693	53	356	49	453	56	183	28	164	19	2210
Jersey C.	100	13	315	40	447	55	318	65	303	44	755	48	2238
Jersey H.	210	24	345	64	245	67	409	85	386	76	609	57	2204
TOTAL	1063	97	2125	259	1777	291	2025	336	1371	221	2678	212	11039
Total Fall and Spring Grazing	1743	197	2735	415	2692	501	2601	497	2015	366	3353	307	15239

* Minutes spent on each crop. ** Number of times cows changed to other crops.

***Total minutes cows were clocked (Actual grazing time).

the barley or ryegrass as often as the other crops. Many times they would walk across these two crops and not do any grazing.

For the entire spring and fall season the cows definitely grazed more on soft wheat, followed by oats, barley, hard wheat, ryegrass, and rye. Almost twice as much time was spent on soft wheat as on rye during the entire season.

Summary and Conclusions

The clipping experiment was designed to be continued over a period of years. The data presented in this paper represents only two years, therefore, no definite conclusions can be drawn. The data presented, however, show the following:

1. Ryegrass produced the highest total forage yield, but most of the growth occurred in late spring.

2. Oats produced the highest total yield of forage of any of the small grains, followed by rye, barley, soft wheat, and hard wheat.

3. Barley produces a quick growth and high forage yield early in the fall.

4. Kawvale soft wheat, Turkey hard wheat, Balbo rye, Winter Fulghum oats, and Ward barley produced the highest forage yields of any varieties.

5. The highest grain producers were Michigan Winter barley, Wintok and Winter Fulghum oats, Abruzzi rye, Blackhull hard wheat, and Kawvale soft wheat.

6. With the exception of oats, the grain yield of all

the small grains was slightly reduced by clipping to March 30th. All small grain yields were reduced by clipping to April 14th.

7. The April 14th clipping gave the highest seed yield of ryegrass.

8. In 1944 the test weight and general quality, of all varieties with the exception of barley was lowered by late clipping.

9. Chemical analyses* show rye to be higher in protein, fat, calcium, and phosphorus but was also high in fiber. Barley was low in fiber and ryegrass low in protein. The protein content of the crops tested ran as high as 35 percent for barley, 31 percent for ryegrass and oats, 33 percent for rye and soft wheat, and 34 percent for hard wheat in their early growth.

10. In the grazing trials for the entire season 1943-44, the cows grazed more hours on the soft wheat followed by oats, barley, hard wheat, ryegrass, and rye. During the fall grazing season the cows spent more time on the barley.

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*Chemical analyses were made only in 1944.

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