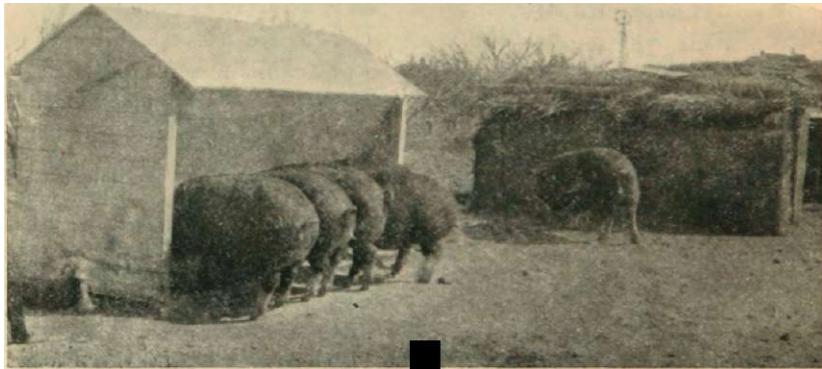


COLORADO DRYLAND FATTENING RATIONS FOR SWINE

BY E. J. MAYNARD, H. B. OSLAND AND J. F. BRANDON



Pigs fattened on proso or hog millet, sometimes called Hershey, plus a protein supplement. These pigs outgained pigs fattened on corn and same protein supplement.

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The Colorado Agricultural College

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COLORADO DRYLAND FATTENING RATIONS FOR SWINE

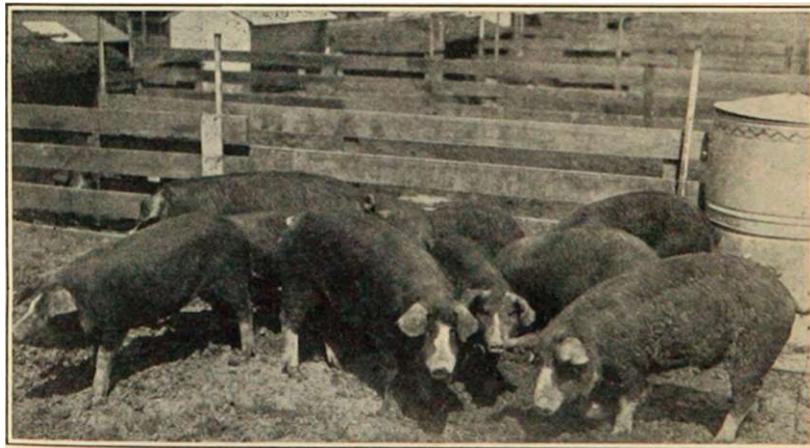
BY E. J. MAYNARD¹, H. B. OSLAND AND J. F. BRANDON

With the extensive development of production of forage and grain crops suited to the non-irrigated plains area of Colorado comes a need for information concerning the best use of these crops for growing and fattening livestock.

Modern livestock-feeding practice calls for an efficient, balanced ration. The need for a certain amount of protein or growth-producing nutrient in such a ration has been well established.

The carbonaceous forage crops—cane, corn, millet and sudan— are the surest crops for Eastern Colorado's non-irrigated areas¹. These crops however, like the grains, corn, wheat, oats, rye and millet which are grown there, are deficient in protein, while the protein they contain is recognized as being low in quality. Combinations with such roughages and concentrates usually make poor growing or fattening rations for livestock unless some good source of high-quality protein is added.

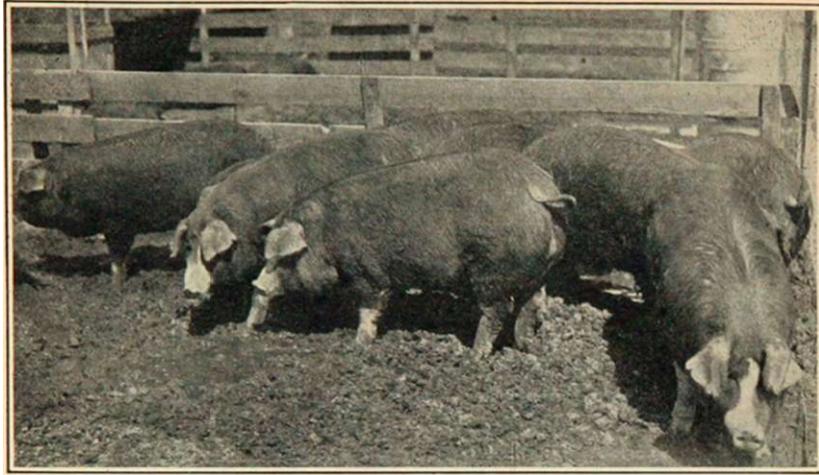
Non-irrigated Eastern Colorado at present lacks a universal home-grown protein supplement comparable to alfalfa or clover in



Pigs fed ground corn and ground millet without a protein supplement. They gained .60 pound daily at a cost of \$9.76 for each hundred pounds gain.

¹ U. S. D. A. Bulletin 1304.

¹ Now head of Animal Husbandry Department, Utah Agricultural College, Logan, Utah.



Pigs fed ground corn, ground millet and tankage. They gained 1.85 pounds daily at a cost of \$6.65 for each hundred pounds gain.

irrigated areas, but with the lower production cost of carbonaceous roughages and grains, efficient concentrated protein supplements can be shipped in and used to advantage in developing cheap growing and fattening rations. Tankage, dry rendered meat and bonemeal, cottonseed meal, alfalfa meal and skimmilk head the list of standard, efficient protein concentrates and supplements that can usually be depended upon to cheapen production costs when used correctly in fattening livestock with the home-grown feeds.

Altho acre yields are necessarily much lower in the non-irrigated areas of Colorado, the much greater non-irrigated acreage under cultivation brings the present non-irrigated grain yield above that in irrigated areas of the state. In 1929, 65 percent of the wheat, corn, barley and oats produced in the state came from non-irrigated areas, representing 84.3 percent of the total acreage for these crops in the state¹.

Proso or hog millet² has proved to be one of the best emergency grain crops for Eastern Colorado drylands. On account of its short growing season this grain has advantages that make it valuable in areas where hail and drouth are common. It can be seeded as late as July 1 and requires only from 70 to 120 days to mature, depending on whether an early or late variety is used and also whether seeded early or late. The same variety will take longer to mature when seeded early. At the United States Government Experiment Station at Akron, millet has averaged 24.6 bushels per acre on fallowed land over

¹ Colorado Yearbook. State Board of Immigration.

² Sometimes locally termed Hershey.

an 11-year period. On small-grain stubble, early spring worked, and kept free from weeds to seeding time, the yield is about 35 to 40 percent less, running about 15 to 17 bushels per acre. It is claimed that over 90 percent of the hog millet produced in the United States at the present time is grown in Northeastern Colorado and in two counties in North and South Dakota. Attention has been attracted to the true fattening value of this grain only recently and the possibilities of producing it in other sections in competition with other fattening grains have yet to be worked out.

There are two main classes of millets in this country—the prosos or hog millets, sometimes referred to as grain millets and botanically classified as the **Panicum Miliaceums**, and the hay millets botanically classified as the **Chaetachloas**. Smaller seed and greater forage production are the distinguishing characteristics of the hay millets. Altho it is customary to use proso or hog millet when a grain crop is desired, the hay-millet seed has also been used occasionally as livestock feed.

The importance of millet as an emergency grain crop in Eastern Colorado during recent years brought it to the attention of farmers and the Colorado Agricultural College Extension Service as a possible standard fattening grain for livestock.

From experimental tests conducted at the United States Government Experiment Station at Akron, Colorado, the Colorado Experiment Station and Bureau of Plant Industry recommend for proso, hog millet or grain millet the following varieties in the following order: 1. Turghai, 2. Red Russian, 3. Yellow Manitoba, 4. Early Fortune. The Kursk variety is perhaps the heaviest seed producer of the hay millets and will produce seed with the best of the grain millets. However the Kursk hay millet requires a longer growing period than the best of the grain millets. For certain ripening the Kursk hay millet should not be seeded later than June 15 while the best of the grain millets may be safely seeded as late as July 1.

SWINE-FEEDING EXPERIMENTS

The advantages of swine production in non-irrigated areas of Eastern Colorado having been recognized, interest has centered on the relative fattening value of the available home-grown grains and especially hog millet. Observations by extension workers led early to the conviction that this emergency grain crop, if properly supplemented with protein, had a much higher fattening value than had been generally recognized. General feeding operations observed seemed to indicate that its established market value in comparison with corn and barley was considerably below its actual fattening value when fed to pigs.

The first drylot pig-feeding experiment conducted during the winter of 1928-29 at the United States Government Experiment Sta-

tion at Akron was planned to determine the relative fattening value of finely ground hog millet, shelled corn and ground barley when fed with a standard protein supplement.

A second winter fattening experiment the following year duplicated this work and included additional tests with other protein supplements and a comparison of grain millet and hog-millet seed. The third winter feeding experiment was a duplication of the second test.

Review of Literature on Hog Millet as Fattening Feed for Swine

In an early experiment comparing hog millet, barley and wheat (all ground) fed without protein supplement to 136-pound pigs, Wilson and Skinner¹ found that millet seed did not furnish as good a fattening ration as either barley or wheat for swine. As a hog feed, 1 bushel of 56 pounds of millet was equal to 1 bushel of 48 pounds of barley in their single feeding experiment. They reported that millet meal, altho producing a pure white fat of superior quality when compared with the fat of pigs fed on barley or wheat, produced a softer quality of fat than did either barley or wheatmeal. The fact that there was no protein supplement fed in this experiment and that only two pigs per lot were used in the single test that was conducted would lead one to the question of the dependability of results secured, based on a present-day knowledge of nutrition and experimental methods. The relatively low feeding value reported for hog millet in this feeding test was reported in standard textbooks and may have been responsible for lack of interest in the crops during ensuing years.

There is at present some question regarding the vitamin A content of hog millet. McCollum² in his earlier work claimed to have found that flaxseed meal and millet seed differed from maize, wheat and oats in containing a much greater amount of this dietary factor. In 1919 McCollum stated³ "The oil bearing seeds judging from the limited data available seem to contain more of the fat soluble A than do the cereal grains but less than millet seed. The latter is richer in this substance than any other seed yet studied." Steenbock, Sell and Jones⁴ in later studies found millets not to be uniformly rich in fat-soluble vitamin, some containing barely enough to give evidence of its presence and none supporting normal growth indefinitely. They question the assumption that millets occupy a unique position among grains with respect to their content of the fat-soluble vitamin. They suggest that fat-soluble vitamin content found in millet by McCollum was introduced with a casein used. They found furthermore that fat-soluble vitamin content bore no definite relation to total yellow pigment contained.

¹ South Dakota Experiment Station Bulletin 83 Published March, 1904.

² McCollum, Simonds and Pitz (1) Page 15.

³ McCollum (3) Page 179.

⁴ Steenbock, Sell & Jones, J. Biol. Chem. Vol. LVI, No. 2, June, 1923, Page 345.

**REPORT OF PIG-FEEDING TEST—DECEMBER 24-
APRIL 28, 1929**

Objects of the Experiment

1. To compare dryland fattening grains when self-fed with the same supplementary feeds to fattening pigs in drylot.
2. To observe the palatability of shelled corn, ground barley and ground proso or hog millet when self-fed with a suitable protein and simple mineral supplement.
3. To compare a mixture of ground corn and hog millet to shelled corn or ground millet fed separately with the same supplementary feeds.

Animals Used

Poland China and grade Hampshire pigs secured from local farmers were used. The pigs were divided into 4 lots of 10 each as nearly uniform as possible with regard to previous treatment, weight, breeding and sex. Averages of three individual weights taken at the beginning and end of the experiment were used.

The different lots were confined in dry pens, each furnished with a separate-compartment self-feeder, straw shed and automatic water tank with heater to prevent freezing. The water was kept open during the coldest weather. The pigs were given free choice of the feeds used. A constant supply of grain, protein mixture, mineral mixture and salt was kept in separate compartments of each feeder at all times.

Description of Grain Used

A grain millet grown near the United States Government Experiment Station and probably yellow Manitoba hog millet weighing 56 pounds per bushel was used in the experiment. It was plump, clean and of excellent quality. It was finely ground for the feeding test. Corn used in the test was a No. 2 yellow, weighing 53.2 pounds per bushel. It was grown locally and was fed shelled in Lot 1 and ground in Lot 4. A No. 1 feed barley, weighing 37.5 pounds per bushel and produced locally, was fed. It was finely ground for the feeding test.

Analysis of Grain Used in 1928-29 Experiment
Carbohydrate

	Water	Ash	Crude Protein	Carbohydrate		Fat	No. Analysis
				Fiber	N.-Free Extract		
Corn	14.7	1.4	9.6	1.8	67.9	4.7	2
Barley	9.0	2.5	11.9	4.9	69.7	2.1	2
Hog millet	9.6	3.5	12.0	8.3	63.4	3.3	2

Rations Fed

Lot 1.	Shelled corn, protein mixture, mineral mixture, salt.
Lot 2.	Ground barley, protein mixture, mineral mixture, salt.
Lot 3.	Ground millet, protein mixture, mineral mixture, salt.
Lot 4.	Ground corn and ground millet (mixed equal parts by weight), protein mixture, mineral mixture, salt.

Protein Mixture

A triple mixture composed of two parts tankage, and one part each of cottonseed meal and alfalfa meal was used in all lots during the first test.

Mineral Mixture

A simple mineral mixture was self-fed in all lots to furnish calcium (lime), phosphorus, sodium and chlorine (salt). Calcium was supplied by reprecipitated lime cake, a by-product of beet-sugar man-

Detailed Report of Experiment.—10 Pigs per Lot fed December 24 to April 28, 1929, 125 Days.

Table Based on One Average Pig

Lot Number	1	2	3	4
Rations self-fed, free choice. Salt and simple minerals self-fed in all lots.	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Gr. millet half Gr. corn half Triple mixture
Feedlot weight at start	74.7	73.9	71.7	72.8
Feedlot weight at finish	269.0	256.1	291.0	293.0
Shipping shrinkage (pounds)	.5	1.1	5.0	7.0
Akron to Denver (Percentage)	.18	.43	1.72	2.39
Market weight at Denver	268.5	255.0	286.0	286.0
Gain at market	193.8	181.1	214.3	213.2
Daily gain based on market weight	1.55	1.45	1.71	1.71
Daily feed consumed (pounds)				
Shelled or ground corn	6.41			3.70
Ground barley		7.05		
Ground millet			7.50	3.70
Triple mixture				
Meatmeal tankage	.46	.38	.35	.30
Cottonseed meal	.23	.19	.17	.15
Alfalfa meal	.23	.19	.17	.15
Mineral mixture	.012	.007	.005	.009
Salt	.007	.004	.005	.003
Feed required per 100 pounds gain				
Shelled or ground corn	413.2			217.0
Ground barley		486.3		
Ground millet			437.5	217.0
Triple mixture				
Meatmeal tankage	29.4	26.0	20.3	17.3
Cottonseed meal	14.7	13.0	10.1	8.7
Alfalfa meal	14.7	13.0	10.1	8.7
Mineral mixture	.8	.5	.3	.5
Salt	.4	.3	.3	.2
Feed cost per 100 pounds gain at market	\$7.17	\$7.25	\$5.25	\$6.15

Financial Statement Based on Actual Costs and Market Returns—10 Pigs per Lot Fed December 24 to April 28, 1929, 125 Days.

Lot Number	1	2	3	4
Rations self-fed, free choice. Salt and simple minerals self-fed in all lots	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Gr. millet hall Gr. corn hall Triple mixture
Cost per pig @ \$10.40 cwt.	\$ 7.77	\$ 7.08	\$ 7.46	\$ 7.57
Feed cost per head	13.89	13.13	11.25	13.11
Est. fixed costs including interest, labor and equipment	2.25	2.25	2.25	2.25
Shipping and selling expense	2.14	2.05	2.24	2.24
Total cost at market	20.05	25.11	23.20	25.17
Selling price per cwt.	11.00	11.00	11.00	11.00
Gross receipts per pig	29.54	28.05	31.46	31.46
Profit per pig	3.49	2.94	8.26	6.29
Dressing percentage, carcass chilled 72 hours, in cooler	72.29	70.09	74.05	73.18
Actual percentage shrinkage of carcass chilled 72 hours in cooler	3.19	3.28	2.93	3.10
Feed costs:				
Shelled corn \$1.35 cwt.			Tankage..... \$72.00 per ton	
Ground corn 1.45 cwt.			Alfalfa meal 20.00 per ton	
Ground barley 1.20 cwt.			Cottonseed meal 50.00 per ton	
Ground millet 95 cwt.			Mineral mixture 20.00 per ton	
Triple mixture			Salt 20.00 per ton	
Meatmeal tankage (60 percent protein)	2 parts			
Cottonseed meal (43 percent protein).....	1 part			
Alfalfa meal (13 percent protein)	1 part			
Mineral mixture				
Spent boneblack	40 parts			
Lime cake	40 parts			
Salt	20 parts			

ufacture, which contains about 96 percent calcium. Phosphorus was supplied by spent boneblack, a by-product of the barium process for desugarizing beet molasses, that had passed thru the Steffens plant. Sodium and chlorine were supplied by finely ground salt. The minerals were mixed in the following proportions by weight: Lime cake 40 parts, spent boneblack 40 parts and salt 20 parts. This simple mineral mixture cost only \$1.00 per cwt. Salt was also self-fed separately.

Marketing Records and Slaughter Tests.—After being on feed 125 days the pigs were weighed at the United States Government Experiment Station at Akron, then trucked 150 miles and marketed at Denver. Thru the cooperation of the Armour Packing Company at Denver a fairly complete study of the slaughter data was made possible.

The slaughter tests except for one instance all established a uniform sequence in dressing percentage. The hogs fed straight millet

Final "Weights of Hogs (By Lots) and Dressing Percentages.—Developed from Feedlot Weights and from Original Records Furnished thru Courtesy of the Armour Packing Company of Denver, Colorado.

Lot Number	1	2	3	4
Rations self-fed, free choice. Salt and simple minerals self-fed in all lots	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Gr. millet half Gr. corn half Triple mixture
No. of pigs per lot	10	9	10	10
Final liveweight at Akron	2690	2305	2910	2930
Liveweight at market (Denver)				
Selling weight	2685	2295	2860	2860
I. liveweight just before slaughter	2640	2250	2840	2820
Warm dressed weights (head on, leaf lard in (head off, leaf lard out	2222	1860	2419	2378
Chilled weight of carcass after 72 hours in cooler	2005	1677	2182	2160
Dressing percentage based on: 1. Feedlot weight and carcass with head off, leaf lard out. Chilled 72 hours in cooler	1941	1622	2118	2093
	72.15	70.36	72.78	71.43
2. Selling. (Warm weight, head weight (off, leaf lard out (Chilled weight after (72 hours in cooler	82.76	81.05	84.58	83.15
	74.63	73.07	76.29	75.52
	72.29	70.69	74.05	73.18
3. Slaughter weight and carcass with head off, leaf lard out, chilled 72 hours in cooler	73.52	72.09	74.58	74.22
4. Selling weight, with head on and leaf lard in and with a 2.5 percent estimated shrinkage (Packer's conventional figure) in cooler	80.67	79.04	82.45	81.01
Percentage shrinkage of carcass (chilled 72 hours in cooler)	2.19	3.28	2.93	3.10

showed the highest dressing percentage followed in order by the millet and corn mixture, straight corn and finely ground barley.

An actual percentage of shrinkage on the carcasses from warm dressed weights to chilled weights after 72 hours in the cooler is of especial significance showing the effect of millet in reducing this shrinkage.

Discussion

1. The apparent palatability of the grains fed to fattening pigs ranged in the following order: Ground millet, ground millet and corn mixed, shelled corn, ground barley. The millet was the most palatable

feed while ground barley was so unpalatable that the pigs wasted quite a bit of it by rooting it out of the self-feeder.

2. Protein requirements per unit gain decreased with the following order of grains fed: Shelled corn, ground barley, ground millet, ground millet and ground corn mixed.

3. More ground barley by 17.7 percent was required than shelled corn to produce unit gains, but 11.6 percent less of protein supplement and 33 percent less of minerals were required where the barley was fed. At existing prices with shelled corn at \$27.00 per ton, ground barley was worth \$23.80 per ton or 88.1 percent the value of shelled corn.

4. Five and nine-tenths percent more ground millet was required than shelled corn to produce unit gains, but 31.1 percent less of the protein supplement and 50 percent less of the minerals were required where the millet was fed. At existing prices with shelled corn worth \$27.00 per ton, the ground millet showed a feed replacement value of \$27.80 per ton or 103 percent the value of shelled corn. Its market value was only \$19.00 per ton ground.

5. A mixture of ground corn and ground millet proved more efficient than corn or millet fed alone but due to the much lower price of the millet, the mixture did not produce as high returns as the millet fed alone with the same protein mixture in this experiment. With the corn and millet mixture, however, an increase of 5.1 percent more grain effected a saving of 41.0 percent in the protein supplement required and a saving of 42 percent in the minerals required over a straight shelled-corn ration.

6. At market all hogs were fed shelled corn. This increased the shrinkage on millet hogs, but in spite of this disadvantage the hogs fed on millet with and without corn produced heavier gains than hogs fed on shelled corn or barley.

7. The order of dressing percentages except in one instance ran highest for hogs fattened on millet, followed by those fattened on millet and corn, then corn and finally barley.

8. The above order prevailed with regard to shrinkage of carcass in the cooler.

9. A cooking test indicated that millet-fed pork has an excellent flavor, quite comparable to corn-fed pork.

10. A curing test was conducted by the packer on the pork fattened on hog millet. The hams that came out of cure, were processed and smoked in the usual manner and were then tested. Quoting from their report: "The hams had a very nice color, were firm and had a good texture as well as Raving very good quality. We would consider them as being of very good grade."

REPORT OF PIG-FEEDING TEST—DECEMBER 13 TO APRIL 30, 1930**Objects of Experiment**

1. To duplicate the previous test comparing dryland fattening grains when self-fed with the same supplements to pigs fattening in drylot.
2. To determine the relative value of barley fed alone and mixed with hog millet.
3. To compare the fattening value of proso, hog or grain millet with hay-millet seed.
4. To determine the value of a protein supplement fed with a corn-and-gram-millet mixture.
5. To compare a 60 percent protein wet rendered tankage, a 50 percent protein dry rendered meat and bonemeal, and a triple mixture of protein supplements—(tankage two parts, cottonseed meal one part and alfalfa meal one part by weight).

Animals Used

Grade Poland China pigs secured from a local breeder were used in this test. The pigs were purchased early in November and were carried on a maintenance ration until the experiment started December 13. At that time they were divided into 9 lots of 10 pigs each. The lots were made as nearly uniform as possible with regard to previous treatment, weight, breeding and sex of individuals. Averages of three individual weights were taken at the beginning and end of the experiment. The pigs were fed in dry pens with straw sheds, separate-compartment self-feeders and automatic water tanks with heaters to prevent freezing during cold weather. The pigs in all lots had free choice of all feeds used. A constant supply of grain, protein supplement, mineral mixture and salt was kept in separate compartments of each feeder at all times.

Description of Feeds Used

All grains used were purchased locally. Corn was a No. 5 yellow and was fed shelled in Lot 1 and ground in other lots. A No. 2 feed barley was ground finely. Yellow Manitoba hog millet weighing 56 pounds per bushel and Dakota Kursk hay millet were plump, clean and of excellent quality. All millet was ground finely for the test.

Discussion of Results

1. As in the previous test, ground millet proved the most palatable of the grains used. It increased grain consumption and daily gains in both corn and barley rations when self-fed mixed with each

Analysis of Feeds Used in 1929-30 Experiment

	Water	Ash	Crude Protein	Carbohydrate			No. Analysis
				Fiber	N.F.E	Fat	
Shelled corn	19.25	1.48	10.51	2.74	62.77	3.25	2
Barley	12.10	3.80	12.24	8.47	60.86	2.47	2
Hog millet	13.85	3.76	12.78	8.19	57.96	3.46	2
Hay millet	12.45	2.82	12.68	9.18	58.51	4.36	2
Cottonseed meal	8.20	5.40	40.60	10.80	26.70	8.30	2
Tankage	8.30	21.60	57.80	1.49	1.03	9.70	2
Meat and							
Bonemeal	8.13	30.56	47.33	2.71		11.00	2
No. 2 alfalfa meal	9.40	7.01	14.33	37.07	30.32	1.87	2

of these grains. Protein requirements were again lowest where a mixture of grains rather than a single grain was self-fed with the triple mixture.

2. On the basis of feed required to produce unit gains, each ton of shelled corn fed replaced 2275.5 pounds of barley, 8.6 pounds of tankage, 4.5 pounds of cottonseed meal and 4.5 pounds of alfalfa meal, and .9 pound each of mineral mixture and salt, or at prices used, ground barley showed only 85.4 percent the fattening value of shelled corn.

3. Grain millet showed 98.9 percent the fattening value of shelled corn. Each ton of shelled corn fed replaced 2000.4 pounds of grain millet, 4.5 pounds of tankage, 2.3 pounds of cottonseed meal and 2.3 pounds alfalfa meal.

4. Ground hay-millet seed showed only 91.5 percent the feeding value of ground grain millet. Each ton of grain millet fed in the test replaced 2158.8 pounds of ground hay-millet seed, 5.9 pounds of tankage, 2.7 pounds of cottonseed meal and 2.7 pounds of alfalfa meal, but required .5 pound more mineral mixture.

5. The tremendous advantage of the addition of a protein supplement of good quality to home-grown grains was demonstrated. Mineral mixture and salt failed to satisfy the cravings of pigs deprived of sufficient protein but each of the three protein supplements added produced remarkable results.

6. Each ton of dry rendered meat and bonemeal fed replaced 23,117.4 pounds of grain, 121.0 pounds of mineral mixture and 384.3 pounds of salt or showed a feed-replacement value, when used to correct an unbalanced grain ration, of \$314.88 per ton.

7. Each ton of wet rendered tankage replaced 26,991.1 pounds of grain, 141.6 pounds of mineral mixture and 477.9 pounds of salt or had a feed-replacement value of \$367.94 per ton.

8. Each ton of triple mixture replaced 18,500 pounds of grain mixture 95.2 pounds of mineral mixture and 327.4 pounds of salt or showed a feed-replacement value of \$252.15 per ton.

Lot Number	1	2	3	4	5	6	7	8	9
Rations self-fed free choice, salt and simple minerals in all lots	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Gr. corn Gr. millet Triple mixture	Gr. barley Gr. millet Triple mixture	Gr. corn Gr. millet No protein suppl.	Gr. corn Gr. millet 60 percent protein tankage	Gr. corn Gr. millet 50 percent protein meat and bonemeal	Gr. hay millet seed Triple mixture
Feedlot weight at start (pounds)	68.8	69.7	69.0	69.4	70.0	68.8	70.3	69.4	69.8
Market weight (Denver)	291.8	265.1	289.6	299.1	288.2	140.3	292.5	309.7	280.8
Gain at market	223.0	195.4	220.6	229.8	218.1	71.5	222.2	240.3	211.1
Daily gain (market weight)	1.86	1.63	1.84	1.91	1.82	0.60	1.85	2.00	1.76
Shipping shrinkage (percentage)	2.40	3.50	2.50	2.10	2.20	2.10	2.30	1.70	0.30
Daily feed (pounds)									
Shelled or ground corn	8.19			4.21		2.24	4.13	4.27	
Ground barley		8.16			4.26				
Ground millet			8.10	4.21	4.26	2.24	4.13	4.27	
Gr. hay millet seed									8.37
60 percent protein tankage							.42		
50 percent protein meat and bonemeal								.56	
Triple mixture									
60 percent protein tankage	.35	.34	.37	.32	.25				.33
Cottonseed meal	.18	.17	.18	.16	.13				.17
Alfalfa meal	.18	.17	.18	.16	.13				.17
Mineral mixture	.002	.005	.001	.003	.004	.011	.003	.002	.004
Salt	.004	.007	.003	.003	.006	.033	.004	.003	.003
Feed required per cwt. market gain									
Sh. or gr. corn	440.6			220.0		375.4	222.9	213.0	
Ground barley		501.3			234.5				
Ground millet			440.7	220.0	234.5	375.4	222.9	213.0	
Gr. hay millet seed									475.7
60 percent protein tankage							22.6		
50 percent protein meat and bonemeal								28.1	
Triple mixture:									
60 percent protein tankage	19.1	21.0	20.1	16.8	14.0				18.8
Cottonseed meal	9.5	10.5	10.0	8.4	7.0				9.4
Alfalfa meal	9.5	10.5	10.0	8.4	7.0				9.4
*Mineral mixture	.1	.3	.1	.2	2	1.8	2	1	2

Pig-Feeding Experiment—Colorado Experiment Station.—Financial Statement Based on Actual Costs and Market Returns. 10 Pigs per Lot Fed
 December 13, 1929 to April 12, 1930—120 Days.
 (Table Based on One Average Pig)

Lot Number	1	2	3	4	5	6	7	8	9
Rations self-fed free choice, salt and simple minerals in all lots	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Gr. corn Gr. millet Triple mixture	Gr. barley Gr. millet Triple mixture	Gr. corn Gr. millet No protein supple.	Gr. corn Gr. millet 60 percent protein tankage	Gr. corn Gr. millet 50 percent protein meat and bonemeal	Gr. hay millet seed Triple mixture
Cost per pig @ \$12.00 per cwt.	8.25	8.37	8.27	8.32	8.40	8.25	8.43	8.33	8.37
Feed cost per head	14.85	14.25	15.51	15.33	14.72	6.98	14.78	15.86	15.64
Est. fixed cost including interest, labor, equipment	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Shipping and selling expenses	1.27	1.15	1.26	1.30	1.25	.61	1.27	1.35	1.22
Total cost at market	26.62	26.02	27.29	27.20	26.62	18.09	26.73	27.79	27.48
Selling price per cwt.	9.45	9.45	9.45	9.45	9.45	9.20	9.45	9.45	9.45
Gross receipts per pig	27.57	25.06	27.37	28.27	27.23	12.91	27.64	29.27	26.54
Profit per pig	+ .95	-.96	+0.08	+1.07	+0.61	-5.18	+0.91	+1.48	-.94
Selling price per cwt. needed to break even	9.12	9.81	9.42	9.09	9.24	12.59	9.14	8.97	9.78
Margin over purchase price per cwt. needed to break even	-2.88	-2.19	-2.58	-2.91	-2.76	+0.89	-2.86	-5.03	-2.02
No. of days required to reach 225 lbs.	81	91	82	79	83	252	81	76	88

Feed prices used:

Shelled corn \$1.25 per cwt.
 Ground corn 1.35 per cwt.
 Ground millet 1.32 per cwt.
 Ground barley 1.20 per cwt.
 Mineral mixture 40.00 per ton
 Salt 30.00 per ton

Tankage 60 percent protein \$80.00 per ton
 Dry Rendered Meat & Bonemeal 50 percent protein 80.00 per ton
 Cottonseed meal 43 percent protein 52.00 per ton
 No. 2 Alfalfa meal 13 percent protein 28.00 per ton
 Triple mixture 44 percent protein 60.00 per ton

**REPORT OF PIG-FEEDING TEST—JANUARY 11 TO
MAY 6, 1931**

Objects of Experiment

1. To repeat previous tests comparing dryland fattening grains when self-fed to pigs fattened in drylot.
2. To determine the relative value of feeding grain alone and mixed.
3. To compare the fattening value of hog millet with hay-millet seed.
4. To demonstrate the value of a protein supplement fed with a grain mixture.
5. To determine the relative value of various kinds of protein supplements.

Animals Used

High-grade Poland-China pigs were purchased from a local breeder early in January. They were good thrifty pigs weighing 47 pounds. Before starting on experiment, these pigs were wormed and vaccinated for cholera. The lots were made up as nearly uniform as possible with regard to previous treatment, weight, breeding, type, sex and condition. Averages of three individual weights were used for the initial and final weights of the pigs.

The lots were self-fed all feeds used; the pigs had access to automatic water tanks and each lot was provided with a straw shed.

Description of Feeds Used

Grain.—Corn was a No. 1 yellow, weighing 55.5 pounds per bushel. It was locally grown corn and contained 13.64 percent moisture during the feeding period. It was fed shelled in Lot 1 and ground in all other lots. A No. 1 feed barley, weighing 39 pounds per bushel and containing 11.09 percent moisture was finely ground for the pigs. Yellow Manitoba hog millet was ground with a hammer mill. It weighed 59 pounds per bushel and showed an average moisture content of 10.28 percent thruout the feeding period. The hay millet used was of a red-seeded variety, probably Siberian, and weighed 52.5 pounds per bushel. The moisture content of this hay millet was 11.21 percent.

Analysis of Grain Used in 1930-31 Experiment

	Water	Ash	Crude Protein	Carbohydrates		Fat	No. Analysis
				Fiber	N-Free Extract		
Corn	13.64	1.50	9.87	2.25	68.93	3.84	2
Barley	11.09	2.95	13.99	7.29	62.61	2.09	4
Hog Millet	10.28	4.43	9.17	10.52	61.80	3.81	2
Hay Millet	11.21	4.12	11.49	11.28	57.54	4.37	2

Protein Supplements.—A 60 percent protein tankage was used in this experiment.

A triple mixture composed of two parts tankage and one part each of cottonseed meal and alfalfa meal was used. It contained 44 percent protein.

The double mixture was composed of one-half tankage and one-half cottonseed meal. The analysis showed this mixture contained 51.0 percent protein.

Mineral Mixture.—A simple mineral mixture containing 40 percent steamed bonemeal, 40 percent lime cake and 20 percent salt was self-fed in all lots. Salt was also self-fed separately.

Discussion of Results

1. No. 1 corn fed in this experiment replaced 2723.56 pounds of barley, 4.37 pounds of triple mixture and .6 pound of salt but required .1 pound more minerals. At present prices used, ground barley in this experiment showed 73.00 percent the fattening value of shelled corn.

2. Hog millet showed 87.91 percent the fattening value of shelled corn. Each ton of shelled corn replaced 2195.99 pounds of millet, 27.39 pounds of triple mixture but required .79 pound more minerals and .17 pound more salt. The comparatively low value of hog millet in this test is practically explained by the fact that No. 1 grade corn was fed in this test whereas No. 2 and No. 5 grades of corn respectively were used and compared to the same grade of millet in the two previous tests. A check-up on the ground hog millet also showed that millet was not ground completely due to worn hammers and screen.

3. Ground hay-millet seed showed 104.92 percent the feeding value of hog millet. Each ton of hog millet fed replaced 1953.20 pounds of hay millet seed, 1.24 pounds of minerals and 1.45 pounds of salt but required 17.82 pounds more triple mixture. The fact that the hog millet was not ground thoroly explains why this experiment shows a higher fattening value for hay-millet seed than is shown in the 1929-30 experiment.

4. The importance of a complete and thoro grinding of hog millet is apparent. Pigs are unable to utilize millet unless it is completely ground. Wherever millet is used in the ration, the **grinding should be watched very closely.**

5. The necessity of adding a protein supplement of good quality to home-grown grains was again demonstrated. The results of this comparison were brought out even more strikingly than in the 1929-30 test because the pigs in this last experiment were much younger and consequently they showed the lack of protein more so than would older pigs. Considerable difficulty was experienced in keeping the pigs alive on that unbalanced ration. The smaller pigs died and clearly showed that malnutrition was the cause. An extremely high mineral and salt consumption failed to satisfy the cravings of the pigs for the lacking elements in the rations.

6. Each ton of tankage fed replaced 22,123.70 pounds of corn, 22,123.70 pounds of millet, 31.09 pounds of mineral mixture and 44.99

Pig-Feeding Experiment—Colorado Experiment Station.—Seven Pigs per Lot Fed January 11, 1931 to May 6, 1931—115 Days.

(Table Based on One Average Pig)

Lot Number	1	2	3	4	5	6	7	8	9
Rations self-fed free choice, salt and simple minerals in all lots.	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Ground corn Ground millet Triple mixture	Ground barley Ground millet Triple mixture	Gr. corn Ground millet No protein supple.	Gr. corn Ground millet 60 percent protein tankage	Ground hay millet seed Triple mixture	Ground corn Ground millet Double mixture
Weight- at start	46.9	45.5	46.4	45.8	45.8	58.8	47.0	46.8	45.8
Market weight	221.4	196.7	214.3	210.7	202.1	93.8	240.3	207.1	219.3
Gain at market	174.6	151.2	167.9	164.9	156.3	34.9	193.3	160.4	173.5
Daily gain (mkt. wt.)	1.52	1.31	1.46	1.43	1.36	.30	1.68	1.39	1.51
Shipping shrinkage (percentage)	1.15	2.97	2.06	1.85	2.38	-1.26	1.77	2.49	1.89
Daily feed (pounds)									
Sh. or gr. corn	5.35			2.76		1.57	3.05		2.47
Gr. barley		6.31			2.64				
Gr. hog millet			5.65	2.76	2.64	1.57	3.05		2.47
Gr. hay millet								5.27	
60 percent protein tankage							.51		
Triple mixture	.82	.72	.86	.77	.66			.77	
Double mixture									.75
Mineral mixture	.009	.008	.007	.004	.005	.028	.007	.010	.001
Salt	.005	.005	.004	.003	.006	.026	.003	.008	.003
Feed required per cwt. market gain									
Sh. or gr. corn	352.7			192.2		515.9	181.5		163.5
Gr. barley		480.3			193.9				
Gr. hog millet			387.2	192.2	193.9	515.9	181.5		163.5
Gr. hay millet								378.2	
60 percent protein tankage							30.2		
Triple mixture	53.8	54.6	58.6	53.7	48.8			55.2	
Double mixture									49.8
Mineral mixture	.6	.6	.5	.3	.4	9.1	.4	.7	.1
Salt	.3	.4	.3	.2	.4	8.6	.2	.6	.2
Feed cost per cwt. market gain	\$4.24	4.61	4.25	4.51	3.93	9.04	4.00	4.86	4.01

Financial Statement Based on Actual Costs and Market Returns.—Seven Pigs per Lot Fed January 11, 1931 to May 6, 1931—115 Days.
(Table Based on One Average Pig)

Lot Number	1	2	3	4	5	6	7	8	9
Rations self-fed free choice, salt and simple minerals in all lots.	Shelled corn Triple mixture	Ground barley Triple mixture	Ground millet Triple mixture	Ground corn Ground millet Triple mixture	Ground barley Ground millet Triple mixture	Gr. corn Ground millet No protein supple.	Gr. corn Ground millet 60 percent protein tankage	Ground hay millet seed Triple mixture	Ground corn Ground millet Double mixture
Cost per pig (g) \$12.00 per cwt.	\$5.63	\$5.46	\$5.57	\$5.50	\$5.50	\$7.06	\$5.64	\$5.61	\$5.49
Feed cost per head	7.51	7.25	7.33	7.62	6.34	3.05	7.91	8.05	7.13
Estimated fixed costs	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Shipping and selling expense	1.44	1.28	1.39	1.37	1.31'	.61	1.56	1.35	1.43
Total cost at market	16.83	16.24	16.54	16.74	15.40	12.97	17.36	17.26	16.30
Selling price per cwt.*	6.60	6.55	6.55	6.75	6.65	5.25	6.75	6.55	6.60
Gross receipts per pig	14.61	12.88	14.04	14.22	13.44	4.92	16.22	13.57	14.47
Loss per pig	2.22	3.36	2.50	2.52	2.96	8.05	1.14	3.69	1.83
Selling price per cwt. needed to break even	7.60	8.26	7.72	7.94	7.62	13.83	7.22	8.33	7.43
No. of days required to reach 225 pounds	116	131	119	122	128	573	104	124	116

Feed prices used:

Shelled corn	\$17.00 per ton	60 percent protein tankage	\$60.00 per ton
Ground corn	19.00 per ton	Triple mixture	45.25 per ton
Ground millet	15.00 per ton	Double mixture	48.50 per ton
Ground barley	14.00 per ton	Mineral mixture	40.00 per ton
Ground hay-millet seed	19.00 per ton	Salt	20.00 per ton

*Figures based on actual selling price and valuation placed on hogs by W. W. Swearingen, Prey Bros. Livestock Commission Company and Earl Elkins, Armour and Company.

pounds of salt or showed a feed-replacement value of \$355.00 per ton. The tankage-fed hogs made 5.6 times greater gain than the non-protein fed pigs and saved \$4.80 for every hundred pounds produced.

7. The triple mixture fed in this test replaced 12,052.50 pounds of corn, 12,052.50 pounds of millet, 24.20 pounds of minerals and 24.90 pounds of salt. At present feed prices, 1 ton of triple mixture was worth \$198.57 when used to supplement an unbalanced ration. The addition of triple mixture increased gains 4.77 times and decreased the cost of producing cwt.-gains \$4.29.

8. Each ton of double mixture replaced 14,148.13 pounds of corn, 14,148.13 pounds of millet, 34.13 pounds of minerals and 26.10 pounds of salt or showed a feed-replacement value of \$227.31 per ton. The pigs made five times greater gain than the non-protein fed pigs and produced every 100 pounds of gain \$4.79 cheaper. A little difficulty was experienced with scours in the small pigs at the beginning of the test, indications were that the large proportion of cottonseed meal was the cause. With larger pigs, however, no ill effects were noted.

General Conclusions

1. Proso or hog millet has proved to be one of the best emergency grain crops for Eastern Colorado drylands.

2. As a fattening grain for hogs, proso appeared more palatable than shelled corn or barley.

3. In an average of three fattening tests with hogs each ton of ground proso replaced 1903.39 pounds of shelled corn, 16.59 pounds of triple mixture, .94 pound of mineral mixture and .15 pound of salt.

4. The value of proso like that of corn and barley was greatly enhanced by the use of proper protein supplements.

5. Complete and thoro grinding of both varieties of millet is very important to insure complete utilization of these grains.

6. A 2-year comparison shows that each ton of hay-millet seed replaced 1858.79 pounds of shelled corn but required 2.65 pounds more triple mixture, .48 pound more minerals and .80 pound more salt.

7. A direct comparison between the two varieties of millet shows hay-millet seed to be worth 95 percent the value of proso millet.

8. Each ton of barley fed in this series of tests replaced 1641.95 pounds of corn less 6.97 pounds of triple mixture, .14 pound of minerals and .27 pound of salt.

9. The necessity of a protein supplement with any of the common grains is very apparent. An average of the two tests shows that lack of protein makes the ration very costly and produces a very low rate of gain.

10. Sixty percent tankage, 50 percent meat and bonemeal, double mixture and triple mixture are all good protein supplements for Eastern Colorado hog-fattening rations and rank nearly the same in efficiency when cost is taken into consideration.