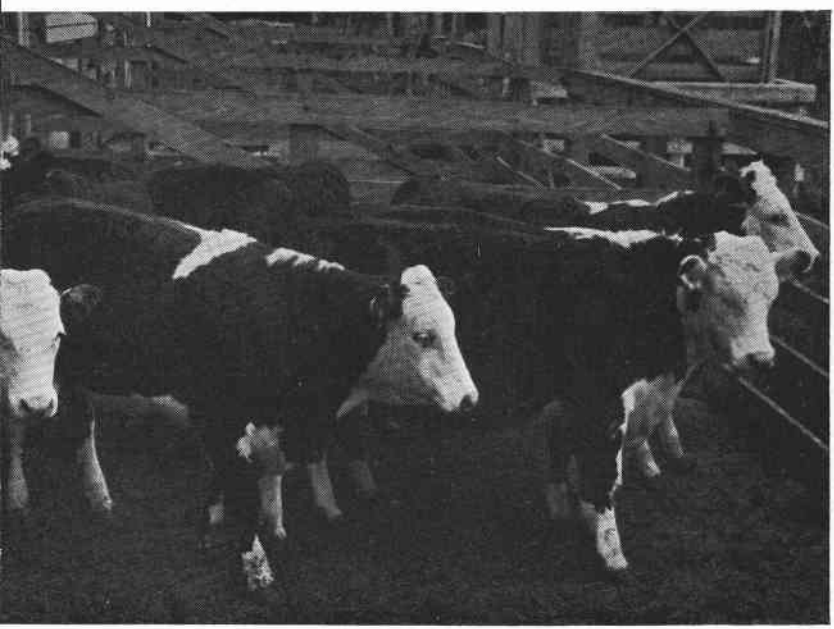
STATION CIRCULAR 137 NOVEMBER 1940

Surplus

Wheat Feeding Experiments



in Oregon

Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College
Corvallis

SUMMARY

1. The need for using more wheat for livestock feed arises from the fact that the Pacific Northwest produces annually an average surplus of 40 million bushels over normal consumption in the producing area. The former export outlet for this wheat has largely disappeared with the result that prices have been reduced in recent years to approximately a feed-grain level.

2. This circular constitutes a summary of the preliminary experimental results in using Pacific Northwest surplus wheat for feeding various types of livestock. The wheat was made available by the Federal Surplus Commodities Corporation for research work at the central and three branch experiment stations. The findings are encouraging. *Wheat appears to be a satisfactory substitute or replacement for every feed grain in every use to which it was applied in Oregon.*

Cattle Feeding Tests

3. In cattle-fattening tests in eastern Oregon about 1,000 pounds of wheat with 1,500 to 1,800 pounds of alfalfa hay were required to fatten a steer. Either steam-rolled or coarsely ground wheat gave satisfactory results. Wheat was equal to or better than barley or other feed grain in the fattening ration.

4. In cattle-feeding tests at the Central Station, ground wheat was successfully used with chopped oats-and-vetch hay for fattening calves. In these tests, with feeder calves costing $7.25 per hundred pounds and the fat calves selling for $9.38 per hundred pounds at home, figured on feed costs alone the cattle made return equal to $10 per ton for all the hay used and more than $50 per ton for the wheat used, or $1.50 per bushel on the farm.

5. Wheat was found to be at least equal with barley as a supplemental feed in fattening beef calves on Ladino clover pasture.

6. In wintering experiments at the Squaw Butte Experiment Station in southeastern Oregon, wheat was found to have approximately one-third the value, pound for pound, of cottonseed cake where cattle received uncut marsh hay as roughage. This hay was extremely low in protein.

7. In tests with growing light-weight weaner calves into good feeders, it was found that these will repay grain-feeding costs when wheat is $30 or less per ton and when weaners sell at 8 cents per pound or better.

8. Wintering tests were carried out with dry beef cows, and cows with nursing calves, in the Coast Range region after they had been pastured during the summer on seeded, cut-over land. Because of the unusually mild winter the addition of wheat to the hay ration did not prove as effective as could be expected under more normal weather conditions.

9. Yearling heifers and steers were also wintered with access to cut-over-land pasture. More pasture than usual was available because of the mild weather, but in all cases the condition of the cattle receiving wheat as a supplemental feed was better in the spring than those receiving only hay and pasture.

Wheat for Sheep and Lambs

10. In lamb-fattening experiments at the Central Station it was found that, if healthy lambs free of internal parasites are used, they will make normal gains when fed a pound of wheat each per day with all the chopped alfalfa hay that the lambs can consume.

11. In feeding experiments at the Eastern Oregon Branch Livestock Experiment Station, it has been shown that 200 pounds of alfalfa hay and 100 pounds of grain are average feed requirements to convert a feeder lamb into a good market lamb in about 90 days. Wheat gave slightly better results than either barley or oats.

12. Breeding ewes were wintered on chopped alfalfa hay and wheat at the Central Experiment Station. During an unusually mild winter the ewes consumed about 47 pounds of wheat and 169 pounds of alfalfa hay per head. They showed no digestive disturbances, produced a good crop of lambs, and produced a wool clip showing a higher percentage of combing wool than was usually produced by this flock.

13. At the Astoria Branch Station on cut-over land, breeding ewes were wintered on low-protein grass hay plus wheat, in comparison with a similar lot fed hay alone. While the feed cost was higher per pound of gain for those receiving wheat, it was observed that this lot had stronger lambs at birth, which made more rapid gains than those fed hay alone. Both lots had access to pasture.

14. Ewe lambs kept for breeding were fed wheat as a supplement to hay, both at the Central Experiment Station and the Astoria Branch Station. Every indication from both these experiments was that wheat as a grain fed with hay is an entirely satisfactory ration for short winter feeding periods. As in similar experiments with other classes of

sheep, additional tests are needed under more severe weather conditions before definite conclusions may be drawn.

Dairy Cattle, Hogs, and Horses

15. Wheat proved an entirely satisfactory substitute for the usual grain ration in feeding dairy heifers through the winter. Heifers fed wheat with a low-quality hay made satisfactory gains and came out in the spring in a thrifty, well-nourished condition.

16. Wheat was substituted for other grains in the ration for dairy cows at the rate of 25, 50, and 75 per cent wheat in the mixture of concentrates. Results showed that wheat can replace up to 50 per cent of the barley, oats, and wheat bran, and can be fed at the rate of 8 to 10 pounds daily without affecting the palatability of the mixture, and without any unfavorable effect on milk flow. Even a 75-per-cent replacement would be justified if price comparisons warranted, although somewhat less palatable than the lower percentages.

17. Wheat used in fattening hogs showed that it is equal to corn in producing gains, and that it produces a high-quality pork with firmer fat, which is preferred by western buyers.

18. Wheat was substituted for oats in a feeding experiment with growing colts. In a direct comparison, those receiving wheat over a 110-day feeding period made just as satisfactory gains as those receiving oats.

19. Ground wheat was fed to draft horses in direct comparison with oats during the working season. A direct comparison was made by having one horse in each team fed wheat while the other received oats. These tests showed that processed rolled wheat is a satisfactory concentrate to use for work horses in combination with ordinary grain-and-vetch hay. Those receiving wheat were maintained in a thrifty and vigorous condition on 20 per cent less wheat than the oats required for their teammates.

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Illustration on cover—

This pen of prime baby beef was fattened on wheat and Willamette Valley oats-and-vetch hay.

Surplus Wheat Feeding Experiments and Demonstrations in Oregon

(A Preliminary Report)

Compiled by

JOHN C. BURTNER, Extension Editor

From research reports of wheat-feeding investigations conducted by experiment station staff members.*

INTRODUCTION

THE state of Oregon, like other states of the Pacific Northwest, produces a surplus of wheat and a surplus of feeder livestock. Formerly the surplus wheat could be exported profitably and livestock men found it reasonably profitable to allow their feeder cattle and sheep to be taken to other states for finishing. With the export outlet for wheat apparently permanently impaired, if not largely destroyed, wheat prices have been forced down to an equality with other feed grains. Meanwhile the market for grain-fed cattle, as well as for well-finished lambs and hogs, has increased on the Pacific Coast.

It has appeared to leaders of the livestock and grain industries and to the Oregon experiment station therefore, that the time has come for changing the type of Oregon livestock production, which will involve the use of surplus Oregon wheat for producing Oregon livestock for market.

While much experimental information is already available regarding the practicability of using wheat as a feed grain, experiments on this subject have lacked the large-scale and state-wide application and the demonstration qualities necessary to convince large numbers of the livestock producers of the profitable possibilities in this field.

With the U. S. Department of Agriculture, through the Federal Surplus Commodities Corporation, holding large tonnages of wheat, it appeared logical that the long-time aims of the Agricultural Adjustment Administration for adjusting wheat production to effective demand might well be furthered by the use of some of this stored surplus wheat for expanding wheat-feeding experiments and demonstrations.

As a result of negotiations to this end carried on by the Oregon congressional delegation, western leaders in the AAA, and the Oregon experiment station, 350 tons of this surplus wheat were made available by the Federal Surplus Commodities Corporation for such experimental use in this state. This wheat was used in projects at the central and three branch experiment stations.

* Experiments reported in this circular were conducted by:
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This report is designed to explain the aims of these experiments, the manner in which they were carried on, and the preliminary results obtained. Although the experiments are being continued to obtain more complete information, the facts developed during this first year, together with those previously established in more limited experiments, are believed to be of economic value to the Oregon livestock industry and are here set forth in a way that is believed to be most helpful to the industry.

ECONOMIC SITUATION

The Pacific Northwest produces annually an average surplus of 40 million bushels of wheat above the normal consumption in the producing area. Oregon produces approximately 13 million bushels of this surplus. The production and consumption of wheat in Oregon for the 10-year period 1925-1934 is shown in the following table:

Average Oregon production		20,109,000 bushels
Used for seed	1,000,000 bushels	
Used for feed	1,600,000 bushels	
Used for human consumption	3,818,000 bushels	
Total consumed in state		6,418,000 bushels
Total surplus		13,691,000 bushels

These figures show that for the 10-year period ending in 1934 slightly more than two-thirds of Oregon's wheat was available for export—an outlet which no longer exists for any such quantity.

Much of the land now used for wheat in Oregon is not well adapted to the production of any other crop. Even on a feed-grain price basis, however, wheat can be produced more economically on such land than can other crops. Many of the lower-yielding areas of Oregon's wheat lands have already been retired from production under the AAA conservation program, so that the bulk of the remainder is of too high value to be used for other purposes than small-grain production, which means principally wheat.

Oregon has from pioneer days maintained an important livestock industry. While the range portion of this major industry has centered in central and southeastern Oregon, both the cattle and sheep businesses are well distributed throughout the state. The following figures show the distribution of dairy and beef cattle in Oregon by districts according to the 1935 census:

Central and Southern Oregon	360,802
Willamette Valley and Lower Columbia counties	243,638
Northeastern Oregon	173,017
Southern Oregon	101,782
Columbia River counties	48,738
Total	927,977

Many of these cattle are sold outside the state as feeders. The Pacific Coast will eventually require at least 100,000 additional grain-fed cattle a year. If this number of cattle were fattened on wheat, 1½ million bushels would be used—this in addition to the amount that might also be used for feed during the growing period.

The Pacific Northwest produces 400,000 feeder lambs that are shipped to other states to be fattened. If these lambs were fattened on wheat and alfalfa

in the northwest, 1 million bushels of wheat could be so used. The 1935 census shows that Oregon had 2,209,898 sheep. About 1 million lambs are marketed annually in Oregon, 20 per cent of which are produced west of the Cascade Mountains, where they are raised in farm flocks of 300 or fewer.

The Pacific trade area ships an average of 2,600,000 hogs a year from the corn belt. If all these were produced here on wheat, approximately the entire surplus would be used.

The 1937 federal estimate credits Oregon with 258,000 head of milk cows. The average cow in the Willamette Valley eats 1 ton of feed grain a year. If wheat were used to the extent of one-fourth to one-half of this grain ration, approximately 2 million bushels of surplus wheat could be used.

The amount of wheat already fed in the state is largely consumed by poultry. Indications are that wheat could still further replace imported corn in the poultry ration, thereby providing an additional outlet for surplus wheat.

EXPERIMENTAL PROCEDURE

The experiments described in this bulletin dealt not only with the fattening of lambs, cattle, and swine, but with supplementary grain feeding during the growing period and with winter feeding of cattle on the eastern Oregon range and on western Oregon logged-off lands. They also dealt with winter feeding of breeding ewes and with wheat as a supplement to pasture for various kinds of livestock, and for use in poultry and dairy rations.

The wheat received from the Federal Surplus Commodities Corporation for use in experimental demonstration work was allotted as follows:

Central Agricultural Experiment Station at Corvallis (fattening steers, lambs, calves, swine, and feeding dairy cattle and poultry)	150 tons
Astoria Branch Experiment Station for use on Northrup Creek cut-over land grazing area (wintering cattle and sheep on logged-off lands)	75 tons
Squaw Butte Regional Range Experiment Station, Burns (wintering range cattle in southeastern Oregon	75 tons
Eastern Oregon Livestock Branch Experiment Station, Union (fattening steers, calves, lambs, and wintering breeding stock)	50 tons
TOTAL	350 tons

The wheat used in the experiments was of the varieties generally classed as soft white wheat, which is the chief kind produced in the Pacific Northwest. Chemical analyses of the various lots gave the following range in constituents:

	Per cent
Crude protein	9.24-10.79
Crude fat	1.88- 1.93
Crude fiber	2.47- 2.82
Calcium	.037
Phosphorus	.270
Ash	1.55- 1.69
Moisture	9.77-10.49
Nitrogen-free extract	73.64-74.60

In computing the results in all of the experiments, the cost of the cattle, feeds, and labor were charged at the regular commercial rate at which they were or could have been obtained. Comparisons were made with other standard feeds on a pound-for-pound basis and also by relative costs at the time the trials were carried on. Wherever possible, the livestock were either appraised or sold following experimental feeding periods in order to determine the actual cash returns under the prevailing commercial conditions.

USE OF WHEAT IN CATTLE FEEDING

CATTLE-FATTENING EXPERIMENTS

Cattle-fattening experiments with wheat as a supplemental feed were carried on at the Eastern Oregon Livestock Branch Experiment Station and at the Central Station.

The experiments at the branch station at Union were the largest and most inclusive, affording comparisons between steer and heifer feeding, comparisons of value of wheat and other grains, and a comparison of difference of hay when fed with wheat or with other concentrates. The fattening tests conducted at the central station in Corvallis were in two parts; the first dealt with two lots of cattle of different ages fed wheat with vetch-and-oat hay, while

Table 1. RESULTS OF FEEDING TRIALS AT EASTERN OREGON LIVESTOCK BRANCH EXPERIMENT STATION

Twelve Hereford Steer Calves Per Lot—Fed 129 Days

	Lot 1	Lot 2	Lot 3	Lot 4
	Alfalfa and grass hay; steam-rolled wheat	Alfalfa and grass hay; ground wheat	Alfalfa and grass hay; one-half wheat, one-half rye	Alfalfa and grass hay; ground wheat; molasses
	Pounds	*Pounds*	*Pounds*	*Pounds*
Average initial weight	550.00	549.60	545.90	550.40
Average final weight	851.20	852.10	865.80	847.90
Average total gain	301.20	302.50	319.90	297.50
Average daily gain	2.33	2.34	2.48	2.31
Average daily feed				
Hay consumed	11.22	11.35	11.22	10.45
Grain consumed	7.67	7.67	7.67	7.67
Molasses consumed	.....	.....	.....	2.71
Average total feed				
Hay offered	1,452.00	1,468.80	1,452.70	1,356.70
Hay consumed	1,446.80	1,463.60	1,447.40	1,347.70
Hay refused	5.20	5.20	5.30	9.00
Grain consumed	989.90	989.90	989.90	989.90
Molasses consumed	.....	.....	.....	349.80
Total hay cost per head	$ 4.72	$ 4.77	$ 4.72	$ 4.41
Total grain cost per head	9.90	9.90	8.66	9.90
Total molasses cost per head	.....	.....	.....	1.75
Total feed cost per head	$14.62	$14.67	$13.38	$16.06
Feed cost per pound gain	0.049	0.048	0.042	0.054
Estimated dressing percentage	60.5%	59.0%	61.0%	58.75%
Market value, Portland, April 29	$10.00	$9.75	$10.00	$9.50

Note: All hay fed chopped and mixed.

Feed prices: Alfalfa and grass hay at $6.50 per ton; wheat at $20 per ton; rye at $15 per ton; molasses at $10 per ton.

the second compared the relative efficiency of wheat with other concentrates as a supplement to Ladino clover pasture.

In the experiment at Union four lots each of steer and heifer calves were used. Each lot consisted of 12 grade Hereford calves. After the calves were weaned in November 1939, they were fed wild hay and ground wheat for about 1 month before they were put in the lots for the different feeding trials. At the start of the trials all cattle were weighed individually and graded so that all lots were as equal as possible in size and quality.

Tables 1 and 2 record the statistical results of the feeding trials.

Table 2. RESULTS OF FEEDING TRIALS AT EASTERN OREGON LIVESTOCK BRANCH EXPERIMENT STATION

Twelve Hereford heifer calves per lot—Fed 129 days.

	Lot 5 Grain hay; ground wheat (first 86 days)	Lot 5-A Alfalfa and grass hay; ground wheat (last 43 days)	Lot 6 Wild hay; ground wheat	Lot 7 Grain hay; ground wheat; linseed meal
	Pounds	*Pounds*	*Pounds*	*Pounds*
Average initial weight	478.00	614.20	491.80	486.40
Average final weight	614.20	723.30	735.90	747.50
Average total gain	136.20	109.10	244.10	261.10
Average daily gain	1.58	2.54	1.89	2.02
Average daily feed				
Peas and barley hay consumed	6.84	.....	.....	8.65
Alfalfa and grass hay consumed	1.06	10.77	1.04	.....
Wild hay consumed	.....	.....	8.37	.....
Grain consumed	6.25	9.67	7.69	7.44
Linseed meal consumed	.....	.....	.....	0.98
Average total feed				
Hay offered	761.10	470.30	1,227.90	1,209.00
Hay consumed	679.30	463.30	1,213.50	1,116.40
Hay refused	81.80	7.00	14.40	92.60
Grain consumed	537.10	415.60	991.50	959.80
Linseed meal consumed	.....	.....	.....	125.80
Total hay cost per head	$1.97	$1.53	$3.17	$3.02
Total grain cost per head	5.37	4.16	9.92	9.60
Total linseed meal cost per head	.....	.....	.....	3.15
Total feed cost per head	$13.03		13.09	15.77
Feed cost per pound gain	0.054	0.052	0.054	0.06
Estimated dressing percentage	57.0%		58.0%	58.5%
Market value, Portland, April 29	$8.75		$9.00	$9.00

Note: Heifers fed 86 days in Lot 5 on grain hay, then changed to alfalfa and grass hay in lot 5A.

Feed prices: Chopped alfalfa and grass hay at $6.50 per ton; peas and barley at $5.00 per ton; wild hay at $5 per ton; wheat at $20 per ton; linseed meal at $50 per ton.

It will be noted from these tables that steer calves made faster gains in the feed lot than heifer calves, a result which confirms previous experience at this and other stations. The heifer calves showed their finish a little more quickly than the steer calves, and each lot consumed about the same amount of feed per day. Considering the feed consumed and gains made, it cost about 1 cent more to put 1 pound of gain on a heifer calf than on a steer calf.

It was also shown in this and previous tests that calves weighing around 450 to 500 pounds, if of good beef breeding and quality, make more economical use of feed than do older cattle. Calves smaller than this make slower gains.

It was found that some 6 to 7 pounds of grain a day are a satisfactory ration for a 5-months feeding period, which is sufficient for western markets. This means that about 1,000 pounds of wheat or other grain are required with 1,500 to 1,800 pounds of alfalfa hay for each animal. The grain feeding was started at the rate of 1 pound per day and increased slowly until, during the last month, 10 pounds of grain per day were fed.

In the steer-feeding tests it was found that steam-rolled wheat and coarsely ground wheat gave approximately the same results. The cattle fed steam-rolled wheat were appraised as having slightly more finish and were valued 25 cents higher than the cattle getting ground wheat.

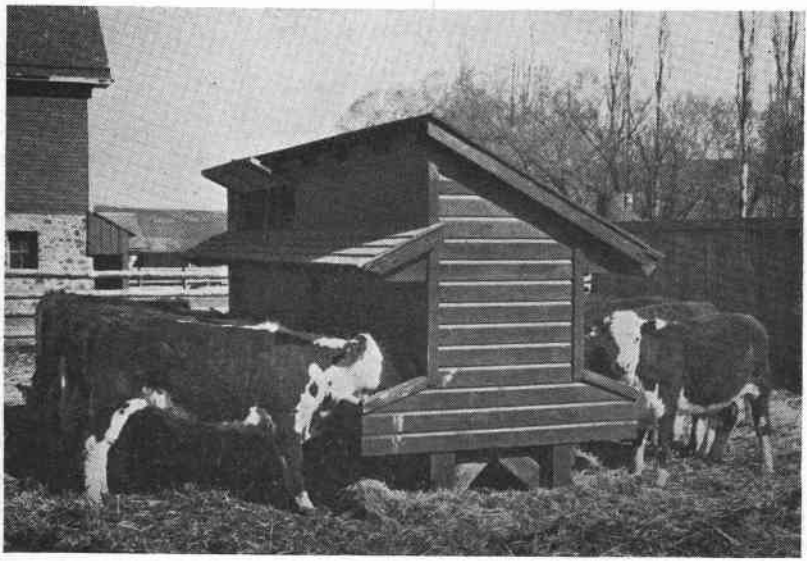

Figure 1. Wheat and chopped alfalfa hay were fed successfully in this type of self-feeder at the Eastern Oregon Livestock Branch Experiment Station.

All lots in this feeding test received wheat as the grain supplement, although in some cases both wheat and rye were fed, and in other cases wheat and linseed meal supplied the concentrate. Previous tests at the same station had shown that wheat was equal to or better than barley or other feed grain in a fattening ration. Tests this year showed that when the grain consisted of half rye and half wheat, faster gains were made than when wheat alone or other combinations were used.

This is considered an important finding as previously rye grain has not been looked on with favor as a desirable grain for fattening cattle. When mixed with wheat, however, it appears to be an entirely satisfactory grain for fattening purposes.

Results of feeding steers in lot 4 with grain supplemented by molasses showed that this combination has no advantage. In fact, the gains made by this lot were at a higher cost and the steers showed a poorer finish.

The tests showed conclusively the value of alfalfa hay as compared with other roughages in fattening cattle, at least in eastern Oregon. The results of the heifer-feeding trials showed that neither grain hay nor wild hay with

ground wheat provided a satisfactory fattening ration unless, as in lot 7, it was supplemented with linseed meal.

The grain hay used in these tests was beardless barley cut at the soft-dough stage. It had a good green color and contained a mixture of white Canadian field peas. The alfalfa hay used was chopped first cutting and contained a mixture of one-fourth grass, which was used to help control bloat.

On the basis of feed required for a hundred pounds of gain, the alfalfa and grass hay was worth $3.55 per ton more than the grain hay. Thus if the alfalfa and grass hay were valued at $6.50 per ton chopped, the grain hay was worth only $2.95 per ton on the same basis.

Lot 6 received 1 pound of chopped alfalfa per head each day with their grain, in addition to all the wild hay they would clean up. This proved to be a valuable protein supplement. Lot 7, fed grain hay, ground wheat, and linseed meal, showed satisfactory gains and were well finished at the end, but this ration was not as economical as that consisting of alfalfa and grass hay with wheat. The wheat was fed twice each day during the early months of the experiment, but was changed to three times a day after March 1.

A more detailed report on the results of this feeding experiment, together with practical suggestions on cattle fattening in eastern Oregon, can be found in Station Circular of Information No. 218.

Central Station experiments. In the cattle-fattening tests at the Central Station two lots of eight calves each were used. These were designated as lots 21 and 22 in the series of trials that have been conducted here. Lot 21 consisted

Table 3. RESULTS OF FEEDING TRIALS AT CENTRAL STATION.
Eight Head of Calves Per Lot—Fed 147 Days*

	Lot 21 5 steers, 3 heifers	Lot 22 8 steers
	Ground wheat, vetch-and-oat chopped hay	Ground wheat, vetch-and-oat chopped hay
	Pounds	*Pounds*
Weights per head		
Weight at beginning of test	459.38	655.50
Weight at end of test	704.50	909.00
Gain	245.12	253.50
Average daily gain	1.67	1.75
Feed record per head		
Wheat offered	679.00	874.53
Hay offered	1,836.25	2,221.17
Salt and bonemeal	ad. lib.	ad. lib.
Daily feed per head		
Wheat offered	4.62	5.95
Hay offered	12.49	15.11
Feed per 100 pounds gain		
Wheat	277.00	340.24
Hay	749.11	864.15
Initial cost per head (@ 7½¢ a pound)	$33.31	$47.52
Cost of feed per head		
Wheat @ $30 a ton	10.18	13.12
Hay @ $10 a ton	9.18	11.11
Total feed cost	$19.36	$24.23
Cost per head cattle and feed	$52.67	$71.75
Cost of 100 pounds gain	7.90	9.42
Final cost cattle and feed per 100 pounds	$ 7.48	$ 7.89

* One steer removed from lot, for slaughter test, 16 days before end of experiment.

of eight head of spring calves, including both heifers and steers, while lot 22 consisted of eight older calves, born in the fall of 1938. The spring calves graded good-quality feeders at the start of the test, while the older calves graded medium.

Both lots of calves were barn-fed and were kept on grain and hay feed for approximately 40 days before actual test records were begun, in order to accustom the calves to the new ration. Each lot was fed twice daily, and each had access to water and to a mixture of equal parts ground salt and sterilized steamed bonemeal. The younger cattle were fed approximately 5 pounds of wheat per head per day, together with all the hay they would consume, while the older lot received 6 pounds of wheat per head per day.

Table 3 shows the results of the trials.

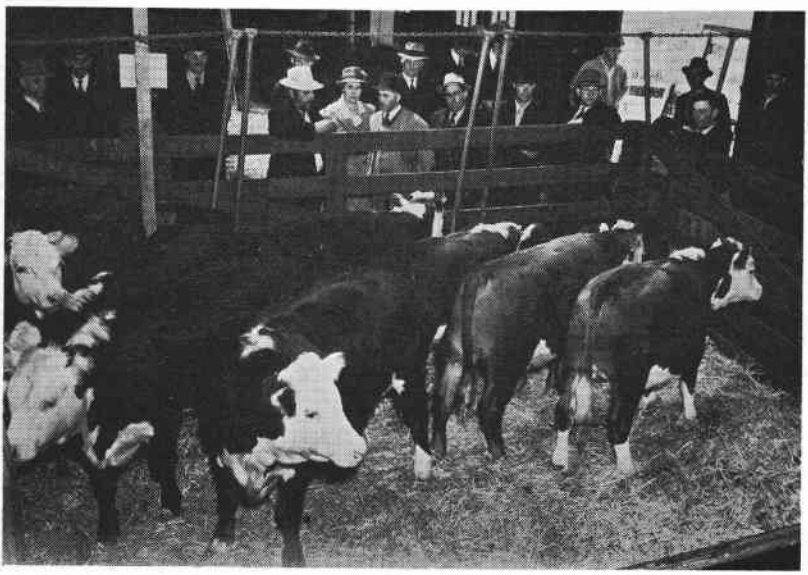

Figure 2. Visitors at the annual beef feeders' day at Corvallis looking over a pen of wheat-fed Hereford calves.

It will be noted in the results that the daily gains averaged somewhat better for the older calves than for the younger, but that the daily gains for each lot were somewhat less than are usually expected of fattening calves. This is partly explained by the fact that these calves had already been on feed for 40 days prior to the beginning of the test. The fact that the grain ration was limited also had some effect on the results. One of the objects of this test was to feed as little grain as possible and still get the calves fat enough for market.

Study of the feed record shows that approximately 15 per cent of the hay offered was refused. The hay was of good color and cure but was of coarse quality, containing a considerable amount of stems.

For the younger calves each 100 pounds of gain required 277 pounds of wheat and 749.11 pounds of hay. The older calves required 340.24 pounds of

wheat and 864.15 pounds of hay for each 100 pounds of gain. The cost of producing 100 pounds of gain was $7.90 for the younger calves and $9.42 for the older lot. The final cost of the younger cattle was $7.46 per 100 pounds, and the older ones $7.89. The average selling price of both lots was $9.38 per hundred, after all marketing expenses were deducted, which was the top market price for cattle for the day they were sold at the Portland stockyards.

Killing data for the two lots revealed that the younger calves dressed 56.4 per cent, while the older dressed 58 per cent, although the quality of the younger calves was considerably better than that of the older. It will be noted, however, that the younger calves were graded higher as feeders than the older, which may account for the difference in carcass grades at the end of the feeding period.

Conclusions. From these two fattening tests in eastern and western Oregon, the following conclusions are drawn:

1. The chemical analysis of the wheat used showed that 100 pounds of wheat had from 3 to 5 per cent more total nutrients and slightly more protein than the same amount of No. 2 feed corn or barley.

2. In the eastern Oregon experiment 6 to 7 pounds of grain a day were found to be a satisfactory ration, along with good hay. Where alfalfa hay was used no protein supplement was necessary. In the western Oregon test less profitable gains were made in feeding 5 to 6 pounds of wheat per day with oats and vetch hay.

3. Either steam-rolled wheat or ground wheat is satisfactory for cattle fattening, and both proved palatable when fed either straight, as in the eastern Oregon test, or mixed with a small amount of cut hay, as was done in western Oregon.

4. The western Oregon tests showed that if hay is charged at $10 per ton and wheat at $30 per ton, a man fattening cattle would have between $1.40 and $1.90 per hundred pounds left above feed costs to pay for labor and interest on his investment and other incidental expenses, estimated at approximately $10 per head. These figures are based on market prices when the experiment was run. The eastern Oregon results were even more favorable because of the lower price for feed in that area and the faster gains, although greater distance from market adds to the freight cost of the finished cattle.

Wheat and pasture for fattening cattle. As irrigated pasture is becoming more and more common throughout the state of Oregon, as well as elsewhere in the west, an experiment was run to compare the relative efficiency of wheat with other concentrates that previously have been fed to beef cattle on Ladino clover pasture. Records were kept to show the cost of gains of cattle on this feed and of the carcass grades and general marketability of beef produced in this way.

Seven head of beef calves, born during the summer and fall of 1939, were taken from the college herd and placed in fenced Ladino clover pasture in April 1940. The lot included three head of Herefords and four head of Aberdeen Angus. Two were steers and the other five were heifers. The calves graded good to choice feeders at the start of the test.

The calves were divided into two lots with three grazed on a 1-acre field and four on another acre, with the two lots alternated during the season. These calves were fed an average of 3.67 pounds of ground wheat per day. After these seven head were fat five other steers were purchased and put on the plots.

Water and salt were available at all times. Table 4 shows the results of the test at the end of 190 days.

Table 4. WHEAT AS A SUPPLEMENT ON LADINO CLOVER PASTURE FOR FATTENING CALVES SUMMER 1940

Twelve head of calves pastured in 190 days.*
Animal days per acre: 565
Average animals per acre: 2.99

	Pounds
Grain (wheat) per head per day	3.67
Grain (wheat) fed per acre	2,087.25
Average initial weight per head	609.25
Average final weight per head	766.16
Gain per head	156.91
Average daily gain per head	1.65
Estimated gains for Ladino clover	546.19
Estimated gains from wheat	395.31
Total gains wheat and pasture	941.50

* Seven head fattened first, followed by 5 head on the same area.

These results compare favorably with those obtained during the summer of 1939, when barley instead of wheat was used for supplemental feed for beef cattle on the same Ladino clover pasture. During the 1939 season 745.4 pounds of beef were produced on each acre of Ladino clover pasture with barley as a supplemental feed. After deducting the fattening value of the barley fed, each acre of Ladino pasture produced 476 pounds of beef. Thus the returns from both pasture and grain were somewhat better when wheat was fed.

CATTLE-WINTERING EXPERIMENTS

Experiments with wheat as a supplemental feed for cattle fed over winter, but not for fattening, were conducted in the Harney Basin of eastern Oregon and at the Northrup Creek cut-over land experimental area in Clatsop County. The problems involved in the two areas are entirely different and in each case results of one year's tests were not conclusive because of unusual weather and other circumstances, but in each case results were indicative of the practical value of wheat as a supplemental feed under certain conditions.

In central Oregon stockmen find that the highest cost in the year's cycle of operations is during the hay-feeding period. With wide variation in precipitation from year to year, a corresponding variation in yield of hay is encountered. This results in periodical hay shortages, when emergency measures are needed to bring the cattle through without loss.

All through southeastern Oregon large acreages of rather low-quality marsh hay are available for use in wintering livestock. If wheat can be used to good advantage in connection with these low-quality hays for wintering stock, it would provide an important safety factor for the stockmen in regions where such hay is available.

One portion of the experiment dealt with wintering breeding cows on low-quality marsh hay supplemented with wheat. The comparative value of the hay available for such winter feeding in this region is shown in Table 5.

The hay consisted mainly of juncus, sedges, salt grass, and some bluejoint. It will be seen that the uncut hay was dangerously low in protein. The bunched hay was cut while green in August and immediately windrowed and

Table 5. COMPARATIVE ANALYSIS OF WINTER FEEDS

Feedstuffs	Crude protein	Calcium	Phosphorus
	Per cent	*Per cent*	*Per cent*
Stacked hay	5.60	0.40	0.130
Bunched hay	5.76	.50	.120
Uncut meadow	2.83	.41	.071
Alfalfa*	14.70	1.43	.210
Timothy and clover*	8.60	.65	.170
Wheat straw*	3.80	.22	.070
Cottonseed cake*	43.20	.24	1.110

* For comparison only.

rake bunched, a common method of processing in that area. Grade Hereford cows and heifers that had been raised on the Squaw Butte Station in the summer months were used in the test. They were divided into three lots as follows:

Lot 1, consisting of 15 mature cows and 5 yearling heifers, was placed on the uncut marsh land and fed .72 pound of wheat per head per day throughout 111 days of the feeding trials.

Lot 2, consisting of 20 cows and heifers, was placed on similar pasture but was fed .72 pound of cottonseed cake per head per day instead of the wheat.

Figure 3. Wheat or cotton cake, plus slough-grass hay cut green and bunched, cuts emergency feed costs in the Harney Basin in years of fall and winter feed shortage. A field with natural shelter and a good water supply is desirable.

Lot 3, consisting of 135 head of cows and heifers, was placed on a pasture where the hay was bunched. No wheat or other concentrates were fed.

Table 6 gives the results of these feeding trials.

Table 6. WHEAT AS A SUPPLEMENTAL FEED FOR WINTERING BREEDING COWS ON MARSH HAY, 1939-40.

	Lot 1 20 cows, 111 days	Lot 2 20 cows, 111 days	Lot 3 135 cows, 111 days
	Wheat	Cottonseed cake	Bunched hay
	Pounds	*Pounds*	*Pounds*
Average weight per head			
Initial	896.90	840.95	751.88
Final	774.50	819.70	778.70
Gain or loss per head			
During first period	—32.14	—20.24	.....
During second period	—18.56	—10.91	.....
During third period	—71.70	+ 9.90	.....
TOTAL FOR WINTER	—122.40	—21.25	+26.82
Total average loss in similar wintering trials*	.....	—10.00	.....
Total average loss on straw alone as emergency feed*	—122.00	—122.00	—122.00
Feed record per head per day			
Wheat	.72	.....	.....
Cottonseed cake	.....	.72	.....
Pasturage	ad lib.	ad lib.	ad lib.
Bunched hay	.....	.....	1.47 acre
Salt and bone flour	ad lib.	ad lib.	ad lib.
Feed costs per head for trial			
Wheat at $20.00 per ton	$ .80	$	$ .....
Cottonseed cake at $40.00 per ton	.....	1.60	.....
Bunched hay at 75¢ per acre (206 A.)	.....	.....	1.10
Pasturage at 50¢ per head per month	2.00	2.00	2.00
TOTAL FEED COST	$ 2.80	$ 3.60	$ 3.10

* Montana and Oregon Agricultural Experiment Station trials.

It will be noticed that lot 1, wintered on uncut marsh pasture plus wheat, lost 122.4 pounds per head during the trial. This weight loss corresponds closely to results obtained in trials run by the Montana experiment station, where straw was used as an emergency winter feed. At the end of the period this lot showed a 20-per-cent loss in grade for condition.

Lot 2, fed cottonseed cake as a supplement, lost only 21 pounds per head during the period. At the end of the trial there was a gain of 16.6 per cent in the grade for condition, which would indicate that the higher protein of the cottonseed cake was an important factor in the results, as total digestible nutrients in the wheat are higher than in the cottonseed cake by a proportion of 83.6 per cent to 75.5 per cent. The protein, on the other hand, was 9.92 per cent for the wheat and 43.30 per cent for the cottonseed cake.

Cows in lot 3, on bunched hay, gained an average of 26.8 pounds per head, and came through the winter in generally satisfactory condition.

Since Montana and Oregon studies have shown that mature cows that start the winter in good flesh can lose as much as 100 pounds without affecting the weaning weight of calves the following fall, this study was based on cow weights only.

Comparison of costs, with all cattle charged 50 cents per head per month for pasture, showed that lot 1, on uncut hay and wheat, was wintered at a cost of $2.82 per head, compared with $3.60 for the group receiving cottonseed cake, and $3.10 for the group on bunched hay alone.

From these results it was concluded, on the basis of one year's study, that with protein the limiting factor in wintering cows on uncut marsh hay, wheat would need to be considered approximately one-third of the value, pound for pound, of cottonseed cake. Mature range cows can be emergency wintered on uncut marsh meadow if given ¾ pound per head per day of cottonseed cake, but can not be wintered satisfactorily on the same amount of wheat.

Bunched hay proved to be very cheap and a satisfactory feed for wintering stock in light-snowfall belts.

Use of wheat in growing out weaner calves into feeder cattle with low-quality marsh hay. This portion of the feeding trial was intended to ascertain the possibility of feeding short-weight weaner calves a grain ration throughout the winter to grow them into feeder cattle of such a size and grade that they could be sold for finishing during the following summer and fall.

Table 7. A COMPARISON OF WHEAT VS. WHEAT PLUS COTTONSEED CAKE FOR GROWING OUT SHORT-AGED WEANER CALVES IN THE HARNEY VALLEY, OREGON, INTO GOOD FEEDER CATTLE, WHEN THE ROUGHAGE USED IS LOW-QUALITY MARSH HAY, 1939-40.

Feeding Period, December 10, 1939 to March 20, 1940.

	Lot 1 8 steers, 17 heifers, 102 days	Lot 2 8 steers,* 16 heifers, 102 days
	Ground wheat and marsh hay	Ground wheat, cottonseed cake, and marsh hay
	Pounds	*Pounds*
Weight per head		
Beginning of test	400.80	387.910
End of test	490.60	502.000
Gain	89.80	114.090
Average daily gain, full period	.88	1.118
1st period on feed	.99	1.197
2nd period on feed	.59	1.107
3rd period on feed	1.07	1.390
Feed record per head		
Wheat offered	580.50	566.000
Cottonseed cake offered	.....	55.400
Marsh hay (ad lib.)	1,200.00†	1,200.000†
Feed per day:		
Wheat	5.70	5.500
Cottonseed cake	.....	.543
Feed per 100 pounds gain		
Wheat	646.40	496.000
Cottonseed cake	.....	48.550
Marsh hay	1,336.30	1,051.800
Salt and bone flour ad lib.	.....	.....
Cost record		
Initial appraisal of cattle per head	$32.50	$32.50
Feed cost per head:		
Wheat at $20.00	5.80	5.66
Cottonseed cake at $40.00	.....	1.11
Hay, 1,200 pounds at $4.00 per ton	2.40	2.40
Total cost per head‡	$40.70	$41.67
Cost per 100 pounds gain	$ 9.42	$ 8.26

* One steer died during trial.

† Impossible to weigh hay. Other trials indicate this age cattle will consume 12 pounds per head per day.

‡ Initial cost and feed alone.

The problem of what to do with fall calves has been a troublesome one, particularly for operators with limited summer range but good fall pastures.

The cattle used were short-aged, good-quality Hereford calves from the cows used in the cow-wintering trials. They weighed approximately 375 pounds on the first of December and were appraised at $32.50 per head. The cattle were separated into two groups. Lot 1 consisted of 8 steers and 17 heifers, and lot 2 of 8 steers and 16 heifers.

Hay was fed daily, and the stock were allowed to refuse some, which was fed to other cattle. Each lot was fed an average of about 5.5 pounds of wheat per head per day, with lot 2 getting ½ pound cottonseed cake in addition. Table 7 shows the results of the test.

With wheat charged at $20 per ton and cottonseed cake and hay at the going price at that time, the cost per hundred pounds of gain was excessive for both lots. Lot 1, on wheat alone, ran $9.42 per hundred pounds of gain. Lot 2 used $8.26 in feed per 100 pounds of gain. Even so, a profit was shown on the cattle because of the improved condition and grading of the lots at the end of the test. They were sold for $46 per head net at the feed lot.

From these preliminary results it is concluded that light-weight weaners in poor flesh, but thrifty, can be wintered on marsh hay and will repay grain-feeding costs when wheat is $30 or less per ton, when cottonseed cake is $50 per ton or less, and when weaners sell at 8 cents per pound or better. Marsh hays of best quality are necessary, however. If cottonseed cake is $50 or less per ton, it pays to feed at least ½ pound per head per day as a protein supplement.

These trials are being repeated to obtain more definite information.

Wintering on cut-over lands. West of the Cascade Mountains in Oregon are vast and increasing areas of cut-over timber lands, some of which are suitable in contour and climatic conditions to be used for summer grazing of livestock. Much of this land is rather distantly removed from tillable areas, which presents a problem of transporting feed for winter use. Mild winters over much of this cut-over area make winter feeding largely a problem of supplementing available grass during periods of snow cover.

A number of advantages result from wintering the livestock on these cut-over lands. These advantages include utilization of fall and winter growth of the grasses, saving of the expense of moving cattle to and from feed supplies, and better control of brush and weeds through browsing.

In the feeding trials hay and wheat were used.

In the first two cattle-feeding tests equal parts of good-quality grass-and-clover hay, and oat-and-vetch hay were used. As a supplemental concentrated feed ground pea screenings were fed in comparison with the wheat. These screenings are a by-product of the Austrian winter-pea-seed business in the Willamette Valley and a considerable tonnage is available. These pea screenings were finely ground and carry a crude protein analysis of 13.36 per cent. The wheat crude-protein analysis was about 10 per cent. A mineral supplement of sterilized bonemeal was mixed with salt and was available at all times. All hay was fed long, while the wheat was dry rolled.

Wintering dry beef cows. As in other cattle regions, economical wintering of dry beef cows constitutes one of the principal problems for the beef operator in this section. In this feeding trial 14 head of cows were divided equally into two lots. Calves were weaned from these cows shortly before the feeding period started. The cows were considerably below average in weight.

Lot 1 received a light hay feeding with 4 pounds of rolled wheat per head

daily. Lot 2 received a full feed of hay only. Results of the feeding trial are shown in Table 8.

Figure 4. Corrals used in handling stock on the Northrup Creek logged-off land experimental grazing area.

Table 8. WINTERING PREGNANT BEEF COWS.
Fed 109 days in Dry Lot.

	Lot 1—7 head	Lot 2—7 head
	Rolled wheat, grass hay	Grass hay
	Pounds	*Pounds*
Average initial weight	846.00	848.00
Average final weight	984.00	962.00
Average total gain	138.00	114.00
Average daily gain	1.26	1.04
Average daily feed		
Grass hay consumed	9.80	19.60
Rolled wheat consumed	4.00	.....
Average total feed		
Hay	1,068.20	2,136.40
Rolled wheat	436.00	.....
Total hay cost per head	$ 4.27	$ 8.55
Total grain cost per head	6.54	.....
Total feed cost per head	10.81	8.55
Feed cost per pound gain	0.078	0.075

Note: All hay fed long.
Feed prices: Grass hay $8.00 ton; wheat $30.00 ton.

It will be seen that the cattle receiving hay and wheat consumed $10.81 worth of feed per head, while the lot receiving hay alone consumed $8.55 worth. The feed cost per pound of gain, however, was approximately the same in both cases. At the end of the feeding test the general condition of the first lot was slightly better than the other. These cows calved shortly after the end of the feeding period, and the calves from the lot receiving wheat made considerably better gains during the early spring. The significance of the better gains cannot be determined until the calves are marketed.

Wintering beef cows and nursing calves. For this experiment 12 cows and their calves were divided into two equal lots. The first lot was fed a ration consisting of rolled wheat, ground pea screenings, and grass hay. The other lot had only ground pea screenings and grass hay. The results of this test are shown in Table 9.

Table 9. WINTERING BEEF COWS AND NURSING CALVES.
Fed 109 days in Dry Lot

	Lot 1 6 cows and 6 calves	Lot 2 6 cows and 6 calves
	Rolled wheat; ground pea screenings; grass hay	Ground pea screenings; grass hay
	Pounds	*Pounds*
Average initial weight, cows	826.00	828.00
Average initial weight, calves	268.00	260.00
Average final weight, cows	978.00	962.00
Average final weight, calves	426.00	418.00
Average total gain, cows	152.00	134.00
Average total gain, calves	158.00	158.00
Average total gain, cows and calves	310.00	292.00
Average daily gain, cows	1.39	1.23
Average daily gain, calves	1.45	1.45
Average daily feed		
Hay consumed	11.8	19.6
Rolled wheat consumed	6.0	.....
Ground pea screenings consumed	2.0	4.0
Average total feed		
Hay consumed	1,286.2	2,136.4
Rolled wheat consumed	654.0	.....
Ground pea screenings consumed	218.0	436.0
Total hay cost per head	$ 5.14	$ 8.55
Total grain cost per head	12.64	5.67
Total feed cost per head	17.78	14.22
Total cost per pound gain	0.057	0.049

Note: All hay fed long.
Feed prices: Grass hay $8.00 ton; rolled wheat $30.00 ton; ground pea screenings $26.00 ton.

The value of these ground pea screenings was such that the cost of wintering the cattle on pea screenings and hay alone was less than where wheat was used. The cost, however, was reasonable in both cases.

Wintering yearling heifers and steers. This experiment was conducted to determine what use young cattle could make of grass on the range during the winter months. While the two previous projects involved dry-lot feeding, the yearlings in this experiment were allowed to graze on the cut-over pasture land.

The yearlings were divided into two lots of 10 head each. Lot 1 had 62 acres of grass pasture to feed over, and these were fed a wheat supplement of 4 pounds per head daily. Hay was available in racks. Lot 2 had access to 130 acres of grass and had hay available in racks but received no wheat supplement. Table 10 shows the results of this trial.

Table 10. WINTERING YEARLING HEIFERS AND STEERS.
Fed 85 days in Shelters on Range.

	Lot 1—10 head	Lot 2—10 head
	Wheat; hay; grass	Hay; grass
	Pounds	*Pounds*
Average initial weight	546.4	548.0
Average final weight	667.5	646.2
Average total gain	121.1	98.2
Average daily gain	1.44	1.16
Average daily feed		
Hay consumed	4.2	13.6
Grain consumed	4.0	.....
Acres grass pasture available	62.0 acres	130.0 acres
Average total feed		
Hay consumed	357	1,156.0
Grain consumed	340	.....
Total hay cost per head	$1.43	$4.62
Total grain cost per head	5.10	.....
Total feed cost per head	6.53	4.62
Feed cost per pound gain	0.054	0.047

Note: Hay fed in racks—available at all times.
Feed costs: Hay $8.00 ton; grain $30.00 ton.

The yearlings receiving the supplemental feeding of wheat did not pasture the grass as closely as those receiving hay alone and they consumed only 4.2 pounds of hay per head daily, compared to 13.6 pounds for the lot receiving no supplemental wheat. In comparison with results in the dry-lot feeding, it appeared that the grass replaced about ½ ton of hay for each head of stock.

Conclusions. As a result of these three feeding tests, which were conducted under unusually favorable weather conditions, it was concluded that wheat is a practical supplementary feed in wintering cattle in the Coast Range, but is not essential where reasonably good hay is available and where weather conditions permit considerable winter grazing.

In all cases, however, the condition of the cattle was better after wheat or ground pea screenings were used as a supplementary feed.

Further tests under varying weather conditions will be necessary before definite conclusions can be drawn as to the economic value of using wheat in wintering livestock in this area.

USE OF WHEAT IN SHEEP AND LAMB FEEDING

LAMB-FATTENING EXPERIMENTS

Lamb-fattening experiments with wheat as a supplemental feed were carried on at the Central Experiment Station.

Prior to the time the surplus wheat was received for these feeding experiments extensive fattening trials using wheat and other Oregon feed stuffs for

finishing lambs had been carried on at the Eastern Oregon Livestock Branch Experiment Station. Those experiments showed that under the conditions prevailing in that section of eastern Oregon, wheat is a superior grain supplement to use with alfalfa hay in feeding out lambs for market.

It was found that 200 pounds of alfalfa hay and 100 pounds of grain are average feed requirements to convert a thin feeder lamb into a good market lamb in about 90 days. In these tests wheat fed to lambs gave slightly better results than barley, which in turn was better than oats. A detailed report of those earlier feeding trials is contained in Station Bulletin 370, *Fattening Lambs on Oregon Feedstuffs*.

In the more recent feeding trials at the Central Station using the surplus wheat, a ration of chopped second-cutting alfalfa hay grown in the vicinity of Corvallis was used with wheat fed whole. The lambs used in the demonstration consisted of two lots, one containing 9 lambs pastured during the summer on Ladino clover, and the other containing 7 lambs that had not been on irrigated pasture.

The first lot had become seriously parasitized during the summer and the animals were treated with carbon tetrachlorethylene to rid them of stomach worms. They showed marked improvement when the feeding trials started December 11, 1939, but later developments showed that they were not sufficiently recovered to be good feeder lambs.

The lambs in lot 2 were healthy animals, with no symptoms of internal parasites.

Each lot was given all the grain and hay the animals would eat, and both were supplied with salt and fresh water at all times. Lot 1 was fed for 71 days and lot 2 for 55 days. Table 11 shows the statistical results of the test.

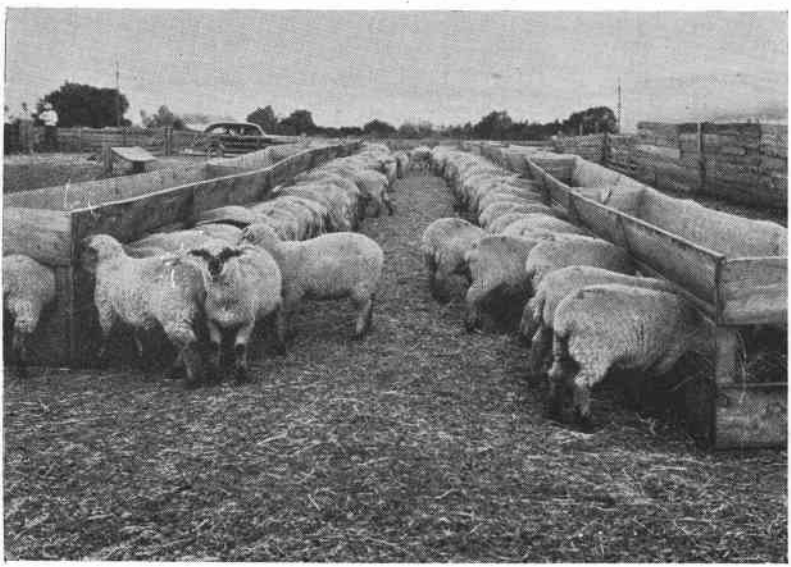

Figure 5. Wheat was fed whole successfully to these lambs in fattening trials at the Eastern Oregon Livestock Branch Experiment Station.

It will be noted that the lambs in lot 1, which had been seriously parasitized, would not consume enough hay or grain to make satisfactory gains. This was possibly due to a tender condition of their stomachs. The lambs in lot 1 consumed only .6 pound of wheat and 2.0 pounds of chopped alfalfa per day, which was not enough to produce economical gains. Lot 2 consumed 1.0 pound of wheat and 2.2 pounds of chopped alfalfa per day, which was at approximately the rate mentioned as satisfactory in the earlier eastern Oregon experiments.

Table 11. DEMONSTRATION OF THE USE OF WHEAT IN WINTER FATTENING OF LAMBS

	Lot 1 11 lambs, 71 days	Lot 2 7 lambs, 55 days
	Pounds	*Pounds*
Average initial weight	90.7	105.6
Average final weight	103.6	123.0
Average final gain	12.9	17.4
Average daily gain	0.182	0.316
Average daily ration		
Wheat	0.6	1.0
Chopped alfalfa hay	2.0	2.2
Average total feed		
Wheat	42.6	55.0
Chopped alfalfa hay	142.0	121.0
Feed required per 100 pounds gain		
Wheat	338.1	316.1
Chopped alfalfa hay	1,100.8	695.4
*Feed costs per lamb**		
Wheat	$0.639	$0.825
Chopped alfalfa hay	.852	.726
TOTAL	1.491	1.551
Feed cost per pound of gain	$0.116	$0.093

* Wheat $30.00 per ton; alfalfa $12.00 per ton.

The daily gains of the second lot were greater and the feed costs per pound of gain were lower than those in lot 1, and, in fact, were lower than in any winter-feeding test previously made at the Central Station using either barley or wheat fed with alfalfa hay. The lambs in lot 2 were killed at the station and showed very satisfactory carcasses.

The experiment revealed that good healthy lambs are necessary for satisfactory feeding regardless of the feed used, as any reduction of feed intake affects the cost of gains. Healthy lambs, free of internal parasites, will make satisfactory gains when fed a pound of wheat each per day, with all the chopped-up alfalfa hay the lambs can consume.

WHEAT WITH PASTURE IN LAMB FATTENING

A project has been started to compare wheat and barley as a grain fed to lambs being fattened on Ladino clover pasture, and to compare wheat plus Ladino clover pasture with wheat and sudan-grass pasture in lamb fattening. For this project 64 lambs were divided into four lots.

As this project was started late in the summer of 1940, the results had not been obtained in time for this report.

WINTERING BREEDING EWES

Tests on the winter feeding of breeding ewes by use of surplus wheat were carried on at the Central Experiment Station and at the John Jacob Astor Branch Station at Astoria.

At Central Station. The experiment carried on at the Central Station was in connection with the college flock of breeding ewes, consisting of 31 cross-breds (Longwool x Rambouillet), 18 Shropshires, 19 Hampshires, and 6 Southdowns.

These 74 ewes had excellent pasture available during much of the normal feeding season; hence they were not fed any grain or hay except during lambing time. These flocks were not bred to lamb at the same dates and consequently the time of the barn feeding varied with the different breeds. The feeding stopped for all of them, however, on April 20, at which time they were turned out to pasture.

During the feeding period they had the run of some lots adjacent to the sheep barns. Their feed consisted of 3 pounds of chopped alfalfa hay per day, and ½ pound of wheat per day prior to lambing. After lambing the grain was increased to 1 pound per day. As in previous tests, the grain was fed whole in flat-bottomed troughs.

These ewes consumed during the feeding period about 47 pounds of wheat and 169 pounds of alfalfa per head. At no time was there any evidence of digestive disturbances. Table 12 shows the changes in body weights during the season.

Table 12. CHANGES IN BODY WEIGHTS OF EWES.

Breed	December 26	January 30	March 4	Immediately after lambing	August 9
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Cross-breds	170.6	181.1	.....	165.9	159.2
Shropshires	161.2	164.4	178.4	167.7	148.0
Hampshires	181.4	176.4	194.6	170.7	154.4
Southdowns	131.4	130.8	.....	123.0	120.4
All lambs	168.1	172.2	.....	164.2	152.5

The ewes gained in weight up to lambing time and lost weight during lambing and during the suckling period. From December 26 to January 30 these ewes gained an average of .12 pound per head per day. During parturition they lost an average of 15.7 pounds per head. The average birth weight for the lambs dropped was 9.4 pounds, leaving 6.3 pounds to be accounted for otherwise. During the suckling period these ewes lost an average of 11.7 pounds per head.

Of the 74 ewes bred, 3 did not lamb, 2 died during lambing, and 4 died in pasture after the feeding period. The 71 ewes that lambed produced a total of 108 lambs, 11 of which were born dead or died before 10 days of age. Six lambs died after reaching that age. Total lambs weaned from these ewes was 91. Expressed in percentages, 91.9 per cent of the ewes were still alive at weaning time, and out of a total drop of 145.9 per cent, a 123-per-cent lamb crop remained to be weaned. The figures on average daily gain shown in Table 13 were obtained by subtracting the birth weight from the weight

on July 20 and dividing by the age in days at that time. Following is the table showing weights and gains of the lambs from ewes receiving supplemental wheat:

Table 13. WEIGHTS AND GAINS OF LAMBS FROM EWES RECEIVING SUPPLEMENTAL WHEAT.

Breed	Number of lambs	Average birth weight	Average age on July 20	Average weight on July 20	Average daily gain since birth
		Pounds	*Days*	*Pounds*	*Pounds*
Cross-breds	41	9.7	144	80.9	0.494
Shropshires	17	9.5	114	67.3	.507
Hampshires	25	9.7	122	76.2	.545
Southdowns	8	6.3	148	59.7	.361
All lambs	91	9.4	132	75.2	.498

The fleeces produced by the ewes averaged 8.9 pounds, and varied with the breeds as follows: Cross-breds, 11.1 pounds; Shropshires, 7.8 pounds; Hampshires, 7.2 pounds; and Southdowns, 5.7 pounds. A higher percentage of combing wool than usual was produced with this flock. It would appear from this feeding test that wheat makes an entirely satisfactory and safe grain to feed breeding ewes.

In addition to supplying information on this point, the experiment also yielded valuable data on changes in body weights and on other factors connected with lambing.

At Astoria. In the experiment conducted at the Astoria Branch Station 250 head of ewes were divided into equal lots of 125 head each, consisting of various aged animals. The feeding period in this instance was for 90 days, with the amount of feed being increased during the last half of the period.

The hay used was principally baled Chewings fescue straw, very low in protein content. This hay is made after the seed is harvested with a combine. The remainder of the grass, including basal leaves, is cut with a mower, after which it is all raked, cured, and baled. The leaves are still green when it is cut. Such hay analyzes about 3.82 per cent crude protein.

The lot fed both hay and grain consumed 1.2 pounds of hay and 1 pound of wheat during the first half of the feeding period, and 1.6 pounds of hay and 1.5 pounds of wheat during the second half. The lot wintered on hay alone consumed 2.7 pounds of hay per head during the first half of the period, and 4.1 pounds during the second half. All of the hay was fed long as no equipment was available for cutting. The wheat was fed whole.

Table 14 shows the statistical results of this feeding test.

It will be noted that the feed cost per pound of gain was higher for those fed wheat than for those wintered on hay alone. This was partly explained by the fact that the two lots had access to 80 and 85 acres of pasture respectively, which yielded considerable feed inasmuch as the winter of 1939-40 was unusually mild.

While no exact records were kept, it was observed that the lot receiving wheat had considerably stronger lambs at birth, which made more rapid gains than those in the lot fed hay alone.

Table 14. WINTERING PREGNANT EWES
Two lots of 125 each, fed 90 days

	Lot 1 (first 45 days)	Lot 1A (second 45 days)	Lot 2 (first 45 days)	Lot 2A (second 45 days)
	Wheat; hay; grass	Wheat; hay; grass	Hay; grass	Hay; grass
	Pounds	*Pounds*	*Pounds*	*Pounds*
Average initial weight	109.7	120.7	110.2	117.6
Average final weight	120.7	137.4	117.6	130.6
Average total gain	11.0	16.7	7.4	13.0
Average daily gain	.244	.369	.164	.289
Average daily feed				
Hay consumed	1.2	1.6	2.7	4.1
Whole wheat consumed	1.0	1.5	.....	.....
Average total feed				
Hay consumed	54.0	72.0	121.5	184.5
Whole wheat consumed	45.0	67.5	.....	.....
Total cost hay per head	$ 0.216	$ 0.288	$ 0.486	$ 0.738
Total cost whole wheat per head	1.675	1.012	.....	.....
Total feed cost per head	.891	1.300	.486	.738
Total feed cost per head for 90-day period	.....	2.19	.....	1.224
Feed cost per pound gain	.081	.078	.065	.057

Note: Hay fed long.
Feed costs: Hay $8.00 ton; whole wheat $30.00 ton.
Lot 1 had access to 80 acres of pasture.
Lot 2 had access to 85 acres of pasture.

FEEDING WHEAT TO BREEDING EWE LAMBS

Use of supplemental wheat in the rearing and wintering of ewe lambs for breeding purposes was tried out in fattening projects at the Central Experiment Station and at the John Jacob Astor Branch Station at Astoria.

In the trial conducted at the Central Station, 8 Hampshires, 3 Shropshires, and 2 Southdown ewe lambs, selected for replacement stock from the 1939 college farm lamb crop, were fed chopped second-cutting alfalfa with wheat as a supplement. These 13 lambs had been grazed on mixed grass and sudan-grass pasture during the summer of 1939, and showed no symptoms of parasitic infestation at the start of the feeding period.

Because of the open fall, the lambs were not placed on winter feed until December 27, at which time they were fed as one lot. An attempt was made to feed about 1 pound of grain per head per day with all the chopped alfalfa they would eat, with about a 16-per-cent wastage. Feeding was continued for 60 days, closing on February 24, when they were moved to good pasture without further grain or hay being fed.

Table 15 shows the results of this feeding trial.

The results obtained compared favorably with the results in feeding experiments elsewhere, as reported in standard works on this subject. No digestive disturbances were noted in the demonstration and the whole wheat fed was readily consumed by the lambs. The lambs used in this test were to be weighed again in the fall of 1940 to obtain final data.

Fleeces from these lambs were tested for strength and no weak places were found. As western Oregon pastures are usually short during December,

Table 15. DEMONSTRATION OF THE USE OF WHEAT IN GROWING BREEDING EWE LAMBS.
13 lambs, 59 days

	Pounds
Average initial weight	103.8
Average final weight	117.7
Average total gain	13.9
Average daily gain	0.236
Average daily ration	
Wheat	0.85
Chopped alfalfa	2.1
Average total feed	
Wheat	50.0
Chopped alfalfa	124.0
Feed required per 100 pounds gain	
Wheat	359.7
Chopped alfalfa	892.1
*Feed costs per lamb**	
Wheat	$0.750
Chopped alfalfa	.744
TOTAL	$1.494
Feed costs per pound of gain	$0.107

* Wheat $30.00 per ton; alfalfa $12.00 per ton.

January, and part of February, adequate feed during this period induces maximum wool development and prevents the occurrence of weak places in the wool fiber.

Every indication from this experiment is that wheat as a grain fed with chopped alfalfa hay to growing ewe lambs is entirely satisfactory for the short winter feeding period.

The Astoria feeding test. Fifty head of grade Romney ewe lambs were used in the feeding trial at Astoria, these being divided into two lots of 25 each. Each lot had available a little more than an acre of pasture per head, which,

Table 16. WINTERING EWE LAMBS
Two lots of 25 head fed 90 days

	Wheat; hay; grass (40 acres)	Hay; grass (42 acres)
	Pounds	*Pounds*
Average initial weight (wooled)	93.1	93.0
Average final weight (wooled)	120.0	117.0
Average total gain	26.9	24.0
Average daily gain	.299	.266
Average daily feed		
Hay consumed	.6	2.2
Whole wheat consumed	.77	.....
Average total feed		
Hay consumed	54.0	198.0
Whole wheat consumed	69.3	.....
Total cost of hay per head	$0.21	$0.79
Total cost of whole wheat per head	1.04	.....
Total feed cost per head	$1.25	$0.79
Total cost feed per pound gain	.046	.033

Feed costs: Hay at 8.00 ton; whole wheat at $30.00 ton.

because of the mild winter, produced considerable feed. Hay was available at all times in racks, and was fed long. Table 16 gives the results of this test.

Figure 6. Excellent new grass cover established on burnt-over land in Northrup Creek area provides considerable winter as well as summer feed in mild seasons, thus reducing the amount of supplemental feed needed for wintering stock.

As shown in Table 16, the lot receiving wheat made slightly better gains but at an increased cost per pound. It is quite likely that in a more severe winter with less grass available, the advantage in favor of the wheat feeding would be greater, with costs more nearly comparable.

Wheat for creep feeding of lambs. A project planned at the Central Station to test the value of wheat for creep feeding of suckling lambs had to be abandoned because pastures were so good that creep feeding was not necessary. The lambs made an average daily gain of nearly ½ pound per head without grain, and those from the cross-bred ewes were ready for market by July 22.

WHEAT IN DAIRY CATTLE RATIONS

The value of wheat in the ration of dairy cattle has not received extensive attention of investigators either at state experiment stations or at the United States Department of Agriculture. This is mainly because wheat usually commands a market price not considered commensurate with its feeding value. With the prospect of fairly continuous price levels on a feed-grain basis, there is need for more facts as to its suitability.

Fairly extensive feeding tests with wheat in dairy rations have been made at the Texas Agricultural Experiment Station, where it was found that wheat could replace milo pound for pound up to 50 per cent of the total grain mixture. Stations in Maine, Ohio, Oklahoma, Kansas, and Kentucky have also reported various findings with wheat feeding for dairy cows over the past 45 years.

EXPERIMENTS WITH DAIRY HEIFERS

The experiments conducted with the surplus wheat in Oregon were carried out at the Central Experiment Station, where 36 heifers of Holstein, Jersey, and Ayrshire breeds, divided into groups, were fed 5 pounds of wheat daily to supplement a poor-quality hay, or both hay and silage. The wheat was fed in rolled, coarsely ground, medium ground, and finely ground forms.

Table 17 shows the results of these feeding tests.

Table 17. RESULTS OF FEEDING WHEAT TO DAIRY HEIFERS

Form of wheat fed	Group	Number of heifers	Period fed	Average daily gain	Normal daily gain
			Days	*Pounds*	*Pounds*
Rolled	B	9	53	1.113	0.667
Rolled	C	13	63	0.581	0.794
Coarse ground	A	8	53	1.770	0.694
Coarse ground	B	13	63	0.460	0.634
Medium ground	A	10	63	0.333	0.611
Fine ground	C	12	53	1.280	1.220

Average daily gain of all heifers in this feeding trial ..... 0.868 pound
Normal daily gain of heifers of this age ..... 0.783 pound

Ration fed daily

Group B—10 pounds oats-and-vetch hay
10 pounds corn silage
5 pounds rolled wheat
Group C—Oat-and-pea hay about 10 pounds
5 pounds rolled wheat
Group A—15 pounds oats-and-vetch hay
5 pounds coarsely ground wheat
Group B—10 pounds oats-and-vetch hay
10 pounds corn silage
5 pounds coarse ground wheat
Group A—15 pounds oats-and-vetch hay
5 pounds medium-ground wheat
Group C—10 pounds sudan-grass hay
5 pounds finely ground wheat

Each group of heifers was fed from December 2, 1939, to February 3, 1940, with one form of wheat, and from February 3 to March 28 on another form. The heifers consumed all forms readily and did not go off feed. Averaging the results with all groups, it was found that the heifers made an average daily gain throughout the period of .868 pound.

The normal daily gain of heifers of similar ages and breeds fed the usual ration of hay and 4 pounds of a concentrated mixture of barley, oats, wheat bran, and linseed oil meal, has been .783 pound, which would indicate that the wheat was an entirely satisfactory substitute for the usual ration. At the end of the winter feeding period, when the heifers were placed on pasture, they gave the general appearance of thrifty, well-nourished animals.

WHEAT FOR MILKING COWS

In the studies with dairy cows, nine animals in the regular dairy herd were selected to receive rations containing 25 per cent, 50 per cent, and 75 per cent

of medium-ground wheat at successive periods in their lactation. These nine Ayrshire and Holstein cows in various stages of lactation were divided into three groups, and received feed throughout their lactation period as follows:

Group I received hay, silage, and the regular herd mixture in early lactation; hay, silage, and the 25-per-cent-wheat mixture for 14 weeks, pasture and the 25-per-cent-wheat mixture for 9 weeks, and pasture with the regular herd mixture for the remainder of the lactation period.

Group II received hay, silage, and the regular herd mixture for from 20 to 24 weeks; hay silage and the 50-per-cent-wheat mixture for 14 weeks; and pasture and the 50-per-cent-wheat mixture for the remainder of the lactation period.

Group III was kept on hay, silage, and the regular herd mixture for from 21 to 33 weeks; on hay, silage, and the 75-per-cent-wheat mixture for 14 weeks; and pasture and the 75-per-cent-wheat mixture for the remainder of the lactation period.

The regular grain mixture, which contained 15.1 per cent of digestible protein and 71.2 per cent of total digestible nutrients, was made up as follows:

250 pounds ground barley
250 pounds ground oats
360 pounds wheat bran
100 pounds linseed meal
100 pounds soybean meal
100 pounds cottonseed meal
25 pounds salt
25 pounds bonemeal

The 25-per-cent-wheat ration, containing 13.89 per cent of digestible protein and 75.16 per cent of total digestible nutrients, was made up as follows:

250 pounds wheat medium ground
200 pounds barley medium ground
200 pounds oats medium ground
100 pounds wheat bran
70 pounds soybean meal
50 pounds cottonseed meal
50 pounds linseed meal
50 pounds peanut meal
20 pounds salt
10 pounds bonemeal

The 50-per-cent-wheat ration containing 13.96 per cent of digestible protein and 77.71 per cent of total digestible nutrients, was made up as follows:

500 pounds wheat medium ground
100 pounds barley medium ground
100 pounds oats medium ground
50 pounds wheat bran
70 pounds soybean meal
50 pounds cottonseed meal
50 pounds linseed meal
50 pounds peanut meal
20 pounds salt
10 pounds bonemeal

The 75-per-cent-wheat mixture, containing 13.94 per cent digestible crude protein and 80.11 per cent total digestible nutrients, consisted of the following concentrates:

750 pounds wheat medium ground
70 pounds soybean meal
50 pounds cottonseed meal
50 pounds linseed meal
50 pounds peanut meal
20 pounds salt
10 pounds bonemeal

It will be noted that ground wheat replaced all of the wheat bran, barley, and oats in the 75-per-cent mixture.

When the cows in group I began receiving the 25-per-cent-wheat ration they held up in production just as well, and possibly somewhat better than when fed the regular herd mixture.

The cows in group II also held up in milk after they received the 50 per-cent-wheat ration, to an even more nearly normal level than when they were receiving the regular herd mixture. The two cows in this group that had a normal lactation curve received 8 pounds of concentrates per day, of which 4 pounds were ground wheat.

The cows in group III, when changed from the normal grain ration to that made up of 75 per cent wheat, received 10 pounds of this mixture daily, of which 7½ pounds were ground wheat. In no case did the cows go off feed when receiving this high percentage of wheat in the ration, and their production was normal for the stage of lactation. It was observed, however, that the 75-per-cent mixture was not quite as palatable as the regular herd mixture, although the cows usually consumed the feed given. This tendency for the grain to be less palatable was especially noticeable during the period when the cows received pasture rather than the hay and silage as roughages.

The indications from this limited experiment are that wheat can replace up to 50 per cent of the barley, oats, and wheat bran in a concentrate mixture for dairy cows fed at the rate of 8 to 10 pounds daily without affecting the palatability of the mixture or its nutritive value, and without any unfavorable effect on the milk flow.

A higher percentage, at least up to 75 per cent, of wheat can be used with no adverse effect other than possible loss of palatability. A 75-per-cent replacement would be justified if the price of wheat in comparison to the other feeds indicated warranted the substitution.

Additional experiments are planned to compare rations containing wheat prepared in different ways as a possible means of affecting palatability.

WHEAT FOR PORK PRODUCTION

Wheat vs. corn. The experiments with feeding wheat to hogs were conducted at the Central Experiment Station. Two lots of 10 pigs each were confined in the hog barn and adjacent pens and provided rations designed to compare the feeding value of wheat and corn and the influence of these grains on the quality of pork produced.

Lot 1 was fed ground corn, fish meal, and alfalfa meal in the proportions of 83, 12, and 5 respectively. Lot 2 received ground wheat, fish meal, and alfalfa meal in the proportions of 85, 10, and 5 respectively. The pigs were fed these rations until the average weight of the animals in each lot was 175 pounds,

at which time they were sold and slaughtered and the carcasses were inspected for firmness of fat.

The corn used in the tests was No. 2 eastern, while the fish meal had a rating of 70 per cent protein. Both corn and wheat were ground to medium fineness in a hammer mill. Table 18 shows the comparative results with the two lots.

Table 18. COMPARISON OF CORN AND WHEAT FOR PORK PRODUCTION
Two lots of 10 pigs each, fed 48 days

	Lot I	Lot II
	Ground corn 83; fish meal 12; alfalfa meal 5	Ground wheat 85; fish meal 10; alfalfa meal 5
	Pounds	*Pounds*
Average initial weight	95.0	95.3
Average final weight	176.9	176.7
Daily gain	1.67	1.66
Daily feed	6.16	6.04
Feed per 100-pound gain	369.0	364.0

When these two lots were slaughtered the fat of 4 of the corn-fed hogs was judged medium hard, and of 2 was judged hard. All of the carcasses from the wheat-fed hogs had hard fat. Additional laboratory tests were made with samples of fat from the two lots that showed both by a refractive index and consistency as indicated by a penetrometer that the wheat produced a harder fat with higher melting point than the corn.

This confirms the oft-expressed opinion of Portland meat packers that western hogs fattened on wheat and other small grains have firmer carcasses than hogs shipped from the corn belt.

In a previous experiment two lots of pigs were fed rations of ground wheat, or ground corn, plus alfalfa meal and skim milk. The results of this test are shown in Table 19 for comparison.

Table 19. COMPARISON OF WHEAT AND CORN FED WITH SKIM MILK TO PIGS
Two lots of 10 pigs each, fed 58 and 52 days

	Lot I	Lot II
	Ground wheat 95; alfalfa meal 5; plus skim milk	Ground corn 95; alfalfa meal 5; plus skim milk
	Pounds	*Pounds*
Average initial weight	80.0	81.4
Average final weight	178.1	178.0
Average daily gain	1.7	1.71
Average daily feed		
Grain	5.0	4.8
Skim milk	8.0	8.16
Feed per 100-pound gain		
Grain	296.0	282.0
Skim milk	473.0	478.0
	Per cent	*Per cent*
Dressing	77.20	77.48

These tests confirmed previous experiments here to the effect that the feeding values of ground wheat and ground corn are equal so far as average

gains are concerned. Because of the firmer character of the carcass of hogs fed wheat as compared with those fed corn, western buyers at least prefer these to the corn-fed animals.

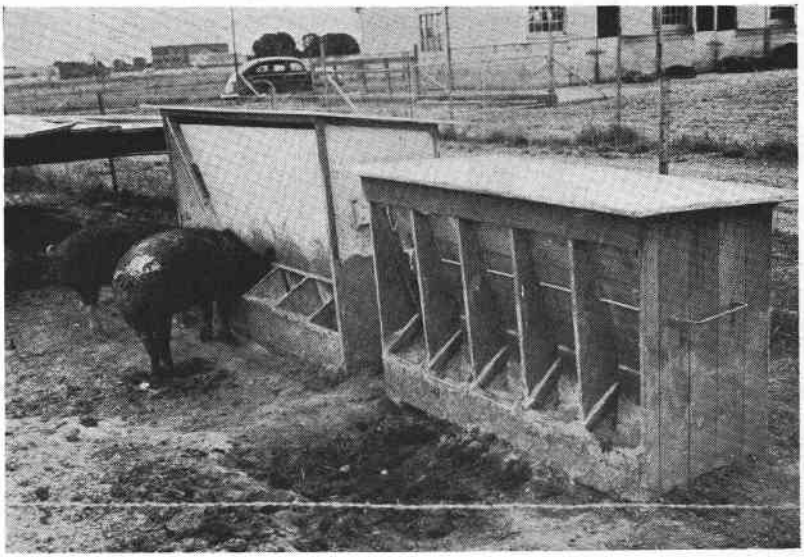

Figure 7. These self-feeders proved satisfactory for feeding wheat to pigs in tests at the Central Experiment Station.

Table 20. RESULTS OF FEEDING WHEAT WITH DRIED CULL PEARS TO PIGS
Four lots of 10 pigs each

	Lot 1 98 days	Lot 2 85 days	Lot 3 85 days	Lot 4 98 days
	Dried pears 4 pounds, ground wheat 1 pound, fish meal	Dried pears 2 pounds, wheat 1 pound, protein	Dried pears 1 pound, wheat 1 pound, protein	Ground wheat and protein mix
	Pounds	*Pounds*	*Pounds*	*Pounds*
Average initial weight	63.2	63.1	62.3	62.2
Average final weight	181.00	173.9	176.2	181.00
Daily gain	1.2	1.32	1.36	1.23
Daily feed of dried pears	3.78	3.41	2.76	.....
Ground wheat	1.02	1.83	2.76	4.63
Protein	0.65	0.59	0.41	0.21
Feed per 100 pounds gain				
Dried pears	314	262	206	.....
Wheat and protein mix	138	186	237	395
Pounds of dried pears to equal 100 pounds grain mix	122	126	130	.....
	Per cent	*Per cent*	*Per cent*	*Per cent*
Feeding value of dried pears in percentage of grain mix	82	79	77	.....

Wheat fed with dried cull pears. Four lots of 10 pigs each were used in an experiment to test the possibility of combining ground wheat with dried cull pears as a ration for pig feeding. These cull pears were sun-dried on the ground and contained, when fed, approximately 7 per cent of foreign material. This was deducted before computing the amount of feed to produce 100 pounds of gain. The pigs were fed in pens at the hog barn and did not have access to any pasture.

The proportions used and the results obtained are shown in Table 20.

It will be seen from this table that the average daily gain ranged from 1.2 to 1.36 pounds compared with an average daily gain of 1.7 pounds for the pigs in the experiment comparing corn and wheat. It required from 138 to 237 pounds of wheat and protein mixture to produce 100 pounds of gain when fed with the pears, as compared with 282 to 296 pounds of grain in the previous experiment.

These tests indicated that dried cull pears have a value of approximately 75 to 80 per cent of that of ground wheat by weight.

WHEAT FEEDING OF DRAFT HORSES

Wheat has never been extensively used as a feed for horses except on wheat ranches, for much the same reason that it has not been used extensively as a feed grain for other animals. Its former price level was such as to discourage its use as a feed grain. In the experiments recounted here an attempt was made to learn the possibilities in feeding wheat to draft horses, both for growing colts and as a concentrate for mature animals during the working period.

Wheat for growing colts. Seven draft colts were used in this test, divided into two lots, the first lot containing 2 animals and the second 5. The colts were born over a period extending from February 22, 1938, to May 12, 1939. The feeding period started December 8, 1939, and continued to March 7, 1940. Both lots were kept in the college barn and each animal was fed individually in a box stall during the test. The colts had all been fed hay and oats prior to being put on the wheat feed.

The average feed consumption for two yearling colts in lot 1 was 5.2 pounds of wheat and 14.9 pounds of hay per day. The five weanling colts in lot 2 consumed 4.5 pounds of wheat and 12.4 pounds of hay. These rations are considered somewhat limited for growing colts, and it was observed that these colts did not fatten but seemed to be in good growing condition.

The wheat fed was steam rolled and seemed very palatable to the colts. None experienced digestive disturbances or other sicknesses during the feeding trial. The hay fed was Willamette Valley hay consisting of vetch with oats and wheat.

Table 21 shows the average weights of the colts at the beginning and at the close of the test.

The older colts made an average gain of 80 pounds per head during the 110-day feeding period, while the younger colts made an average gain of 81.4 pounds per head.

The test revealed that wheat can be satisfactorily fed as a substitute for other farm grains commonly used for growing colts. While the daily gains in these tests were small, they compared favorably with those obtained here and elsewhere with colts on limited rations of other grains.

Table 21. RESULTS OF FEEDING WHEAT TO GROWING COLTS

Individual colts	Average weight December 8	Average weight March 27	Total gain
	Pounds	*Pounds*	*Pounds*
Lot 1			
King Laet	1,217	1,300	83
Golden Laet	1,120	1,197	77
AVERAGE	1,168.5	1,248.5	80
Lot 2			
Silver	805	897	92
Gray	720	822	102
Plate	770	843	73
Charlie	687	767	80
Millie	643	703	60
AVERAGE	725	806.4	81.4

Wheat for working horses. This test was designed to obtain information on the palatability of wheat for working horses, and to compare its efficiency with oats and its effect on the general health of draft horses. The oats used to compare with the wheat were No. 2 gray feed oats testing 36 pounds per bushel and containing 9.6 per cent crude protein. The hay used was locally produced on the college farm and was a mixture of oats, wheat, and vetch. All of the hay was fed uncut. It analyzed 6.74 per cent crude protein, such as is found in average Willamette Valley hay of this type.

Nine draft mares and a gelding kept for ordinary work on the college farm and campus were used in this experiment. The horses varied in age considerably, although each team was made up of animals of approximately the same age. The youngest was a team of 4-year-olds and the oldest team was 15 years old. All horses were fed individually in box stalls.

The amount of feed varied according to the work the horses were doing. While working, the horses usually received 1 pound of whole oats for each 100 pounds the horse weighed. When the horses were not working the grain ration was reduced and the hay ration increased.

In order to get a direct comparison, one horse in each team was fed steam-rolled wheat and hay, and the other horse was fed whole oats and hay. The horses were then worked together as much as possible, although sometimes single animals had to be used and consequently the number of hours each horse in a team worked was not necessarily the same as that of its team mate.

Some mares in the test produced and suckled foals and others were in foal during the test. Allowance was made for this and such mares were divided as equally as possible between the two groups receiving oats and wheat.

Table 22 shows the average daily rations fed the two sets of horses.

Table 22. RATIONS FED TO DRAFT HORSES IN COMPARING VALUE OF WHEAT AND OATS

Horse number	Average daily ration		Horse number	Average daily ration	
	Oats	Hay		Wheat	Hay
	Pounds	*Pounds*		*Pounds*	*Pounds*
1	10.94	21.35	1w	8.80	21.71
2	15.04	20.14	2w	11.94	20.08
3	9.91	21.73	3w	8.69	21.99
4	9.07	21.44	4w	8.97	21.31
5	12.65	20.88	5w	8.33	21.84
Average	11.72	21.11	Average	9.34	21.39

The horses fed wheat in this test received an average of 20.3 per cent less grain than the horses on the oat ration. This was in order to keep the total nutrients in the two rations as nearly the same as possible. The average ration shown is for the entire 236 days of the test, hence this includes the periods while the horses were idle as well as when they were at work. There was no difficulty in getting the horses to eat the rolled wheat and no digestive disturbances occurred.

The horses receiving wheat began to shed more than a month and a half earlier than those receiving oats. Nearly all of the winter hair was shed from the wheat-fed group before the oat-fed group started to shed on March 20. Both groups of horses appeared thrifty and in good health throughout the test.

The horses receiving oats made an average gain of 117.4 pounds during the test, while the horses receiving wheat gained an average of 69.8 pounds. Part of the difference is accounted for, however, by the fact that two of the mares receiving wheat had suckling foals and showed a loss of 45 and 136 pounds respectively.

As the foals were not fed any grain direct, it would seem logical to add the combined weight of the foals in each group to the gains made by the mares. When this was done the average gain per horse for the oat-fed group was 193.4 pounds, while the average gain for the wheat-fed group was 227.8 pounds.

Average hours of work by the two groups varied somewhat, although probably not enough to affect the experiment materially. The horses receiving oats worked an average of 1,091.4 hours, while those on the wheat ration worked an average of 968 hours.

From these tests it appears that steam-rolled wheat is a satisfactory concentrate to use for work horses in combination with ordinary Willamette Valley grain-and-vetch hay. The tests revealed that 80 pounds of wheat have a feeding value equal to 100 pounds of No. 2 feed oats; hence horses can be maintained on 20 per cent less wheat than oats. The horses receiving wheat were in a thrifty and vigorous condition all during the experiment and the mares fed wheat raised normal healthy foals.

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Agricultural Engineering

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Bacteriology

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