Summary

Presently Midland is the variety of bermudagrass best suited for most sections of Oklahoma. Bermudagrass has a much higher carrying capacity and a greater ability to respond to fertilization than native grasses but appears to be less palatable. Although individual animal performance is often 10 to 15 percent less for cattle grazing bermudagrass compared to native grass, the per acre weight gains may be four to five times greater on bermudagrass. Fertilization is absolutely necessary for satisfactory performance on bermudagrass. Although irrigation can increase forage and beef production significantly it is not necessary in most sections of the state for satisfactory production. Management of bermudagrass is the key to its successful use. If good native grass is available it appears that an integrated pasture system in which bermudagrass is used in conjunction with native grass is advisable.

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The Value of Cottonseed Meal, Fish Meal and Urea in Milo Rations for Fattening Calves*

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Many cattle feeders are located in a "one grain area", due to availability and price of grains. This is true in much of Oklahoma and the Southwest, and the "one grain" in this area is milo. One of the serious weaknesses of milo is its poor feed efficiency, which is often 10-20 percent poorer than that of corn and barley. Attempts to improve the utilization of milo through supplementation are continuing at this station.

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Since the protein in milo is less readily soluble than the protein in corn, a readily soluble source of supplemental nitrogen (protein) might enhance the utilization of milo. Urea is a readily soluble source of nitrogen. It has been known for many years that fattening cattle utilize urea rather efficiently as a substitute for protein, and recent research at the Iowa and Indiana stations has demonstrated that almost all of the supplemental nitrogen in a corn ration can be in the form of urea. However, a previous trial at this station indicated that 100 percent replacement of cottonseed meal with urea resulted in lowered feed intake, rate of gain, and feed utilization[1]. The trial reported herein was conducted to determine the most optimum level of substituting urea for natural protein at levels lower than 100 percent.

Another objective of this trial was to compare fish meal with cottonseed meal as a source of supplemental protein in milo rations. In a previously reported pilot trial fish meal promoted greater daily gain and better feed efficiency than cottonseed meal. The protein of fish meal is of relatively low solubility. It is possible that a combination of fish meal and urea, with low and high nitrogen solubilities, might improve the utilization of milo. Furthermore, in the previously mentioned research a complex vitamin-trace mineral supplement improved performance of cattle receiving urea as the only source of supplemental nitrogen. Since fish meal is a richer source of certain vitamins and trace minerals than is cottonseed meal, fish meal might enhance the utilization of a high urea ration.

Procedure

Sixty-four Hereford steer calves with an average weight of approximately 525 lbs. and an average age of 8 months were obtained from the Experiment Station herds. They were divided into eight uniform lots primarily on the basis of sire and weight. The feeding period was 161 days long, from November 5, 1964 to April 15, 1965. Initial and final weights were based on an average of two weights taken after the calves were without feed and water for 16 hours. After the conclusion of the feeding trial the calves were shipped to Arkansas City, Kansas, for slaughter. Carcass data were obtained after a 48-hour chill.

The ingredient makeup of the rations is given in Table 1. Milo was finely ground through a hammer mill with a 3/16 inch screen. Rations 1-4 contained cottonseed meal, Rations 5-8 fish meal. Rations 1 and 5 contained no urea. In the remaining rations, the following percentages of natural protein supplement were replaced with urea: Rations 2 and 6, 25 percent; Rations 3 and 7, 50 percent; and Rations 4 and 8, 75 percent. The urea was added at a level to provide 25 percent more nitrogen than the amount in the natural protein which it replaced to compensate for its expected lower utilization. Milo was increased in each case as the level of natural protein was decreased. Levels of bonemeal and monosodium phosphate were varied in an attempt to equate

[1] See Okla. Agr. Exp. Sta. Mis. Pub. MP-76, P60.

Table 1. Ingredient Makeup of Rations

Lot and ration no.	1	2	3	4	5	6	7	8
Natural protein source	Cottonseed meal				Fish meal			
Level of urea, %[1]	0	25	50	75	0	25	50	75
Milo (finely ground)	63.6	65.5	67.4	69.3	67.7	68.6	69.5	70.4
Cottonseed meal[2]	10.0	7.5	5.0	2.5	----	----	----	----
Fish meal[3]	----	----	----	----	6.4	4.8	3.2	1.6
Urea[4]	0	0.5	1.0	1.5	0	0.5	1.0	1.5
Alfalfa hay (ground)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Cottonseed hulls[5]	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Molasses, blackstrap	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Salt	.5	.5	.5	.5	.5	.5	.5	.5
Bonemeal	.5	.5	.5	.5	----	.2	.3	.4
Monosodium phosphate	----	.1	.2	.3	----	----	.1	.2
Ammonium chloride	.4	.4	.4	.4	.4	.4	.4	.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Vitamin A[6]	+	+	+	+	+	+	+	+
Aureomycin[7]	+	+	+	+	+	+	+	+

[1] Indicates the percent of supplemental protein replaced with urea. The urea was added at a level to provide 25 percent more nitrogen than the amount in the natural protein which it replaced.
[2] 41 percent protein, "old process".
[3] 64 percent protein, herring meal from Nova Scotia.
[4] Feed grade urea containing 42 percent nitrogen.
[5] Cottonseed hulls fed initially at a level of 30 percent, then reduced to 20 percent and 10 percent over a four week period. Milo was increased as cottonseed hulls were decreased.
[6] Included at a level of 1,000 I.U./lb. of ration.
[7] Included at a level of 3.5 mg/lb. of ration.

calcium and phosphorus levels among rations. Ammonium chloride was included in all rations to miminize the occurrance of urinary calculi, and vitamin A and aureomycin were added to all rations. No hormones were used.

Proximate, calcium and phosphorus analyses of milo and the eight rations as fed are presented in Table 2. The basal cottonseed meal and fish meal rations (Rations 1 and 5) were formulated to contain 12 percent protein, on the assumption that the milo contained 8.5 percent protein. The feed analyses, available near the completion of the trial, showed that the milo contained an average of 10.4 percent protein. Consequently, all rations were higher in protein than anticipated.

All rations were self-fed throughout the feeding period. Each lot of calves had access to ample area in an open shed and an outside lot, and water (warmed in winter) was available at all times.

Results and Discussion

Feedlot performance, for each of the eight lots, is shown in Table 3. The substitution of urea for 25 or 50 percent of the cottonseed meal resulted in the highest feed intake and fastest gains among the lots

Table 2. Chemical Composition of Feeds (Percent)

Feed	Dry matter	Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Ca.	P.
Milo	91.56	1.7	10.4	3.5	2.6	73.4	0.37	0.31
Ration no. 1	92.07	4.2	15.0	3.3	9.7	59.9	0.39	0.44
Ration no. 2	91.64	4.3	15.2	3.3	9.9	58.9	0.33	0.40
Ration no. 3	91.28	4.5	15.5	3.3	13.1	54.9	0.35	0.46
Ration no. 4	91.81	4.2	16.0	3.5	10.9	57.2	0.48	0.44
Ration no. 5	92.10	4.0	15.0	3.3	10.6	59.2	0.41	0.38
Ration no. 6	91.66	4.3	15.4	3.5	13.0	55.5	0.46	0.39
Ration no. 7	92.19	4.5	15.8	3.9	10.8	57.2	0.46	0.42
Ration no. 8	90.98	4.1	16.4	4.5	9.2	56.8	0.45	0.40

Table 3. Feedlot Performance, by Lot (161 days, 8 steers per lot)

Lot and ration no.	1	2	3	4	5	6	7	8
Natural protein source	Cottonseed meal				Fish meal			
Level of urea, %	0	25	50	75	0	25	50	75
Av. initial wt., lb.	522	526	525	522	525	526	526	522
Av. final wt., lb.	894	930	933	888	923	909	922	844
Av. daily gain, lb.	2.32	2.52	2.55	2.28	2.48	2.39	2.47	2.25
Av. daily feed, lb.	19.3	20.6	21.2	18.7	20.5	19.3	19.8	17.5
Feed/cwt. gain, lb.	832	818	830	820	828	807	801	775

receiving cottonseed meal, while replacement of 75 percent of the cottonseed meal resulted in a small decrease in feed intake and a rate of gain comparable to the all cottonseed meal group (Ration 1). Differences in feed efficiency were small. The pattern among the fish meal lots was less clear, although substitution of urea for 75 percent of the fish meal resulted in a daily gain which was the poorest of the fish meal lots, and considerably lower than the all fish meal group (Ration 5). There was a tendency for feed intake to decrease and feed efficiency to improve as the level of urea substitution for fish meal increased.

Slaughter and carcass data for each of the eight lots are given in Table 4. Differences in all carcass traits which were measured were very small, although the calves fed the 75 percent levels of urea (Lots 4 and 8) tended to produce carcasses which had less fat cover and graded lower than calves fed lower levels of urea.

Feedlot performance and carcass data are summarized by treatment in Table 5. Cottonseed meal and fish meal (Comparison 1 in Table 5) produced almost identical results. Cattle which were fed fish meal were slightly more efficient, but all other comparisons were very similar if not identical. Comparison 2 in Table 5 combines cottonseed meal and fish meal lots according to level of urea replacement. The results indicate that rations containing urea at levels of 25 and 50 percent replacement were comparable to the natural protein rations. Rate of gain and feed efficiency were actually better at the 50 percent urea level than at the 0 and 25 percent levels, but differences were very small. The 75

Table 4. Slaughter and Carcass Information, by lot (8 steers per lot)

Lot and ration no.	1	2	3	4	5	6	7	8
Natural protein source	Cottonseed meal				Fish meal			
Level of urea, %	0	25	50	75	0	25	50	75
Dressing %[1]	61.0	61.0	60.6	60.8	60.7	61.6	61.6	60.2
Carcass grade[2]	9.5	10.5	9.9	8.8	10.0	10.0	9.6	8.9
Ribeye area, sq. in.[3]	10.4	10.9	10.8	10.8	10.7	10.8	10.3	10.8
Fat cover, in.[4]	.72	.68	.64	.63	.66	.68	.70	.58
Cutability, %								
Carcass basis[5]	49.1	49.6	50.0	50.4	50 0	50.0	49.1	50.8
Live basis[6]	30.0	30.3	30.3	30.6	30.3	30.8	30.2	30.6
Round yield,%								
Carcass basis[7]	21.8	21.4	21.8	22.4	21.8	21.9	21.4	22.0
Live basis[8]	13.3	13.1	13.2	13.7	13.3	13.5	13.1	13.2

[1] Calculated on basis of shrunk Ft. Reno live weight and chilled carcass weight.
[2] USDA carcass grade converted to following numerical designations: high prime — 15, average prime — 14, low prime — 13, high choice — 12, average choice — 11, low choice — 10, high good — 9, average good — 8, low good — 7.
[3] Determined by measurement of tracings of ribeye.
[4] Average of three measurements determined on tracings of the ribeye.
[5] Calculated as follows: percent of carcass as boneless trimmed retail cuts from the four major wholesale cuts = 51.34 (fat thickness) — .462 (percent kidney fat) + .740 (ribeye area) — .0093 (carcass weight).
[6] Trimmed retail cut yield as determined in footnote 5 multiplied by dressing percent.
[7] Trimmed round expressed as percent of chilled carcass weight.
[8] Percent round as determined in footnote 7 multiplied by dressing percent.

Table 5. Feedlot Performance and Carcass Information, by Treatment

Lot and ration no.	Comparison 1		Comparison 2			
	1-2-3-4	5-6-7-8	1-5	2-6	3-7	4-8
			Level of urea, %			
Treatments compared	Cottonseed meal	Fish meal	0	25	50	75
No. steers	32	32	16	16	16	16
Av. daily gain, lb.	2.42	2.40	2.40	2.45	2.51	2.27
Av. daily feed, lb.	19.9	19 3	19.9	19.9	20.5	18.1
Feed/cwt. gain, lb.	825	803	830	832	816	798
Dressing%[1]	60.9	61.0	60.8	61.3	61.1	60.5
Carcass grade[1]	9.7	9.7	9.8	10.2	9.8	8.8
Ribeye area, sq. in.[1]	10.7	10.7	10.6	10.8	10.5	10.8
Fat cover[1]	.67	.66	.69	.68	.67	.60
Cutability,[1] %						
Carcass basis	49.8	50.0	49.6	49.8	49.6	50.6
Live basis	30.3	30.5	30.1	30.5	30.3	30.6
Round yield, %[1]						
Carcass basis	21.9	21.7	21.8	21.7	21.6	22.2
Live basis	13.3	13.3	13.3	13.3	13.2	13.4

[1] See footnotes in Table 4.

percent level of urea resulted in a lower rate of gain, decreased feed intake, less fat cover, lower carcass grade, but better feed efficiency than lower levels of urea.

Some cost and return estimates, based on certain assumed current prices, are presented in Table 6 (by lot) and Table 7 (by treatment). Although these estimates will obviously vary as prices change, they do

provide a basis for current economic considerations. The calculations terminate with the return per steer above feed cost. This figure is determined by the actual cost of the ration, feed efficiency, total gain per steer, the value of the carcass based on grade, and dressing percentage, and represents the amount of money available to pay non-feed costs and return a profit. It should be emphasized that the final market value of the steers was determined by actual carcass weight and grade and not by live weight and appraised value.

As the level of urea increased, the cost per cwt. of feed decreased. Because of lower feed cost, the rations containing urea allowed a greater dollar return per steer above feed cost compared to the rations containing no urea, with one exception.

Table 6. Cost and Return Estimates by Lot (8 steers per lot)

Lot and ration no.	1	2	3	4	5	6	7	8
Natural protein source	Cottonseed meal				Fish meal			
Level of urea, %	0	25	50	75	0	25	50	75
Initial value/steer, $[1]	130.62	131.41	131.25	130.62	131.25	131.56	131.41	130.62
Final value/steer, $[2]	239.01	251.44	249.19	233.89	246.12	246.56	248.94	230.95
Increase in value/steer, $[3]	108.38	120.04	117.94	103.26	114.87	115.00	117.53	100.32
Total feed/steer, lb.	3094	3311	3397	2998	3292	3091	3172	2805
Cost/cwt. feed, $[4]	2.22	2.19	2.17	2.15	2.43	2.35	2.23	2.20
Feed cost/steer, $[5]	68.60	72.65	73.79	64.43	80.05	72.63	70.74	61.57
Return/steer above feed cost, $[6]	39.78	47.39	44.15	38.83	34.82	43.36	46.79	38.76

[1] Initial weight × $.25/lb.
[2] Av. carcass value/lb. × carcass weight. Carcass prices used were ($/lb.): High choice, .450; average choice, .445; low choice, .440; high good, .435; average good, .425; low good, .415.
[3] Final value − initial value.
[4] Feed prices: Ground milo, $2.15/cwt.; cottonseed meal, $78.00/ton; fish meal, $170.00/ton; urea, $95.00/ton; ground alfalfa hay, $30.00/ton, cottonseed hulls, $22.00/ton; molasses, $36.00/ton; salt, $1.20/cwt.; bonemeal, $5.60/cwt.; monosodium phosphate, $10.00/cwt.; ammonium chloride $11.75/cwt.; vitamin A, $.08/million I.U.; aureomycin, $.06/gm.
[5] Total feed/steer × cost/cwt. feed.
[6] Increase in value/steer − feed cost/steer.

Table 7. Cost and Return Estimates, by Treatment

Lot and ration no.	Comparison 1		Comparison 2			
	1-2-3-4	5-6-7-8	1-5	2-6	3-7	4-8
Treatments compared	Cottonseed meal	Fish meal	Level of urea, %			
			0	25	50	75
No. steers	32	32	16	16	16	16
Initial value/steer, $[1]	130.98	131.21	130.94	131.48	131.33	130.62
Final value/steer, $[1]	243.38	243.14	242.56	249.00	249.00	232.42
Increase in value/steer, $[1]	112.38	111.93	111.63	117.52	117.73	101.79
Total feed/steer, lb.	3200	3090	3193	3201	3285	2902
Cost/cwt. feed, $[1]	2.16	2.31	2.32	2.27	2.20	2.17
Feed cost/steer, $[1]	69.12	71.44	74.20	72.73	72.30	63.02
Return/steer above feed cost, $[1]	43.26	40.49	37.42	44.79	45.44	38.77

[1] See footnotes in Table 6.

The return per steer from the urea rations was especially favorable when carcass grade or rate of gain or feed efficiency was improved. The replacement of 25 or 50 percent of the natural protein resulted in the greatest profit per steer in both the cottonseed meal and fish meal groups. The replacement of 75 percent of the natural protein supplement with urea resulted in less profit than 25 or 50 percent replacement because of less gain and lower grade, in spite of a favorable feed efficiency. When all cottonseed meal lots were compared with all fish meal lots, cottonseed meal feeding was more profitable due to the high cost of fish meal ($170 vs. $78/ton).

This trial and previous research at this station indicate that feed intake, rate of gain and carcass grade decline when more than 50 percent of the natural protein supplement is replaced with urea. However, urea is a cheaper source of nitrogen than is natural protein, so a cattle feeder may be able to tolerate a reduced rate of gain and carcass grade in some cases in order to obtain a more economical gain. The price of urea is expected to decrease further.

Sizeable improvements in feed efficiency *per se* were not obtained through the use of various combinations of nitrogen sources, except when accompanied by a lowered rate of gain which was observed when urea replaced 75 percent of the fish meal. It appears that the greatest value of urea in the ration is in terms of decreasing the feed cost.

Summary

A group feeding trial with milo rations indicated that:

(1) The replacement of 25 or 50 percent of the natural protein with urea caused no decrease in feed intake, rate of gain or carcass grade. In the case of cottonseed meal, 25 or 50 percent replacement with urea actually resulted in some increase in feed intake and daily gain, but this tendency was not apparent in the fish meal lots.

(2) The replacement of 75 percent of the natural protein with urea resulted in decreased feed intake, rate of gain, and carcass grade.

(3) Feed efficiency tended to improve as the level of fish meal replaced by urea increased. The best feed efficiency was observed when 75 percent of the fish meal was replaced with urea.

(4) Little difference in the average feeding value of cottonseed meal and fish meal was noted, although feed efficiency slightly favored the fish meal rations.

(5) Current feed prices favor the use of urea, especially at a level of 50 percent replacement of natural protein.