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University of Tennessee Agricultural Experiment Station

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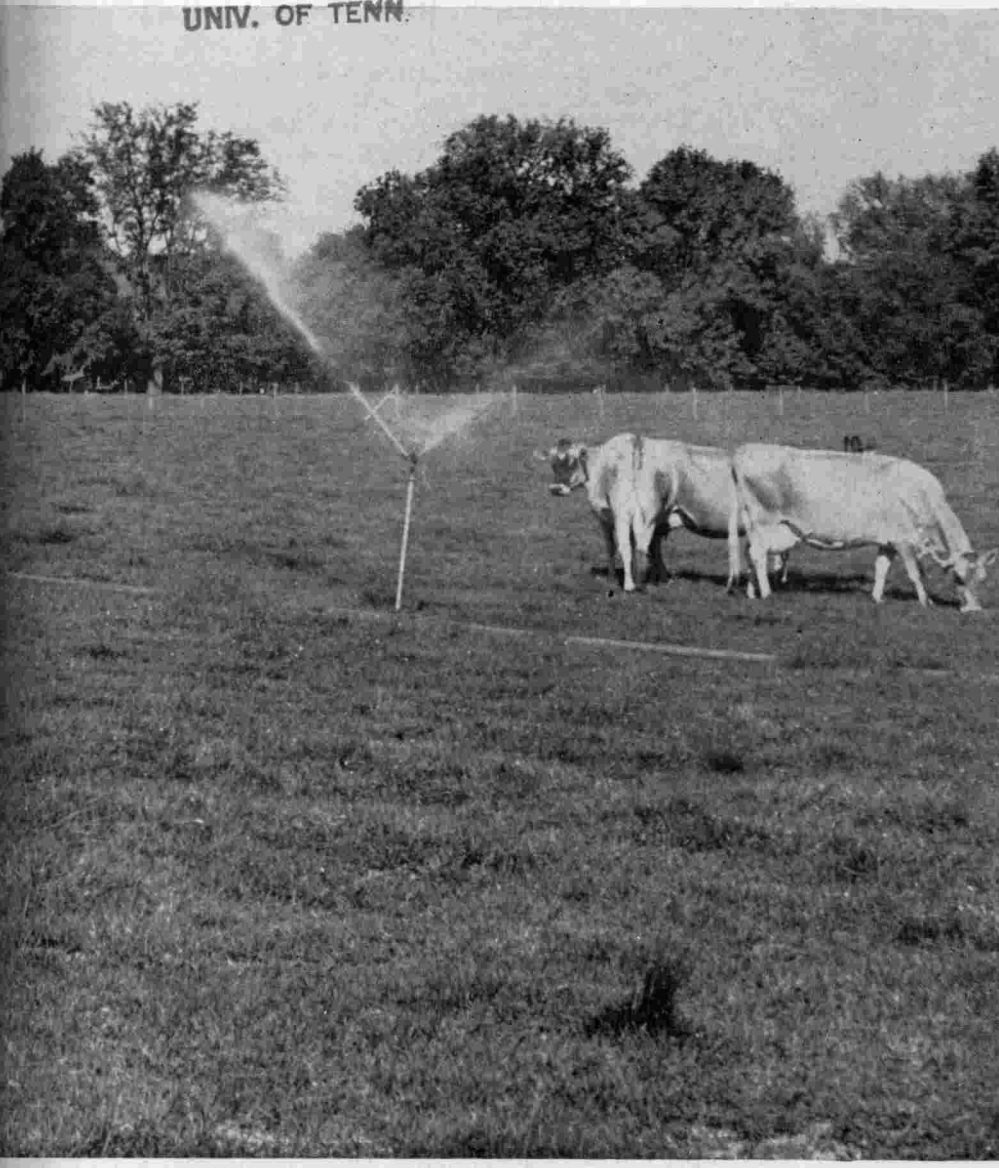

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
Knoxville

IRRIGATED PASTURE FOR DAIRY COWS

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Introduction

In Middle Tennessee, as in much of the South, pastures usually suffer from lack of moisture at some time during the grazing season, especially in the late summer. During the past few years extreme drouths have stimulated interest in irrigation of pastures. Permanent pastures in Middle Tennessee, on the high-phosphate soils, are lush in the spring but by the last of June, when dry weather normally begins, are usually poor. Milk production from July through October shows a decided drop, as indicated in the dairy receipts by milk plants in the area (4). Many farmers are forced to give their cattle supplemental feeding during this period. The irrigation of fertilized permanent pastures, where an ample source of water is available, will increase milk production per acre economically. Additional information is needed on the amount of water to apply and the time of applications.

Previous Tests

Ewalt and Jones (2), from studies over a period of ten years, concluded that it was profitable to establish and irrigate Ladino clover and grass pastures for dairy cattle. They also found that the increased yields due to irrigation called for increased fertilization. A well-fertilized irrigated Ladino clover and grass pasture provided 2 cows per acre with 75 to 85 percent of their total feed during the grazing season. Carraker, Liddell and Henderson (1) in a two-year study at Athens, Georgia, found dairy heifers on irrigated pasture gained 32 percent more in weight and grazed 34 percent more days than heifers on non-irrigated pasture. The cost of irrigation was figured at $3.80 per acre-inch for 1948, a wet year. The gains in weight were more than twice as great in 1947, a dry year, as in 1948. The average total cost of producing 100 pounds

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of total digestible nutrients from irrigated pastures in 4 California counties in 1945 was only $0.77 (3). Per acre cost averaged $33.52.

A project was initiated at the Middle Tennessee Experiment Station, in 1938, in cooperation with the Tennessee Valley Authority, to study the practicability of supplemental irrigation on permanent pasture for lactating dairy cows. The study included the effects of pasture irrigation on milk production, carrying capacity of pasture, on length of the grazing season, the need for supplemental feed, the growth and development of the animal, the cost of the operation, and the species composition of the pasture sward.

In 1938, 6.5 acres of permanent pasture, consisting primarily of Bermuda-grass, with some bluegrass and white and hop clover, was divided into two equal plots. One plot was irrigated and the other was used as a check. Water was applied by the overhead rotating sprinkler method. One group of dairy cows was kept on the irrigated plot and a similar group on the non-irrigated plot. The plots were irrigated alternately from year to year. The test was continued until 1941. Results indicated that permanent pasture could be irrigated satisfactorily for dairy cows at a cost approximately twice the usual charge for pasturing cows, which was considerably less than the cost of substituting winter feeding in the summer. In alternating fields each year, there was no cumulative effect on this pasture due to irrigation. The pasture was predominantly Bermuda-grass, which is not a satisfactory midseason pasture grass because it is not as palatable as other grasses. For this reason, another test was started on a newly seeded pasture, one-half of which was irrigated each year.

The Pasture Plots

This new pasture was established on a fertile level field of predominantly Elk silt loam with some Emory silt loam. Both of these soils are nearly level, possess good tilth and permeability and in this particular location are naturally very high in phosphate. In 1942 the field was in lespedeza, which was removed for hay after being pastured during July and August. The land was marked well with a disk harrow, and hop clover and annual ryegrass was seeded on one half of the field and hop clover and orchardgrass was seeded on the other half. Fair stands were secured, and the following February bluegrass, redtop, white clover, and Ladino clover were sown. The following spring the field was divided into nearly equal tracts so that each tract included both ryegrass and orchardgrass seedings (7.0 acres and 6.23 acres). The tracts were pastured moderately and mowed. The irrigation was started and the fields were grazed for two months. Some hay was made. The following year hop clover seed was saved and a cutting of hay made. In the spring of 1945 the pasture sward in the two plots was considered

equal and the test was started April 1. In the fall of 1945 additional Ladino clover was sown and in the spring of 1946, 2 tons per acre of ground limestone was applied to each plot.

Irrigation Method

Water from an adjacent stream was pumped by a gasoline-operated centrifugal pump into an overhead rotating sprinkler irrigation system. Two inches of water was applied at one setting and as often as necessary to prevent the pasture species from wilting. The water applied by years is shown in table 1. Some difficulties were experienced in the operation of the gasoline engine. The ever-constant load of the pump delivering from 150 to 170 gallons per minute at 40 pounds pressure tended to cause the motor to heat. At one time considerable repair was necessary. An electric motor would have been much more satisfactory and more economical. Since the system was capable of irrigating 20 acres and was used on adjoining fields, the per-acre charges for interest and depreciation as shown in table 3, were computed on 20-acre basis.

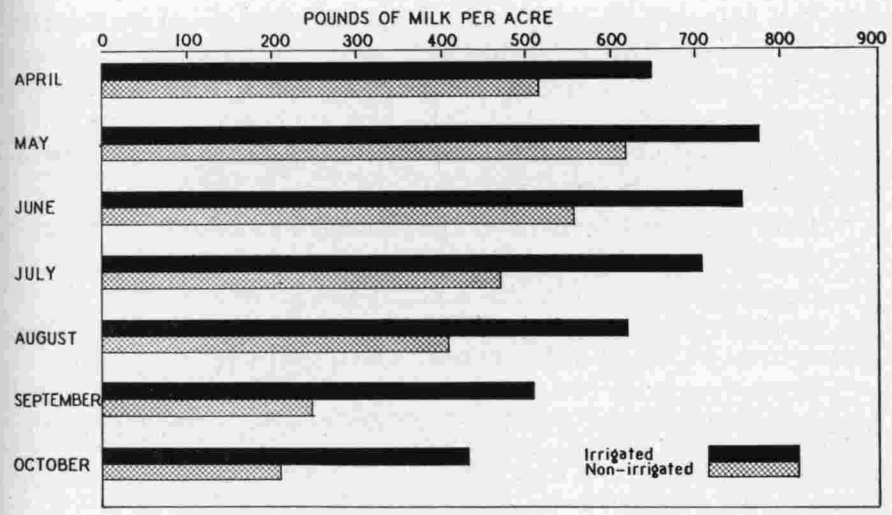
Pasture cages were placed in each plot and clippings were made to determine the growth and amount of forage produced. The species composition of the pasture sward of each plot was determined by the point quadrat method in the spring and fall of each year beginning in 1946. These results are shown in table 4.

Animal Selection and Management

Each spring registered Jersey cows were selected according to age, past and present production records, gestation status, body weight, and previous treatment. Cows were on pasture from the first of April through October each year. Their ration of grain was fixed at 2 pounds per day during the entire season. Alfalfa hay was fed in self-feeder racks in the pasture and the cows were kept on the pasture night and day.

Results

During the experimental period (1945-1948) fluorine-bearing effluents from nearby chemical plants had a detrimental effect on the cattle. Injury cannot be measured exactly, but it is believed that the two groups, being evenly paired, would be affected to the same degree since there was no significant difference in fluorine content of forage samples taken from the two pastures. Cattle born since the chemical plants started increased operations are injured more than older cows that reached maturity before a large majority of chemical plants started operations. This may explain why the highest milk production was obtained in 1946 (See tables 1 & 2). The cows selected and used in the test in 1946 averaged approximately 8 years in age. In other years the animals used were considerably younger.



Four year average milk production by months.

The 4 year average milk production, by months for both the irrigated and the non-irrigated pasture are shown in figure 1. The milk production per acre for the critical months of July, August, September, and October was greatly increased by irrigation and for September and October it was more than doubled. The number of cow days per acre for the irrigated pasture ranged from 171 to 225; the cow days on the non-irrigated pasture ranged from 135 to 159. The results for the 4 year period (1945-1948) show that the pasture species used, bluegrass, orchardgrass, white clover, and Ladino clover, will furnish more grazing for a longer period than the same species not irrigated. Over the 4 year period average daily milk production by cows on the irrigated pasture was 21.1 pounds, while the average daily milk production for cows on the non-irrigated pasture was 20.5 pounds. Thus under irrigation, the big increase in total milk production is largely due to the increased pasture-carrying capacity as shown by more cow pasture days per acre (Tables 1 & 2).

The yield was calculated also in terms of total-digestible nutrients (1). The procedure follows: the requirements for maintenance, gain or loss in weight, and milk production are calculated by use of the Morrison standard (5); the total digestible nutrients fed, in hay and concentrates, are subtracted from the total required nutrients, and the difference is the amount of total digestible nutrients supplied by the pasture. As shown in tables 1, 2, and 3, the total digestible nutrients from the irrigated pastures have been maintained at a higher level, as compared to the amount of nutrients from the non-irrigated pasture. The difference is especially marked in 1948, a drouth year.

The income per acre above feed and irrigation costs shown in tables 1 and 2 reveal a profit due to irrigation in all years except 1945; in 1948 the income was more than double on the irrigated plot. One acre-inch of applied water cost slightly more than $1.50, approximately one-third of this amount being charges for depreciation and interest on investment.

Data presented in table 4, shows what has been happening to the species composition of the pasture sward during this period. The big change has been in the amount and growth of white clover. By the end of the grazing season in 1948 very few white clover plants could be found in the non-irrigated pasture.

Green-forage yields, determined by clipping the forage under a 4x4-ft. cage and subtracting the clipped forage from an equivalent grazed area, were 51-percent greater in 1946 on the irrigated, as compared to the non-irrigated plot. This difference is about the same as the difference in total digestible nutrients calculated for the two plots. That this difference is greater than the difference in milk or cow-days is probably due to the fact that the cows on the non-irrigated pasture consumed 6.5 pounds of hay per day, whereas the cows on the irrigated pasture consumed only 4.0 pounds of hay per day, even though the number of cows was adjusted according to the available grazing. The irrigated pasture was more palatable. Both groups gained in body weight, with a slight difference in favor of the cows on the irrigated pasture.

Conclusions

A 4-year average (1945-1948) at the Middle Tennessee Experiment Station, Columbia, Tennessee, indicated the possibility of profitably irrigating an adapted permanent pasture for dairy cows where an adequate water supply exists. The study further indicated that late-summer milk production can be maintained during a period when many dairymen have to resort to heavy supplemental feeding. Irrigated pasture produced 41-percent more cow-days of grazing, and 43-percent more milk, and returned 43-percent more income ($61.30 per acre) above feed and irrigation costs, than cows on similar non-irrigated pasture. Good pasture can be maintained much longer with desirable pasture species such as white clover, when irrigated.

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(3) Jones, Burle J., and Brown, J. B., Irrigated Pastures in California, California Agricultural Extension Circular 125 (Rev.), 1947.

(4) Milk received by milk plants in Middle Tennessee.

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(6) Preliminary report on pasture investigations technique. Journal Dairy Science 26:353-369. 1943.

Table 1 Annual Yields Per Acre and Other Data—Irrigated Pasture

ITEM	1945	1946	1947	1948
Cow Pasture Days	171	228	216	225
Total Milk—lbs.	3866	5401	4726	3717
Total Fat—lbs.	220	284	238	227
Gain in Body Weight—lbs.	43	64	113	108
Water Applied—inches	10	8	16	18
Rainfall—inches	24.33	27.56	17.13	13.28
Irrigation Cost	$15.74	$14.72	$24.38	$26.46
Income Above Cost	$136.48	$248.62	$208.06	$219.19
T. D. N. From Pasture—lbs.	2382	2618	2824	2575

Table 2 Annual Yields Per Acre and Other Data—Non-Irrigated Pasture

ITEM	1945	1946	1947	1948
Cow Pasture Days	152	159	150	135
Total Milk—lbs.	3708	3733	2971	1972
Total Fat—lbs.	209	200	151	105
Gain in Body Weight—lbs.	23	66	110	116
Income Above Cost	$146.46	$179.09	$142.90	$98.71
T. D. N. From Pasture—lbs.	2144	1799	1748	1112

Table 3 Average Yields Per Acre and Other Data— 1945 - 1948

ITEM	IRRIGATED	CHECK	PERCENT INCREASE DUE TO IRRIGATION
Cow Pasture Days	210	149	41
Total Milk	4428 lbs.	3096 lbs.	43
Percent Fat	5.46%	5.37%	
Total Fat	241.91 lbs.	166.25 lbs.	45
Value of Fat	$248.53	$162.96	52
T. D. N. from Pasture	2599 lbs.	1728 lbs.	55
Alfalfa Hay Consumed	975 lbs.	972 lbs.	
Concentrates Consumed	420 lbs.	298 lbs.	
Rainfall	20.32 inches	20.32 inches	
Inches Water Applied	13 inches		
Cost of Irrigation[1]	$20.32		
Income above Cost[2]	$203.09	$141.79	43=$61.30

[1] Cost includes Operation, Interest, and Depreciation.
[2] Feed and Irrigation Cost.

Table 4 Species Composition of Pasture Sward[1] 1946 - 1948

SPECIES[2]	Percent Composition of Various Species									
	IRRIGATED					CHECK				
	4-46	4-47	9-47	3-48	8-48	4-46	4-47	9-47	3-48	8-48
Bluegrass	33.3	52.6	64.4	81.0	75.9	35.4	49.8	61.0	61.6	79.2
Orchardgrass	13.3	12.4	10.7	4.6	1.4	19.2	13.2	12.5	4.1	4.9
White Clover	38.2	31.0	15.0	13.0	7.8	34.2	19.1	6.1	10.5	0.6

[1] Determined by Point Quadrat.
[2] Red Top, Hop Clover, and Species, and Weeds not listed.