Second Year Observations . . .

BEEF PRODUCTION ON IRRIGATED PASTURE IN NORTH DAKOTA

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INTRODUCTION

The 1973 acreage of irrigated land in North Dakota has been estimated at about 75,000 acres. This acreage has increased at a relatively steady rate from about 20,000 acres in 1940, to 35,000 acres in 1950, 48,000 acres in 1959 and 63,000 acres in 1969 (11, 12, 13, 14). The average increase has been about 2,300 acres per year, but accelerated to about 8,200 acres in 1973. Irrigated pasture or grazing land accounted for about three per cent of the total irrigated acreage in 1964 and 1969.

This study was initiated in 1971 in cooperation with the Standing Rock Sioux Tribe, Fort Yates, North Dakota, to determine the potential of irrigated pasture in North Dakota. The tribe provided all major inputs for the irrigated pasture grazing study. The NDSU Extension Irrigation Task Force and the Sioux County Extension Agent were responsible for managing livestock and pastures and maintaining grazing records.

Pasture Establishment and Management

The pastures were established in 1971, using an alfalfa-grass mixture (1). During the 1972 grazing season the established stand was composed of approximately 80 per cent orchardgrass, 20 per cent alfalfa and a trace of bromegrass and Garrison creeping foxtail. The stand composition at the beginning of the 1973 grazing season consisted of about 90 per cent orchardgrass, 5 per cent alfalfa, and 5 per cent bromegrass and Garrison creeping foxtail. Orchardgrass exhibited no signs of winterkill during the 1972-73 winter.

Fertilizer was scheduled to be applied in the fall and following the second grazing cycle each year. Seventy-five pounds of nitrogen and 50 pounds of P_2O_5 were applied in October following the close of the 1972 grazing season to promote early spring forage growth. A composite soil sample of all four pastures was taken prior to fall fertilization in 1972 and pastures were individually sampled on May 2, 1973. The fall composite sample indicated 75 pounds of nitrate-nitrogen per acre, a low phosphorus level and a very high level of potassium. The spring sampling indicated 21, 24, 37 and 34 pounds of nitrate-nitrogen per acre on pastures 1, 2, 3 and 4, respectively, following fall fertilization. Spring phosphorus levels were very high on two pastures, and high and medium on one pasture each. Potassium levels were very high on all pastures. Since nitrogen levels appeared low in the spring following fall fertilization, another 85 pounds of nitrogen per acre was applied on May 14, 1973 and irrigation water applied. Another 75 pounds of nitrogen was applied following the second grazing cycle. Total fertilizer applied during the 1973 grazing season was 235 pounds of nitrogen and 50 pounds of P_2O_5 per acre.

Forage production and utilization of irrigated pastures by yearling steers were estimated by surface clipping seven one-square yard samples per pasture at the beginning and end of each grazing period in each grazing cycle. Forage production, while cattle were grazing each pasture, was not measured using this clipping procedure. Therefore, each rotation pasture had 29 to 34 days of growth while being grazed not accounted for in the total production on each pasture. Forage clippings were individually bagged, dried and weighed to obtain dry matter production per acre.

Soils and Irrigation

The irrigated pasture is a loam texture and has the capability to hold five to seven inches of available water (8). Pastures were irrigated with an average of 3.3 inches of water prior to the start of the grazing season. During the grazing season each pasture was irrigated at the close of each grazing period and again several days prior to grazing in the next grazing cycle, except pastures did not receive the second irrigation during cycle four. This method of irrigation main-

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tained excellent growth of forage throughout the grazing season.

The pastures received an average of 26.7 inches of supplemental water and 6.6 inches of rainfall during the growing season for a total of 33.3 inches. Measureable rainfall was recorded on 30 different occasions during April through September 20. However, one-tenth inch or less was recorded on 13 of these occurrences and one-fourth inch or more was recorded on nine different occasions. The highest recorded precipitation was on September 3, 1973 when 1.2 inches was recorded. If total water applied plus rainfall is considered to be 80 per cent efficient, total effective moisture received would be approximately 26.6 inches during the growing season. The approximate irrigation water applied and rainfall for the months of April through September 20 are shown in Table 1. Irrigation water in grazing cycle 5 was applied following grazing, therefore, water was used for fall regrowth and to recharge the soil profile, so the estimated seasonal net water use was approximately 24 inches.

Table 1. Approximate Inches of Irrigation Water Applied by Grazing Cycles on each Pasture and Growing Season Rainfall.

Grazing Cycle	Inches of Water Applied/Pasture 1	2	3	4	Average
0	2.9	2.0	2.1	6.0	3.3
1	3.9	5.3	5.0	5.3	4.9
2	6.8	7.3	6.3	6.9	6.8
3	5.3	3.8	4.0	7.5	5.2
4	3.5	4.0	3.5	3.5	3.6
5	3.0	3.5	1.8	3.7	3.0
Water Applied	25.4	25.9	22.7	32.9	26.7
Rainfall*					6.6
Total Irrigation Water Plus Rainfall					33.3

* *Fort Yates, North Dakota. 1973. U. S. Weather Bureau records.*

Animal Management

Thirty head of yearling Hereford steers were purchased by the Standing Rock Sioux Tribe at area sales rings. The steers were purchased in two groups on two separate auction days during the month of April. Steers were fed dry grass and alfalfa hay prior to grazing.

All cattle were grazed on the reserve pasture and fed dry forage during the initial weigh period. The cattle were taken off water each evening and weighed the following morning for three successive days at the start of the grazing study. The average initial weight of the 30 head was 532 pounds, based on the average of three weighings.

Fifteen head of steers representing a cross-section of the 30 head weighing an average of 531 pounds were randomly selected and designated as the tester animals. All other steers were designated as grazers and were grazed on the reserve pasture or on the irrigated pasture under a "put and take" system as needed to obtain proper utilization of the forage.

Tester animals were weighed once at the close of each grazing cycle following an overnight shrink. All grazing data for the study were calculated using the average of the 15 tester steers. Final steer weights at the close of the grazing season were determined by averaging three weighings on separate days, the same as used to obtain the average initial weight.

All steers were implanted with 36 mg. of zeranol during the initial weighing. Studies have shown that this growth stimulant will increase animal gains similar to or slightly less than stilbestrol, which has been banned from use (2, 3, 6, 7).

Salt and minerals were fed free-choice throughout the grazing season. Poloxalene blocks were fed to steers on the reserve pasture as a precaution against bloat. No poloxalene was fed steers grazing the irrigated pastures because the percentage of alfalfa was insignificant in relation to the total forage available. There were no instances where bloat was noticed during the grazing season.

Fly control was practiced using an automatic portable backrubber containing Korlan 24 per cent emulsifiable concentrate mixed with special backrubber oil.

Pinkeye was again a problem during the first half of the grazing season. All steers were treated on June 27 with an injection of 10 c.c. of Carnation milk. A special aerosol preparation was applied to the eyes of infected steers as needed at the close of each grazing cycle.

Dry, low quality grass hay was fed to the steers on irrigated pasture during the last grazing cycle. Steers grazing the reserve pasture were fed dry hay from July to the end of the grazing season. The reserve steers were also fed oats during the last grazing cycle to maintain weight gain. Growing season precipitation was too low to maintain sufficient forage growth on the reserve pasture for the "put and take" steers.

Results and Discussion

The grazing season began on May 16 and ended on September 21, 1973 for a total of 128 days of grazing. The average initial weight of the 15 tester steers was 531 pounds and the average ending weight was 721 pounds (Table 2).

Table 2. Average Beginning and Ending Weights of Yearling Hereford Steers Grazing Irrigated Rotation Pasture by Grazing Cycle.

Grazing Cycle	Average Yearling Steer Weight	
	Initial	Ending
	——pounds——	
1	531	597
2	597	591
3	591	652
4	652	677
5	677	721

The steers grazed the rotation pastures through five complete grazing cycles, the same as in 1972. Grazing cycles varied in length from 23 to 28 days (Table 3). Grazing was initiated when grass growth was 6 to 8 inches tall. Thirty head or all steers available for grazing were placed on the 7-acre irrigated pasture in an attempt to duplicate an actual farm grazing management practice. This method of stocking would permit cattlemen to utilize all grazable forage during the peak production period, provided the pastures were adequately stocked.

Table 3. Days of Grazing on Irrigated Rotation Pasture by Grazing Cycles.

Grazing Cycle	Days Grazing by Pasture				
	1	2	3	4	TOTAL
1	5	4	6	8	23
2	7	7	6	6	26
3	7	7	7	7	28
4	8	8	7	5	28
5	7	6	7	3	23
Totals	34	32	33	29	128

The grazing plan was to graze all pastures at a high intensity per acre and for a shorter period of time during grazing cycles 1 and 2. This was done in an effort to limit seed head formation and maintain a palatable, leafy growth of forage. However, growth was very rapid by late May and a stocking rate of 4.3 steers per acre could not properly utilize the forage produced during the peak growth period of late May and June. Grazing should have been initiated earlier or more steers should have been grazing the pastures during cycles 1 and 2. Forage utilization was higher during the early part of the grazing season in 1972 when heavier steers were grazed — 621 pounds initial weight in 1972 versus 531 pounds in 1973. However, total pounds of live animal grazed was greater in 1973. The additional 85 pounds nitrogen applied prior to spring grazing, not applied in 1972, may have promoted the heavier early growth of forage.

Another alternative in managing the peak flush of forage early in the season is to graze less steers initially and harvest a portion of the pasture acreage early for hay. The portion harvested early for hay could then be grazed later in the grazing season when production naturally declines.

Grazing cycle 5 was also 23 days in length. The days of grazing during this cycle were limited on pasture 4 to maintain adequate grass leaf area for production and storage of food reserves in roots before the first killing frost.

The pastures were stocked at a rate of 4.3 steers per acre during the peak forage production period in cycles 1 and 2, and 2.9 steers during all other grazing cycles (Table 4). Grazing cycle 3 shows slightly less steers than cycles 4 and 5. This is because one steer jumped the fence and was not returned to the pasture until the beginning of grazing cycle 4 even though adequate forage was available for grazing.

Table 4. Average Number of Steers, Animal Units, Acres Per Steer and Steerdays Grazing Per Acre by Rotation Grazing Cycles.

Item	Grazing Cycles					
	1	2	3	4	5	Summary
Steers/acre	4.3	4.3	2.8	2.9	2.9	3.39
Animal units/acre	2.4	2.6	1.7	1.9	2.0	9.0
Acres/steer	.23	.23	.36	.35	.35	.30
Steerdays/acre	99	111	78	80	66	434

The pastures were grazed to maintain a minimum of 3 to 4-inches of grass leaf area at the close of each grazing period. Grazing intensities used often left more growing grass on the ground. Steers required slightly less than one-fourth acre per head during grazing cycles 1 and 2, and about one-third acre per head during the remainder of the grazing season.

The pasture system had an average carrying capacity per acre of 2.1 animal units per month or about 9.0 animal unit months (A.U.M.'s) of grazing per acre based on growing season conditions at Fort Yates, North Dakota.

The carrying capacities of the pasture system in A.U.M.'s per acre were identical in 1972 and 1973. The identical pasture carrying capacity in 1973 is, we believe, due to higher rates of nitrogen fertilizer applied — 170 pounds in 1972 and 235 pounds in 1973. Higher rates were used in 1973 because spring soil tests showed relatively low nitrate-nitrogen levels in the soil following an application of 75 pounds of nitrogen in October 1972. Due to lower than expected nitrate-nitrogen

levels in the spring of 1973, an additional 85 pounds of nitrogen was applied. A strip down the center of pasture 3 was not spring fertilized as the pasture was being irrigated and could not be driven on due to wet soil conditions. Regrowth on the fertilized area following grazing in cycle 1 was four to six inches taller and a deeper green color than the check area, indicating that the additional spring applied nitrogen increased rate of forage growth. Present nitrogen fertilizer recommendations for irrigated pasture, 150 pounds nitrogen per acre, may be low for stands of nearly pure grass (4, 9), and early spring fertilizer application may be more desirable based on observations in 1973.

The carrying capacity of irrigated pasture in North Dakota will be less as one moves northward in the state due to length of grazing season. The carrying capacity may vary from 7.0 to 10.0 animal unit months (A.U.M.'s) per acre from north to south depending upon level of management and pasture mixture being grazed.

Steer gains were quite variable throughout the grazing season. The highest average daily gain was 2.9 pounds per day during the first 23 days of the grazing season (Table 5). Steers lost an average of 0.26 pounds per day or 6.7 pounds per head during the next 26-day grazing period. This loss cannot be explained; however, yearling steer gains in area dryland trials were minimal during a similar weigh period. Daily high temperatures during the period were greater than 80° but less than 90° F. on 13 days of the grazing cycle as compared to grazing cycle 3, which had daily highs greater than 80° on 20 days. Temperatures were 90° or higher on 10 days, six days of which were 100° to 109° F. based on records obtained from the U. S. Weather Bureau, Fort Yates, North Dakota. Daily steer gains during grazing cycle 3, the highest temperature period, were 2.2 pounds. The exact cause of the weight loss cannot be explained based on methods and procedures used unless forage quality was low due to stage of maturity by the end of the grazing cycle. This aspect of the study is being investigated by the North Dakota State University Departments of Agronomy and Animal Science.

Steers grazing the irrigated pasture did not appear as thrifty, similar to the 1972 grazing study, as compared to steers on the reserve dryland pasture. Dry, low quality grass hay was offered the steers during the last grazing cycle in an effort to firm-up the feces and improve overall thriftiness of steers. Consumption of dry feed was not measured, although the steers appeared to eat approximately one-half of the feed offered or about two pounds per day per head. Studies in the State of Washington (9) indicate steers consumed one pound of wheat straw per day when fed as a precaution against bloat. Based on the limited time fed and observations of the steers no definite conclusions can be drawn in this study. The dry feed did not firm up the steer feces. The average daily gain was about 1.5 pounds per day in 1973 as compared to 1.97 pounds in 1972 when mostly crossbred yearling steers were grazed.

Table 5. Average Daily Gain, Gain Per Head and Gain Per Acre of Yearling Steers Grazing Irrigated Pasture.

Grazing Cycle	Average daily gain	Average gain/head	Gain per acre
1	2.88	66	284
2	—0.26	— 7	— 29
3	2.19	61	171
4	0.89	25	71
5	1.93	45	127
Summary	1.48	190	624

Average seasonal gain per head was 190 pounds for an average of 624 pounds per acre. Total beef gain per acre in 1973 was approximately 12 per cent less than in 1972. Since the pasture productivity was greater during the 1973 grazing season, differences may be due in part to an estimated 20 per cent reduction of alfalfa in the pasture stand, lower stocking rates in relation to forage available, straight-bred steers in 1973 versus crossbred steers in 1972, the negative gain obtained in grazing cycle 2 and forage quality. Washington studies (9) show decline in steer gain per acre of 8.4 per cent for orchardgrass-alfalfa pasture and 29.5 per cent for a straight orchardgrass pasture during the second year of grazing.

The Washington studies further emphasize the value of alfalfa-grass mixtures to obtain highest animal gain per acre. Irrigated alfalfa-grass pastures containing about 50 per cent alfalfa, produced 1,172 and 939 pounds of beef per acre compared to a fertilized orchardgrass which produced 702 and 495 pounds of beef per acre during the first and second grazing year, respectively.

There are a number of precautionary measures (4, 5, 9, 10) which can be taken to guard against the ever-present hazard of bloat while grazing alfalfa or grass-alfalfa mixtures. These include feeding a poloxalene-grain or molasses-poloxalene mixture daily; placing cattle on pastures with a fill of dry hay; avoiding grazing immature stands; maintaining alfalfa-grass mixture of 50-60 per cent grass; where bloat has been a problem, providing overnight feeding of sudangrass or oat hay. Heinemann (4) states, "Sufficient good forage to graze can be a factor in the

incidence of bloat.———grazing was terminated on a given area when it was estimated that about 20 per cent of the forage remained. . . . . when removing animals from one rotation plot to the next, there must be sufficient growth and degree of maturity on the new plot. This calls for close correlation of stocking rate and growth of forage. Pastures containing alfalfa should have attained a plant growth of from 12 to 14 inches. ——— at these stages there may be an occasional blossom on alfalfa (after first grazing) . . . . Forage at these stages of maturity will have somewhat more fiber and less water and seems to cause bloat less frequently. Also, the production of beef will be greater."

Forage production data show that the irrigated pastures had an estimated dry matter yield of 7,943 pounds or 3.97 tons per acre (Table 6). The difference between forage present immediately prior to grazing and forage not consumed was considered as forage consumed by the steers. A total of 5,978 pounds of forage dry matter was consumed for an average utilization of about 75 per cent compared to about 84 per cent in 1972.

Table 6. Dry Matter Production and Utilization Percentages of Irrigated Rotation Pastures.

Pasture No.	Pounds Dry Matter/Acre Produced	Consumed	Per Cent Utilization
1	9006	5964	66.2
2	6041	4852	80.3
3	9328	7852	84.2
4	7396	5242	70.9
Average	7943	5978	75.3

The grazing season was terminated at the close of grazing on September 20. The steers were not sold by the Standing Rock Sioux Tribe for several weeks following grazing. Therefore, timely sales data is not available for an economic analysis. However, an analysis of the pasture system may be made following the procedure outlined in the first year results of this study (1). Profitability of yearling steers grazing an irrigated pasture depends to a very large extent upon (1) purchase price, (2) selling price, (3) pasture productivity, (4) beef gain per acre, (5) the cost of producing an acre of irrigated pasture, and (6) level of pasture management.

Table 7 summarizes the results of the 1972 and 1973 yearling steer grazing study.

Table 7. Irrigated Rotation Pasture Grazing Summary 1972-73.

Item	1972	1973	Average
Initial steer wt. (lbs.)	621	531	576
Final steer wt. (lbs.)	881	721	801
Days grazed	132	128	130
Avg. no. steers/acre	2.7	3.4	3.1
Acres/steer	.37	.30	.34
Animal unit months/acre	9.0	9.0	9.0
Steerdays grazing/acre	355	434	395
Avg. daily gain (lbs.)	1.97	1.48	1.73
Gain/head (lbs.)	260	190	225
Gain/acre (lbs.)	710	624	667

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