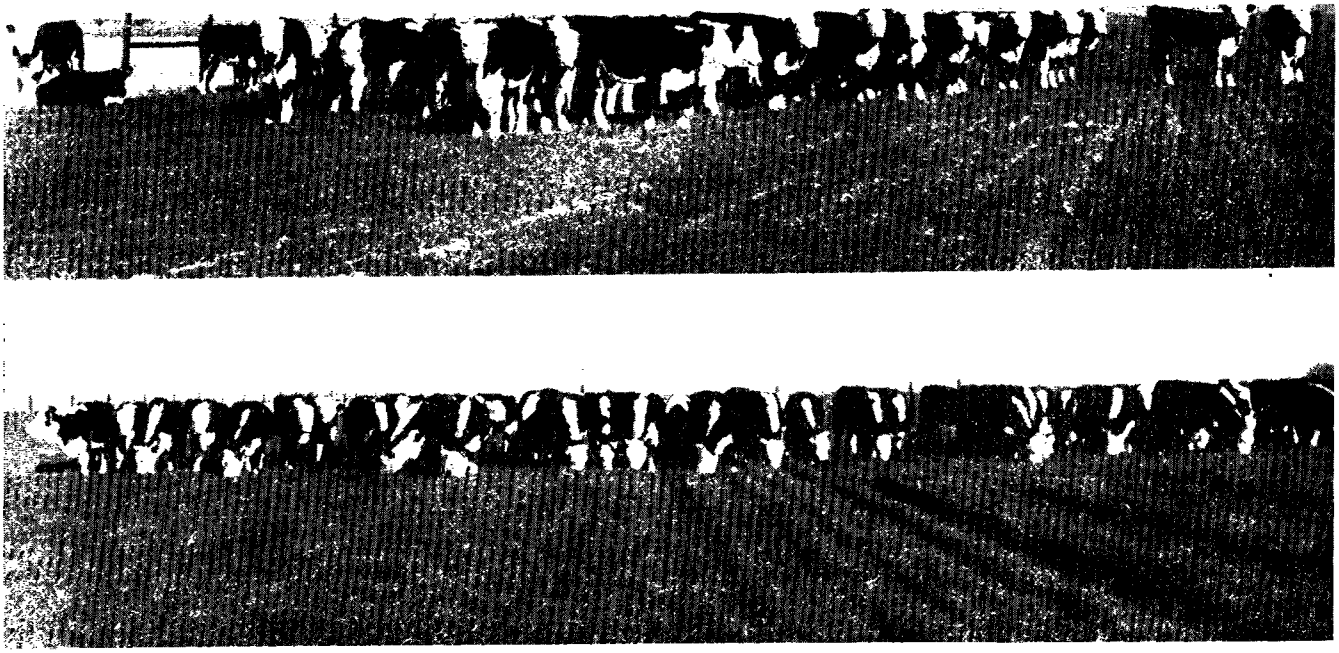
JANUARY, 1935 BULLETIN 271

AGRICULTURAL EXPERIMENT STATION
KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE
Manhattan, Kansas

PASTURING WINTER WHEAT IN KANSAS

PRINTED BY THE
KANSAS STATE COLLEGE PRESS
MANHATTAN, KANSAS
1935

TABLE OF CONTENTS



SPRING CALVES ON FALLOWED WINTER WHEAT, NOVEMBER, 1934
Fort Hays Agricultural Experiment Station, Hays, Kansas

PASTURING WINTER WHEAT IN KANSAS[1]

A. F. SWANSON[2]

INTRODUCTION

The utilization of winter wheat for pasture is a common practice in Kansas where from ten to twelve million acres of this crop are grown annually. About 65 per cent of this acreage is pastured to a greater or lesser degree from November to April. This pasturage has an approximate annual value of from six to seven million dollars.

A large number of farm animals are produced each year in Kansas. The openness and relative dryness of the winters in the region often make it feasible to graze this livestock on winter wheat for a considerable portion of their subsistence. In recent years it has become a commercial practice among the larger Kansas wheat growers and livestock operators to ship in young cattle and lambs from the ranges of Texas, New Mexico, Colorado, and Wyoming to be grazed on winter wheat. Such livestock is grazed on green wheat from 60 to 120 days, or more, and then shipped to the river markets from February to April, with gains that compare favorably with those produced on summer grasses. Such enterprises are generally carried out on fallowed land, the acreage of which has greatly increased in Kansas with the advent of power machinery and the conversion of the level grass lands into cultivation. These activities are largely confined to the major wheat region of the western half of the state,

Winter wheat pasturage in no way competes with or replaces the 28 million acres of native grasses found in the state. Rather winter wheat is a supplement to the native grasses while the latter are dormant. The native grasses are a most valuable source of feed for the production of livestock during the summer months, and winter wheat is of great value during the winter when no other green feed is available.

It is the purpose of this bulletin to supply information on (1) the effect of grazing on the yields of wheat, (2) methods of utilizing the crop as a green pasture with the least reduction in the yield of grain, (3) the nutritive value of the green wheat pasturage, and (4) the gains that may be expected from pasturing wheat when supplemented with dry feeds.

Acknowledgment.—In the preparation of this bulletin the writer is greatly indebted to more than 125 wheat growers and stockmen who generously supplied information in answer to questionnaires or by personal interviews. Valuable data and guidance from staff members of the Kansas Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, are acknowledged.

1. Contribution No. 16 from the Fort Hays Agricultural Experiment Station, Hays, Kansas.

2. Associate agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, in charge of cereal crops, Fort Hays Agricultural Experiment Station.

THE INFLUENCE OF GRAZING ON YIELD OF WINTER WHEAT

Several factors determine to what degree the yields of wheat are influenced by winter grazing. The most important factor is the amount of stored moisture available in the seedbed, which in turn determines the vigor of the vegetative growth from the time the crop emerges in the fall to early spring. The preparation of the seedbed, the type and character of the soil, the severity of the grazing, and the duration of the grazing period must also be given consideration.

In general the yield of wheat is not materially reduced, and may often be somewhat increased by moderate winter grazing when conditions are favorable for rank growth. This is particularly true when the crop is grown on a well prepared seedbed supplied with stored moisture. Such a condition generally prevails when wheat is grown on fallowed land and when moderate and well managed grazing is practiced.

On the other hand when the crop has made a limited fall growth because of lack of rainfall or inadequate seedbed preparation, the yield of wheat is reduced from grazing. If wheat is severely grazed over an extended period or late in the spring, the reduction in yield of grain is usually pronounced. The amount of reduction will vary with the type of seedbed and general rainfall, but regardless of how favorable these factors are, it is the rule rather than the exception that there will be a reduction in yield from excessive grazing.

EFFECT OF GRAZING ON WHEAT YIELDS AS OBSERVED ON KANSAS FARMS

The extent to which yield of wheat was increased or decreased by winter grazing under farm practice was indicated in a summary made from 62 questionnaires and personal interviews with representative Kansas wheat growers. Twenty-four per cent of the wheat growers reported a gain in yield from 1 to 3 bushels per acre when wheat was pastured. Sixty-nine per cent of the operators felt that grazing wheat had neither a stimulating nor depressing influence on the yield, but that the pasturage was of great value. Seven per cent of the operators reported losses of 1 bushel or less. These gains or losses were estimated to have occurred when moderate and managed grazing (fig. 1) was practiced on fields of winter wheat well established on a good seedbed with an adequate supply of stored moisture. A few farmers were opposed to pasturing wheat under any conditions.

When conditions were unfavorable for a vigorous top growth of wheat in the fall and early winter, and when stored moisture was limited, it was almost the universal opinion of growers that yields were reduced by grazing. Under such conditions reductions in yields were estimated to vary from 5 to 50 per cent with an average estimated loss of approximately 20

per cent, or, if otherwise stated, from 2 to 10 bushels per acre. The majority of farmers indicated that when conditions were unfavorable for normal growth they did not make a practice

FIG. 1.—Cattle grazing on a well-prepared field on winter wheat near Collyer, Kan. (Photographed April 11, 1934.)

of pasturing their wheat. The effect of grazing on yield of wheat as observed on Kansas farms is in line with the results obtained experimentally on controlled plots at the Hays station.

EFFECT OF GRAZING AS DETERMINED ON EXPERIMENTAL PLOTS

Pasture experiments with winter wheat on the Hays station were undertaken in 1926 and continued for five years to determine (1) the effect on yield and (2) the amount of pasturage which the crop could furnish under varying conditions of growth. The experiments were conducted on well fallowed land and on land previously cropped to wheat, to secure the range of conditions under which wheat is grown in Kansas.

Well prepared seedbeds were used for plots during the five years of testing. One-tenth-acre plots were grazed with horses. Five methods of grazing wheat, similar to those practiced on Kansas farms, were included in experiments on each of the two types of seedbeds referred to above. The methods follow:

1. Severe pasturing for the long period from October 15 to May 1, except during the time when the ground was frozen and the plants dormant. The plots were pastured during wet weather. The wheat was kept closely grazed to the ground so that the plots had the appearance of being cut with a lawn mower.

2. Moderate pasturing from October 15 to April 15. Precaution was taken not to graze the plots too closely and no grazing was done during extremely wet weather. Every effort was made to follow a system of well managed grazing which would be considered good farm practice on a large field scale.

3. Moderate spring pasturing similar to the above but with the first grazing deferred until March 1, or when the wheat emerged from dormancy to active growth, and continued until April 15.

4. Moderate fall pasturing same as the moderate seasonal pasturing but continued only for a period of 60 days or until the plants became dormant.

5. Late spring pasturing, April 15 to April 30, after wheat had reached the jointing stage of growth and a height of from 8 to 12 inches. In this test the wheat had generally reached a rank vigorous growth.

The wheat sown on fallowed land made a heavy growth during the years of 1926, 1928, and 1930. The growth of wheat on fallowed land was somewhat restricted for the seasons 1927 and 1929 because of limitation of fall moisture. Where wheat followed wheat on cropped land, excessive growth occurred only during the season of 1928. Well established stands were obtained for the remaining four years on the cropped land.

The effect of pasturing on the yield of wheat grown at the Hays station on fallowed and on cropped land for the five-year period, 1926 to 1930, is shown in Table I.

Since heavy growth of wheat occurred for the most part on fallowed land, moderate fall pasturing for a period of 60 days resulted in an average gain of 3 bushels per acre for the five-year period. When wheat was pastured moderately for 105 days and not later than April 15, the average gain was 2.3 bushels. When the wheat was grazed moderately from the time plants started growth in the spring until April 15 there was a loss of 1 bushel per acre. Severe grazing for 120 days and as late as May 1 resulted in a loss of 3.1 bushels. The greatest reduction in yield was from moderately severe pasturing for the short period from April 15 to May 1, when the loss was 6.2 bushels. In the last method the grazing was always spotted and the shock to the plants very great since the newly formed heads were destroyed in the boot.

The reduction in yield for all methods of grazing on cropped land where wheat followed wheat, for the five-year period ranged from 0.9 to 4.9 bushels per acre as shown in Table I. This reduction in yield was generally due to less stored moisture in the cropped land than in the fallowed land, resulting in less vigorous plant growth. It was found, however, that when ample growth of wheat was available on the cropped land, as was the case in 1928 and 1930, moderate pasturing gave increased yields. Wheat on cropped land in years of favorable moisture supply tends to give a response to grazing which approaches that generally obtained from fallowed land.

Table I indicates that in 1929 higher yields were obtained at Hays on the cropped land than on the fallowed land. This

TABLE I.—ANNUAL AND AVERAGE GRAIN YIELDS FROM VARIOUS METHODS OF PASTURING WINTER WHEAT. Hays, Kan., 1926 to 1930

Type of seedbed and method of pasturing	Time pastured	Bushels per acre							
		1926	1927	1928	1929	1930	4-yr. av., 1927 to 1930	5-yr. av., 1926 to 1930	Comparison with 5-yr. average
Fallowed Land									
Fall pasturing	Oct. 15 to Dec. 15	21.0	15.5	54.7	16.3	40.3	31.7	29.6	+3.0
Moderate seasonal pasturing	Oct. 15 to Dec. 15; Mar. 1 to Apr. 15	22.2	11.0	56.8	13.8	40.8	30.6	28.9	+2.3
Check (not pastured)	.....	16.7	14.5	48.3	16.8	36.7	29.1	26.6	....
Spring pasturing	Mar. 1 to Apr. 15	21.6	11.1	48.3	14.2	32.8	26.6	25.6	—1.0
Severe seasonal pasturing	Oct. 15 to Dec. 15; Mar. 1 to May 1	13.8	11.8	52.7	11.0	28.0	25.9	23.5	—3.1
Late spring pasturing	Apr. 15 to May 1	13.8	9.6	40.7	17.4	20.3	22.0	20.4	—6.2
Land Previously Cropped to Wheat									
Fall pasturing	Oct. 15 to Dec. 15	19.5	9.5	38.2	27.7	31.8	26.3	25.3	—0.9
Moderate seasonal pasturing	Oct. 15 to Dec. 15; Mar. 1 to Apr. 15	19.9	9.2	42.0	22.1	31.7	26.3	25.0	—1.2
Check (not pastured)	.....	26.7	6.7	42.8	28.8	26.2	26.1	26.2	....
Spring pasturing	Mar. 1 to Apr. 15	20.3	9.4	38.8	22.4	26.5	24.3	23.5	—2.7
Severe seasonal pasturing	Oct. 15 to Dec. 15; Mar. 1 to May 1	18.4	7.2	38.8	18.8	23.5	22.1	21.3	—4.9
Late spring pasturing	Apr. 15 to May 1	....	8.3	35.8	23.1	20.0	21.8	....	(a)—4.3

(a) Four-year average.

was due to the dry fall of 1928 when the surface soil of fallow was too dry to maintain the seedling plants to a full stand. On the cropped land germination did not take place until a late rain in October at which time a crop of volunteer wheat also emerged. As a consequence the growth of wheat on the cropped land exceeded that on the fallowed land.

WHEN TO PASTURE WINTER WHEAT

While wheat pasture is generally available from 120 to 150 days in normal seasons, the yield of grain may be greatly reduced if grazing is practiced for the entire period. The length of the average season as reported by representative farmers over the state was 84 days with a range of from 45 to 150 days. There was a tendency for farmers to pasture for a longer period in the western third of the state than elsewhere. In practice, length of the grazing period depends on growth of the wheat, amount of rainfall, and to some extent on the shortage of other feeds.

The pasturing of winter wheat is generally started in the fall when the plants are so firmly rooted that they will not be pulled out by the animals. This period of growth is usually reached about November 1 which is the date when most farmers begin the fall grazing, although this may vary from October 15 to November 15. Grazing is sometimes deferred until March 1 at about the time wheat emerges from winter dormancy.

April 1 is regarded by most farmers as the optimum time to remove all livestock from growing wheat. The range is from March 1 to April 15. A few farmers discontinue grazing as early as February 1 on the theory that the tramped and packed seedbed would still have a chance to be mellowed by alternate thawing and freezing temperatures before the advent of spring. In general practice, livestock are removed from wheat just before the jointing stage. Judgment and experience are the best guides as to how long and when to pasture wheat.

METHOD OF GRAZING TO AVOID REDUCTION IN YIELD

Well established wheat with vigorous leafy top growth on a good seedbed can nearly always be pastured with benefit to grain yield, if pastured moderately. The best results will be obtained if the grazing is started in November or when the plants are well established and have made a strong leafy top growth. Moderate grazing should continue except when periods of extremely cold weather retard the active growth of the plants. At such times and during muddy weather the livestock should be removed from the wheat fields. If spring pasturing is practiced the grazing should begin as soon as the wheat emerges from winter dormancy. The plants will then develop a moderate number of uniform stocky spreading tillers devoid of excessive leafy growth.

While the leafy top growth can be largely removed from the wheat plants (fig. 2, left) with the approach of spring without permanent injury, care must be taken not to graze so closely as to destroy too many of the tillers arising from the crown of the plant. Each plant is capable of producing a dozen or more

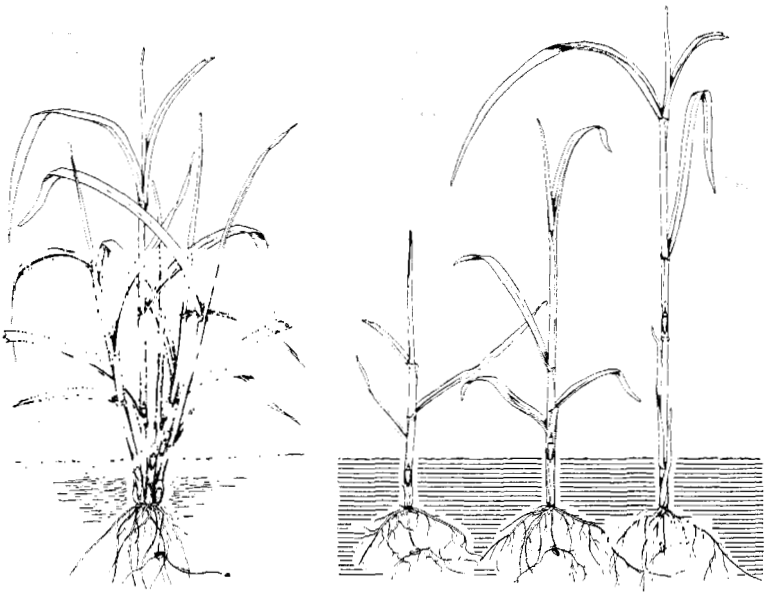


FIG. 2—(Left) Diagrammatic drawing of a typical Turkey wheat plant showing buds, or culm tips, of the various tillers in the process of development. Not all culm tips develop into heads. (Right) Position of culm tips with reference to surface soil on April 19, 28, and May 5. When a culm tip is removed by grazing, the tiller will fail to develop a head. (Adapted from Nebr. Agr. Expt. Sta. Research Bul. 31.)

tillers and while some will be destroyed by grazing, others must be left available to take the place of those destroyed. (Fig. 2.)

Grazing should be discontinued just before the period when the plants show a strong tendency to make erect growth in preparation for jointing, if maximum yields of wheat are to be produced. This usually occurs about April 10 in the Hays section, but somewhat later toward the western and northern limits of the state. At this stage plants will generally be grazed to a uniform height over the entire field, giving the field somewhat the appearance of having been cut with a lawn mower. (Fig. 3.) If grazing is discontinued at this stage the plants will make rapid recovery. While some of the older and more advanced tillers will have been destroyed by livestock, younger

tillers will soon replace them. Moderate grazing of heavy growth wheat has the same effect as the practice of pruning fruit trees. (Fig. 4.) In either case care and judgment must be used.

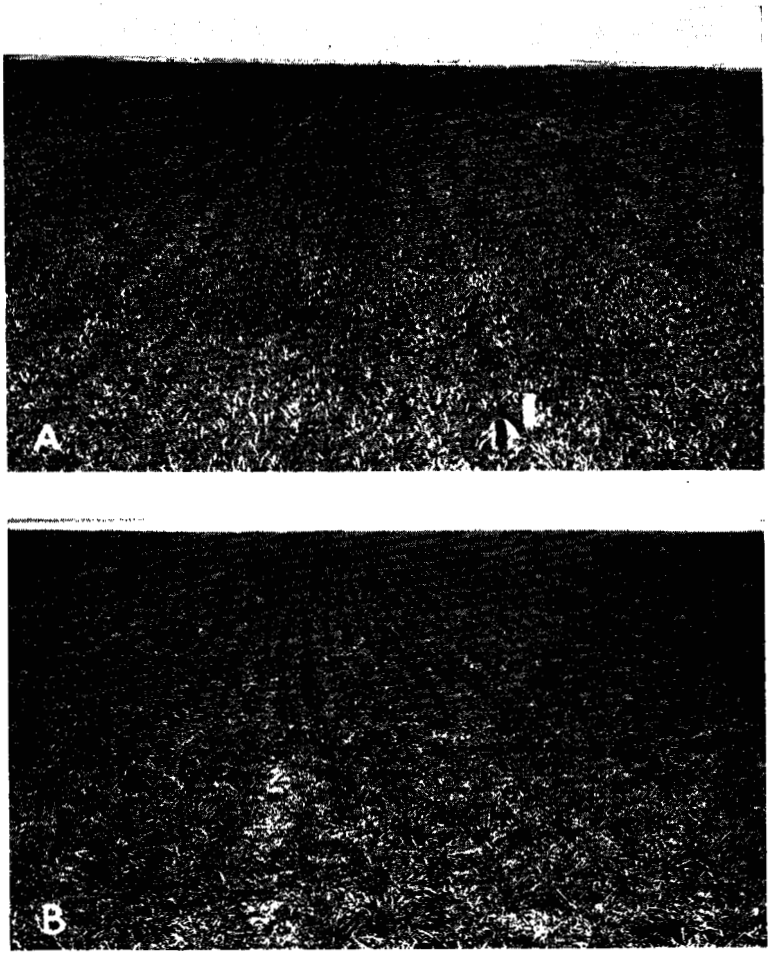


FIG. 3.—(A) An unpastured field of fallowed wheat. (B) A well grazed fallowed field of winter wheat shortly after removal of cattle. Note stockiness of plants and uniformity of grazing. Such plants recover their growth in ten days to two weeks after grazing is discontinued. (Both fields photographed April 12.)

The greatest reduction in yield from grazing wheat comes from turning livestock into a field of wheat for the first time late in the spring after plants have made upright growth. Live-

stock invariably will graze in selected spots in such a field leaving much tall growth which will not be touched, The reason for this is that new growth thus formed in the selected spots is more succulent than the older top growth. The animals will continue to graze in these spots. In late grazing the shock to

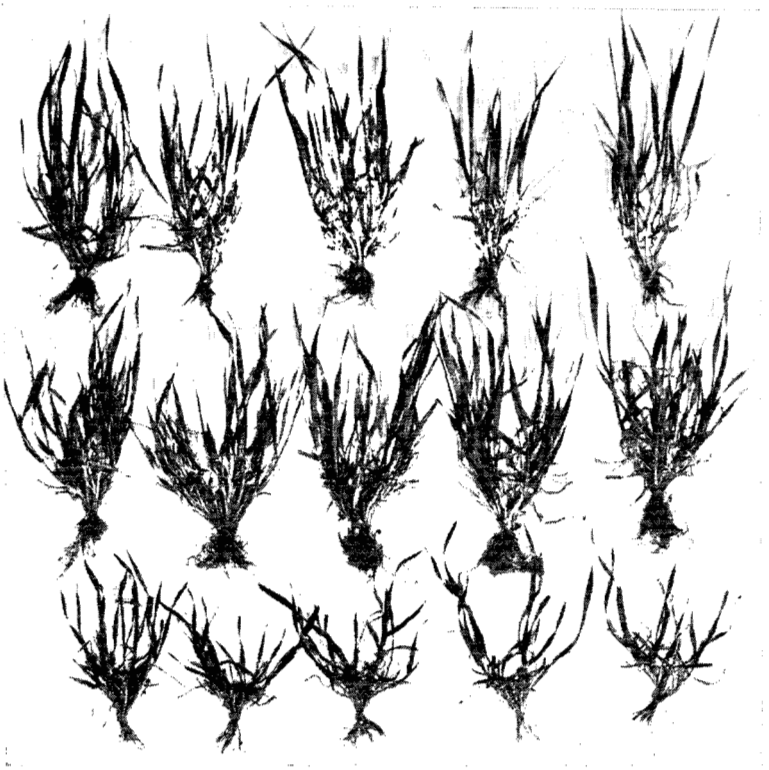


FIG. 4.—Random samples of wheat plants subjected to different degrees of grazing as grown on fallowed land. (Top row) Plants from unpastured plots. (Middle row) Plants from plots grazed moderately. (Bottom row) Plants from plots grazed severely. Livestock removed on April 4 and plants photographed April 14. Note stockiness of the moderately grazed plants.

the plants is great and complete recovery is never made. The fields become uneven in growth and in ripening, a condition highly undesirable especially in combine harvesting.

EFFECT OF GRAZING WHEAT ON SOIL BLOWING AND FIRMING OF SEEDBED

The danger of soil blowing is increased in grazing wheat when the growth is limited and the stand thin, particularly if

the surface soil is dry. The danger is still greater if wheat is grown on sandy soil, such as found in the Arkansas river valley. In fact, on sandy soil it is an open question among some farmers whether wheat should ever be grazed. However, when wheat has made a satisfactory growth on fallowed land or a well prepared seedbed the firming of the soil is often beneficial, for the reason that in a well prepared seedbed the alternate freezing and thawing of the stored moisture tend to make the soil friable and loose. Grazing such a seedbed moderately has much the same effect as the use of a cultipacker. As the growth of wheat covers the ground the danger of soil movement is not great. The firming of the soil seems to protect the root system and probably results in a better retention of the moisture.

Wheat growers greatly prefer to pasture wheat when the surface soil is a little wet, rather than abnormally dry. Grazing wheat during wet weather in the early part of the season, even if the ground is considerably roughened by tramping, does not always cause serious reduction in the crop yield. The roughened areas will be considerably mellowed by spring, because of alternate freezing and thawing of the seedbed. However, grazing during periods when the ground is muddy in the late winter or early spring may injure the plants considerably, and consequently reduce the yield.

A limited study was made at the Hays station on the influence of tramping and puddling plots of growing wheat. Three plots were laid out on well prepared fallowed land. One plot was severely puddled and tramped by horses during the fall and early winter. A number of plants were depressed or buried in the imprints left by the horses. Another plot was tramped only when the ground was dry, but this was done during the early spring as well as during the late fall and early winter. The third plot was a check plot and was not tramped. No grazing was allowed on any of the plots, but the horses tramped the ground of the two plots until few areas were left which did not have imprints. The yields were as follows:

Plot tramped and puddled while wet (fall)	**25.0 bus.**
Plot tramped when dry (fall and spring)	**23.6 bus.**
Check plot, not tramped	**26.7** bus.

In the western part of the state where sheep and cattle are grazed extensively, opinions differ as to which class of livestock is preferred for the efficient utilization of wheat pasture. If the fields are inclined to be muddy, lambs do not sink so deeply into the seedbed because of their lighter weight. If the seedbed has surface moisture, the tramping effects of the two classes of animals are not materially different. If the surface soil is dry, sheep may pulverize the soil into a condition to blow more readily since they graze in compact groups, whereas cattle scatter over the fields.

GRAZING IN RELATION TO CULTURAL METHODS AND GROWTH OF WHEAT

The primary objective of most farmers in preparing a good seedbed for winter wheat is to produce larger yields of grain, rather than to provide the additional pasturage which the fields might supply. Choice of method used in seedbed preparation is not so important as the timeliness and thoroughness of the work. Only a few farmers modify their methods of growing wheat in order to secure more pasturage, except that land is sometimes fallowed to secure a more abundant wheat growth for grazing. When grazing is to be done the crop is sometimes seeded somewhat earlier than the optimum date for grain alone. A few farmers reported sowing a peck more grain to the acre than the normal rate when grazing was contemplated. Relatively deep seeding to establish the crowns of the plants well in the soil was also recommended.

EFFECT OF GRAZING ON MATURITY OF WHEAT

It was observed at the Hays station that the maturity of grazed wheat was from one to four days later than that of wheat not pastured. The more severely wheat was grazed, the later was the maturity of the crop. Late spring grazing had a marked tendency to retard the maturity of winter wheat.

EFFECT OF GRAZING ON NUMBER OF CULMS

The number of culms per acre of grazed wheat is reduced in direct proportion to the severity of the grazing as observed at

TABLE II.—COMPARISON OF PERCENTAGE SURVIVAL OF CULMS IN PLOTS SUBJECTED TO VARIOUS METHODS OF GRAZING AND IN THE UNPASTURED CHECK PLOT, HAYS, KANSAS.

Kind of Pasturing	Per cent of culms surviving			
	Fallowed land		Cropped land	Average for three series
	1927	1929	1929	
Check, unpastured	100.0	100.0	100.0	100.0
Fall pasturing	90.6	91.2	89.5	90.4
Moderate pasturing	91.8	88.4	90.8	90.3
Late spring pasturing	73.0	83.6	86.3	81.0
Severe pasturing	62.2	78.2	87.6	76.0

the Hays station in 1927 and 1929. The results are shown in Table II.

Observations made at the Hays station have shown that a reduction in the number of wheat plants or culms to the extent of 10 per cent from winter killing did not decrease the yield of winter wheat, when seeding was at the rate of 1 bushel per acre.

This would indicate that a slight loss of plants or culms due to grazing before April 1 would not have a depressing effect on the yield of winter wheat.

GRAZING OF WHEAT TENDS TO PREVENT LODGING

It was the opinion of approximately 90 per cent of the farmers interviewed that grazing prevented lodging of wheat to a greater or less extent in years when excessive growth was due to more than normal rainfall. Ten per cent of the growers were of the opinion that grazing did not prevent wheat from lodging. A few stated that grazing was of little help in the prevention of lodging unless severely done late in the spring. Late grazing of wheat generally causes a heavy reduction in the potential yield. However, if the crop is largely lost because of lodging, the yield from late-grazed fields may be above that obtained from tangled wheat.

In the grazing experiments conducted at the Hays station lodging was not a factor, but general observation would indicate that when wheat has made excessive growth on fallowed or rich bottom land, moderate pasturing would be helpful in the reduction of lodging, although the practice might not entirely eliminate it.

One of the great difficulties encountered in fallowed wheat when the rainfall is more than normal is to overcome excessive growth which often is followed by lodging. Lodging can not be controlled by dates of planting nor by rates of seeding, and only to a limited extent by varietal differences when abnormally favorable conditions of growth prevail. Well managed grazing begun early in the season appears to be an effective control. In most seasons lodging is less likely to occur in the western part of the Kansas wheat belt than in the eastern section.

STORED MOISTURE SUPPLY AS AFFECTED BY GRAZING WHEAT

It has often been assumed that grazing wheat would tend to deplete the moisture supply from the seedbed. This theory is based on the fact that additional stored moisture is required to renew the growth that is removed by grazing. On the other hand, farmers sometimes pasture a heavy growth of wheat to avoid the loss of moisture if drouth is threatened in the early spring.

Limited moisture determinations were made in 1934 at the Hays station in plots of wheat on fallowed land. One plot of wheat was severely grazed, another moderately grazed, while the third plot was not pastured. The moisture determinations were made on April 13, 10 days after the livestock had been removed from the pastured plots. The winter and early spring months were deficient in rainfall so that the crop was growing largely on stored moisture. The unpastured and moderately pastured plots contained approximately the same amounts of

stored moisture. A somewhat higher moisture content was found in the severely pastured plot.

While the data secured at Hays were too limited to draw definite conclusions they indicated that excessive growth of wheat during the fall to early spring may utilize the stored moisture supply too freely. Frequently the excessive top growth of wheat freezes back, resulting in more or less wasted energy by the plants. If the top growth of wheat can be utilized as pasturage with no marked loss of stored moisture, there would be added justification for grazing.

VARIETIES OF WHEAT BEST ADAPTED TO GRAZING

Little information is available as to the best varieties of wheat to grow when the crop is to be grazed. Farmers who have had experience with both varietal types expressed a preference for the type represented by Turkey and Kanred over the Blackhull type. The Turkey type of wheat was preferred because of its ability to tiller more vigorously in the early stages of growth and thus make more pasturage.

Observations made at Scott City during the 1933-'34 season, showed Blackhull to be inferior to the Turkey type of wheat when pastured under similar conditions in that it lacked stamina in recovering. Pastured and unpastured plots at the Hays station in 1934 under drouth conditions indicated that Blackhull did not recover so readily as Kanred. Turkey wheat has the tendency to grow more prostrate during the winter months than Blackhull. The response of different varieties of wheat to grazing is under further investigation at the Hays station.

WINTER RYE AND WINTER BARLEY FOR PASTURE

Winter rye and winter barley are often used for winter pasturage. Either crop will generally furnish more pasturage than wheat in the fall and early winter. Winter barley is used rather extensively in the southern part of the state. Its use is limited because of winter killing especially in the northern and western sections of the state.

Winter rye has one objectionable feature in that it volunteers freely and often contaminates fields of winter wheat. A mixture of rye in the grain of winter wheat reduces its milling quality and lowers its price. For this reason the extensive use of winter rye for pasture is not recommended.

GRAZING CAPACITY OF WINTER WHEAT

The carrying capacity of winter wheat for grazing purposes varies from year to year depending upon the rainfall, type of seedbed, and growth of the crop. Wheat may not make sufficient growth to furnish pasture in the fall, but usually does so in the spring.

The calculated number of acres required to carry horses

under varying degrees of grazing was determined at the Hays station for the three-year period, 1926 to 1928. The results are shown in Table III. The acreage required to pasture horses is regarded as higher than for cattle. The estimated number of acres required to carry cattle was obtained from representative farmers throughout the state. These estimates were based on well established fields of wheat. These results are shown in Table IV for grown cattle, yearlings, and calves and for the different sections of the state. The figures given in Table IV for south central Kansas are probably the most reliable as the information was based on a larger number of informants than from other sections of the state. Also the growth of wheat is generally more luxuriant in south central Kansas than farther west and north.

TABLE III.—ACRES REQUIRED TO CARRY ONE HORSE FOR DIFFERENT METHODS OF PASTURING.

Hays, Kan., 1926 to 1928

Type of seedbed and method of pasturing	Number of days pasture was available	Number of acres to carry one animal			
		1926	1927	1928	3-yr. av.
Fallowed Land					
Fall pasturing	60	3.0	4.3	7.0	4.8
Moderate seasonal pasturing	105	2.4	2.6	3.1	2.7
Spring pasturing	45	1.0	.8	3.0	1.6
Severe pasturing	120	1.4	1.4	2.9	1.9
Late spring pasturing	15	.5	.2	.7	.5
Land Previously Cropped to Wheat					
Fall pasturing	60	4.0	6.0	7.5	5.8
Moderate seasonal pasturing	105	3.8	5.0	7.5	5.4
Spring pasturing	45	3.5	1.3	5.6	3.5
Severe pasturing	120	1.6	1.9	5.7	3.1
Late spring pasturing	15	...	.6	1.4	(a) 1.0

(a) Two-year average.

During the fall from 3 to 7 acres of wheat may be required to carry an adult animal depending on the condition of the seedbed, rainfall, and growth. Subnormal mean temperatures during October may retard growth of wheat and limit the amount of pasturage. During the early spring from 2 to 4 acres may be required to carry an animal. The greatest carrying capacity is from April 10 to 30 when one-half of an acre will carry an animal in seasons of normal growth, but the greatest losses in yield also occur when wheat is pastured during this period. This is due to the advanced stage of growth of the plants.

Calves in the fall require approximately one-half, and year-

lings in the spring two-thirds as much acreage as grown animals. Cows carrying calves are said to graze wheat more severely than other classes of cattle, and for that reason are discriminated against when grazing is under contract. Observations made in Kiowa county during the late fall and early winter of 1933 indicated that 1 acre of well established wheat grow-

TABLE IV.—ESTIMATED NUMBER OF ACRES OF WELL ESTABLISHED WHEAT REQUIRED TO CARRY ONE UNIT OF CATTLE OF DIFFERENT AGES FOR DIFFERENT SEASONS UNDER FARM PRACTICE IN KANSAS.

Section of Kansas	Acres required per animal unit			
	Grown cattle		Calves	Yearlings
	Fall-winter	Spring	Fall	Spring
South central	3.2	2.2	1.6	2.2
North central	2.4	2.5	1.3	2.7
Northwestern	3.3	2.0	1.8	2.0
Southwestern	3.0	3.0	2.6	3.0
Average	3.0	2.4	1.8	2.5

ing on a good seedbed was sufficient to carry one spring calf for a period of 36 days during mild open weather with no apparent harm to the crop.

CUSTOM RATES FOR WHEAT PASTURE

The rate for pasturing winter wheat is based upon the price per head per month. These rates differ for localities, being somewhat higher in south central Kansas than elsewhere, possibly because of more consistent growth of wheat in this area. The amount of wheat growth, price of livestock, and scarcity of other feeds are factors which govern the pasture rates. Average comparative rates for wheat pasture in different localities in Kansas as determined in 1933-'34 are shown in Table V.

Since 1929, the average price for good wheat pasture has been approximately $1 per month per head for grown cattle, 75 cents for yearlings, and 50 cents for calves. Before 1929, when higher cattle prices prevailed, the rates for mature animals ranged from $1.50 to $2 per head per month.

In south central Kansas the prevailing rate for pasturing sheep on wheat is from 20 to 25 cents per head per month, while in the western third of the state the rate is often as low as 10 cents per month. When water is made readily available the price may be 15 cents per head per month.

LIVESTOCK LOSSES FROM PASTURING GREEN WHEAT

Reports from wheat growers and stockmen indicate that cattle losses may range from one-fourth to one-half of 1 per cent from grazing winter wheat. These losses are chiefly due to bloating, which is most likely to occur when the cattle are grazed on frosted wheat, and when the wheat is wet or covered with dew. Removal of the livestock from the fields under such conditions is the best prevention. The use of dry feeds before turning the cattle out to graze in the morning is also helpful.

TABLE V.—CUSTOM RATES FOR WHEAT PASTURE IN KANSAS (AS DETERMINED IN 1933-'34).

Section of Kansas	Rate per unit animal per month		
	Cows	Calves	Sheep
South central	$1.06	$0.57	$0.20 to $0.25
North central	.80	.25	.....
Northwestern	.62	.38	(a) .10
Southwestern	.88	.61	.....

(a) When water is furnished the price may be 15 cents per head.

Livestock should gradually become accustomed to green wheat before having unlimited access to the fields.

Scouring, with resulting low gains, sometimes becomes troublesome to livestock when pastured on wheat. It is most likely to occur when the crop is in the early stages of growth or when highly succulent from rapid growth. If scouring becomes too acute the animals afflicted should be removed from the green wheat. A good preventive is to have dry feed available to the livestock while pasturing green wheat.

Wheat "poisoning," an ailment of a different nature than bloating, may occur when cattle are grazed on wheat in the late fall and early spring. The danger seems to be greatest when the crop is growing under drouthy conditions, or when frost at night is followed by days warm enough for plant growth to continue. The symptoms appear suddenly, being of the nature of tremors, stiffness, staggering gait, and finally convulsions and often death. The treatment requires the services of a veterinarian and consists of injecting a solution of calcium gluconate and a dye solution into the jugular vein. If treatment is given in time the animals recover rapidly.

Livestock losses may occur from compaction due to relatively large quantities of dirt or sand accumulating in the stomachs of the animals. The difficulty becomes prevalent when animals graze on poorly established wheat growing on a loose seedbed

with a thin stand and limited top growth. The difficulty is further intensified if supplementary feeds are not made available to meet a part of the maintenance needs of the animals.

In handling large flocks of lambs for the market, some losses occur regardless of whether fed in lots or grazed on wheat. In Scott county during the winter of 1933-34 a loss of 2.4 per cent occurred in a band of 3,000 lambs pastured on wheat for 90 days. The weather was open and the lambs given more than ordinary range care. According to one operator, from the time lambs are shipped in from the ranges until they reach the market losses as high as 6 to 8 per cent may occur. These percentages include all losses in shipping and in handling the lambs in large bands on Kansas wheat fields without supplementary feeds, extra care, or protection against inclement weather.

THE NUTRITIVE VALUE OR WHEAT PASTURE

Winter wheat in the earlier stages of growth is rich in protein and mineral constituents.

The feed constituents are shown in Table VI comparing Kanred wheat with little bluestem, an important grass in the eastern half of the state. Unfortunately, the information is not available for the native buffalo-grama grass mixtures of the western portion of the state. Samples of Kanred wheat taken on November 4 and 14, 1928, analyzed 28.28 and 26.88 per cent protein, respectively, with a high ash content of 12.34 and 16.3 per cent on the basis of dry matter. Little bluestem grass the following May and again in June, in approximately the same stages of growth as winter wheat in the fall, showed 13.8 and 9.11 per cent of protein. Similar comparisons are made for winter rye and for Atlas silage and Atlas fodder. Since silage and fodder are made from mature plants the percentages of protein and ash are low in proportion to crude fiber and carbohydrates.

The high protein content of the young plants of winter wheat and rye account for their high nutritive value; and when used in connection with dry feeds and a limited amount of concentrates, should meet the requirements for a well balanced ration.

The ash content of grass plants, which include wheat and allied crops, is made up of five important minerals along with others of lesser importance which are essential to animal growth. The more important minerals in this regard are calcium, phosphorus, iron, manganese, and copper. It is essential that calcium and phosphorus should exist in the right propor-

tions and in sufficient quantity, not only in green pasture but in dry feeds. As shown in Table VII, the amount of calcium and phosphorus in winter wheat compares favorably with native grass. Investigational work with grasses in this and other countries indicates that the amount of calcium should be at least

TABLE VI.—FEED CONSTITUENTS OF GROWING WINTER WHEAT, RYE, NATIVE GRASS, AND OF SORGHUM SILAGE AND FODDER.
Manhattan, Kansas.

Crop or Native Grass*	Date sample was collected	Total moisture per cent	Per cent of dry matter				
			Protein	Ether extract	Crude fiber	Ash	N-free extract
Kanred winter wheat	Nov. 14, 1928	.....	26.88	4.93	11.96	15.30	40.93
	Dec. 20, 1928	.....	20.85	4.20	11.00	17.35	46.60
Kanred winter wheat	Nov. 4, 1928	82.55	28.28	4.59	13.25	12.34	41.54
	Apr. 26, 1929	79.38	17.76	3.18	21.52	11.44	46.10
Winter rye	Nov. 4, 1928	83.18	29.97	5.90	15.07	12.90	36.16
	Apr. 27, 1929	86.19	28.00	4.97	19.46	13.46	33.72
Little bluestem	May 8, 1928	.....	15.80	2.68	26.00	8.58	46.94
	Dec. 20, 1928	.....	2.29	1.26	36.60	8.05	51.80
Little bluestem	June 5, 1929	72.01	9.11	2.09	31.36	8.03	49.41
	June 19, 1929	63.37	6.43	2.41	32.55	7.13	51.48
	Aug. 1, 1929	49.21	3.84	2.80	34.53	6.98	51.85
Atlas silage	Apr. 13, 1932	69.25	6.09	2.65	22.18	6.87	64.01
Atlas fodder.....	Apr. 13, 1932	24.94	7.14	3.03	22.23	7.17	60.67

*Information on winter wheat, rye, and bluestem grass supplied through the courtesy of A. E. Aldous, while the information on Atlas silage and fodder was supplied by A. D. Weber and W. E. Connell, Agricultural Experiment Station, Manhattan, Kan.

1¼ times that of phosphorus if proper metabolism is to take place. Winter wheat meets this requirement.

Not only are the green grasses, growing wheat, and related crops rich in protein and minerals, but in the active stages of growth they contain certain properties which through the processes of animal metabolism, or otherwise, become the sources of the several vitamins so essential to health. Protein and mineral deficiencies in dry feeds, or in pasturage if they occur, can be supplemented by cottonseed cake or minerals. Vitamins are largely provided for through green pasturage, the action of sunlight, or by the careful processing of green plants. In summer the native grasses become the important sources of vitamins

while during the dormant season winter types of wheat, rye, or barley can be substituted for grass with much benefit to livestock.

LIVESTOCK GAINS OBTAINED FROM PASTURING WINTER WHEAT

The high nutritive content of green wheat, as shown in Tables VI and VII, accounts for the satisfactory gains made by livestock when the crop is grazed. Information on the gains made by cattle and sheep from grazing on winter wheat was obtained from experienced wheat growers and stockmen,

GAINS MADE BY CATTLE WHEN PASTURED ON WHEAT

Wheat growers and stockmen reported average seasonal gains varying from 200 to 300 pounds for grown cattle, and 100

TABLE VII.—MINERAL CONTENT OF NATIVE GRASS AT DIFFERENT STAGES OF GROWTH COMPARED WITH GROWING WINTER WHEAT. Manhattan, Kansas, 1928.

Crop or Native Grass*	Date sample was taken	Per cent of dry matter					Condition of growth
		Iron	Manganese	Copper	Calcium	Phosphorus	
Little bluestem	May 28, 1928	0.099	0.0106	0.0036	0.408	0.299	In succulent stages of growth
	May 19, 1928	.069	.0086	.0028	.540	.258	
	June 5, 1928	.041	.0058	.0047	.554	.196	
Little bluestem	July 30, 1928	.065	.0037	.0016	.390	.138	Height 18 inches, cured grass
	Dec. 20, 1928	.039	.0047	.0022	.328	.086	
Winter wheat	Nov. 14, 1928	.130	.0069	.0018	.398	.460	In succulent stages of growth
	Nov. 20, 1928	.154	.0105	.0014	.322	.418	

*Information supplied through the courtesy of A. E. Aldous, Agricultural Experiment Station, Manhattan, Kan.

to 200 pounds for calves and yearlings, on well established fields of wheat. The pasturage was supplemented by a limited supply of dry feeds. Fortunately in pasturing wheat the dry feeds may be straw, cured native grasses adjoining wheat fields (which would otherwise be wasted), sorghum hay, fodded, or stover. A supply of dry feed should, of course, be available for extreme weather, which in Kansas is generally of short duration. A good example of typical seasonal gains from pasturing winter wheat is one reported from Lane county during the winter of 1933-'34. Two hundred yearlings were weighed out of Kansas City on October 10 with an average weight of 660 pounds and returned to Kansas City April 4 with an average weight of 905 pounds. These yearlings were pastured on green wheat and had access to straw stacks and dry grass which were greatly relished. The season was open and the growth of wheat good.

A summary of the daily estimated gains reported by farm-

ers from different sections of Kansas is shown in Table VIII. The best information available indicates that on good wheat pasture, supplemented by dry feeds, older animals will make average gains of from 1½ to 1¾ pounds per day. Thin, but

TABLE VIII.—ESTIMATED DAILY GAINS MADE BY LIVESTOCK PASTURED ON WINTER WHEAT SUPPLEMENTED BY DRY FEEDS, AS REPORTED BY KANSAS FARMERS.

Section of Kansas	Pounds per head daily gain	
	Calves	Cows
South central	1.5	1.7
North central	1.5	1.7
Northwestern	1.1	1.3
Southwestern	1.5	1.6

well bred cattle of good bone and conformation, when pastured during the open winter on good wheat supplemented with dry feeds, will, in the initial pasturing period, gain as much as 2½ to 3 pounds per day. As the animals increase in flesh the daily gains become less. Older cattle usually make greater seasonal gains than calves. If from poor management or from natural causes the growth of wheat is limited and little or no supplementary dry feed is available, about all that can be expected is to maintain the herd.

GAINS MADE BY LAMBS WHEN PASTURED ON WHEAT

Gains of 5 to 10 pounds per month were reported for lambs when grazed on well established fields of winter wheat. (Fig. 5)

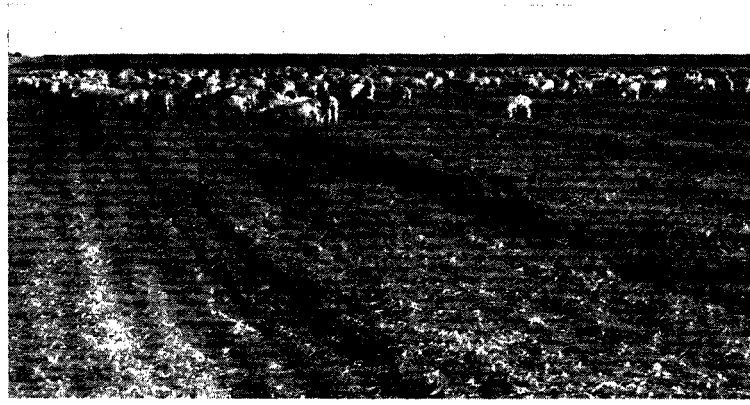


Fig. 5.—A band of Wyoming lambs grazing on wheat near Oakley, Kansas. Lambs are grazed for 60 to 100 days and then shipped to the market.

A gain of 10 pounds per month can only be expected with relatively small flocks having access to a light supplement of grain and dry feed in addition to the green wheat.

The commercial practice of pasturing lambs on wheat in western Kansas is to use no supplementary feeds. Under this method one large operator stated that the average monthly gain per head was approximately 5 pounds per month from the time the lambs left the Wyoming ranges until they reached the Kansas City market. In another instance, where careful records were kept, 6,000 lambs made a net gain of 17 pounds over a period of 60 days.

METHODS OF GRAZING WINTER WHEAT FOR BEST GAINS

As has been pointed out heretofore, green wheat is rich in protein and minerals. In the early stages of growth it is also highly laxative, becoming less so as the season advances and as the vegetative growth increases. Because of the high nutritive content and the laxative nature of green wheat, it is the opinion of more than 95 per cent of the operators interviewed, that the best gains are made when dry feeds are available to the livestock to balance the ration.

The dry feed requirement is greatly lessened when livestock are grazing on winter wheat. When cattle have free choice of green wheat and dry feeds in open weather, they will derive from 70 to 85 per cent of their ration from wheat, and the remainder from dry feeds. There is a saving in the labor expense of hauling feed. Cattle on green, growing, succulent wheat crave a limited amount of dry feeds and will eat straw, dry grass, or sorghum hay, which does not necessarily need to be of choice quality. (Fig. 6.) However, a few operators in the western third of the state reported that, except in stormy weather, cattle consumed scarcely any dry feeds when on wheat pasture. This may be due to the fact that the wheat in western Kansas does not make so succulent growth during the late fall and winter months, as compared with a crop grown in southern Kansas, because of less rainfall and lower temperatures. The top growth of wheat is also more severely killed back by freezing weather in the western area, resulting in a condition where it is less laxative. Where the wheat remains in active growth during most of the winter, as in southern Kansas, there is little doubt but that dry feeds are essential for best gains.

Silage as a rule is not fed to cattle when grazing on wheat, except when it is impractical to give them the run of the fields because of inclement weather and other causes. Because of its succulent nature, silage makes a good substitute for green wheat under such conditions until the cattle can be returned to the fields.

A few sheep operators have also found that it is good prac-

tice to feed silage to the lambs if for some reason they must be removed from the green wheat. They will continue to hold their gains on silage until they can be returned to the fields. When lambs are run on contracted wheat pasturage by large operators, little provision is made to have feed available for an emergency, the preference being to take a speculative chance with

FIG. 6.—Cattle relish dry feeds when on green wheat pasture. The dry-feed requirement, however, is reduced from 70 to 85 per cent when an abundance of green wheat is available. (Picture taken near Brookville, Kan., January, 1934.)

the elements. Needless to say heavy losses have sometimes occurred from such a practice.

When cattle are pastured on green wheat, protein and mineral supplements are practically dispensed with, most stockmen holding the view that they have little or no value in proportion to the cost. A light ration of grain, consisting of approximately 2 pounds a day, is sometimes fed, but opinion differs as to the value of grain if dry forage is not available.

It is the practice of most wheat growers and stockmen in the eastern part of the Kansas wheat belt to corral their cattle at night. The cattle are then fed dry feeds either in the evening or in the morning before being turned out to graze on wheat. In the western Kansas wheat belt, the cattle usually graze on the wheat throughout the entire period coming in only for water and to places where dry feeds may be available. Sometimes sorghum hay and dry grass are made available to the cattle near the wheat fields and the cattle allowed to help themselves.

POSSIBILITY OF WHEAT PASTURE DOES SOT ELIMANATE NECESSITY FOR FEED CROPS

The one drawback to winter wheat as a pasture, when the crop is primarily grown for grain, is that the growth is not al-

ways sufficient to maintain livestock in unfavorable seasons. Therefore a safe farm practice is to provide feed crops, if livestock are to be maintained.

The probability of inclement weather also makes it inadvisable to depend entirely on winter wheat pasturage as the sole source of feed through the winter months. The Plains region is subject to severe storms, generally of short duration, but with driving snow and low temperatures. Such storms are most likely to occur from January to April and may cause heavy losses of livestock, unless silage and dry feeds (fig. 7) are available with shelter.

FIG. 7.—A supply of sorghum hay in reserve for emergency feed during inclement weather when cattle cannot graze on green wheat.

On the other hand, since Kansas rainfall is variable, there is frequently an overproduction of both wheat pasturage and dry feeds for a season, sometimes followed by a low supply the next year. If winter wheat is used freely in years of abundant growth, silage and dry feeds can be held in reserve for emergency use in seasons of low supply. In this regard, winter wheat pasturage may often be of inestimable value in accumulating reserve supplies of dry feed and thus averting forced sales of livestock due to crop failures.

SUMMARY

Ten to twelve million acres of winter wheat are grown annually in Kansas. Approximately 65 per cent of this acreage is pastured to a greater or lesser extent.

Wheat grown on fallowed land or on a well prepared seedbed, with normal rainfall, produces a vigorous vegetative

growth before the plants go into winter dormancy. As the plants emerge from winter dormancy in early spring additional vegetative growth develops. This growth of green wheat is highly nutritious and makes excellent pasture which is relished by all livestock. It is often the only available green feed during a part of the winter months.

Wheat growers and stockmen have found that such fields of wheat can be profitably grazed from the standpoint of livestock gains. When moderate grazing is properly managed, the yield of wheat usually is not reduced and may be somewhat increased.

When conditions are unfavorable for the growth of the wheat plant, grazing may result in heavy losses in grain yield.

The best gains from pasturing green wheat are made when the livestock have access to dry feeds. The amount of dry feeds necessary to carry livestock through an open winter is reduced from 75 to 85 per cent if well established fields of winter wheat are available as pasture. During bad weather, silage is a good substitute for green wheat pasture because of its succulent nature. This is especially true for lambs.

The possibility of wheat pasture does not eliminate the necessity for the production of an abundant supply of silage and dry feeds from such crops as sorghum and alfalfa. In a year when an abundant supply of both winter wheat pasture and feeds is produced, the utilization of winter wheat as a pasture will make it possible to withhold reserve feeds for use in a season of reduced production. Such a practice may be of great value in stabilizing the livestock industry of the state.

In the fall 5 to 7 acres of green wheat are required to carry an adult animal, whereas in the spring 2 to 4 acres may be sufficient, depending on the vegetative growth. Yearlings require about three-fourths and calves one-half this acreage.

Gains in seasons of open weather vary from 200 to 300 pounds per head for grown cattle and 100 to 200 pounds for calves and yearlings on well established fields of wheat supplemented with dry feeds.

When livestock have unlimited access to a heavy growth of green wheat, protein and mineral supplements are dispensed with by most stockmen. The high protein and mineral content of green wheat is reported as sufficient to meet these requirements according to experienced operators.

Winter wheat is grown in Kansas primarily for grain, and pasturage is secondary consideration. No special cultural methods are employed in producing well established stands of wheat when grazing is contemplated, other than that seeding is sometimes a little earlier and the rate of seeding is sometimes increased 1 peck to the acre above the normal.

Pasturing winter wheat tends to reduce the number of culms, retards maturity, and is helpful in preventing lodging.

CONCLUSIONS

1. In Kansas, winter wheat pasturage is a by-product occurring in seasons of adequate rainfall and on well cultivated fields in which subsoil moisture has been stored.

2. Winter wheat pasturage, when available, is produced at no extra expense, is high in nutritive value, and excellent livestock gains can be made on it. Its use conserves dry feeds for emergency needs.

3. When properly managed, a good growth of wheat may be moderately grazed during the winter months without reducing the grain yields. Under extra favorable conditions for growth the yield of winter wheat may be increased from grazing.