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Nitrogen fertilization of Irrigated Pastures

to improve forage production capacity

Increasing production costs are forcing many growers to consider nitrogen fertilization as one means of increasing yields of irrigated pastures.

Experiments at Davis showed that nitrogen increased yields only when the pastures were largely or entirely composed of grass.

The first experimental plots of a two-year test were sown on October 3, on Yolo fine sandy loam, a soil considered to have an adequate supply of phosphorus but somewhat low in available nitrogen. Certain plots were sown to ladino clover, others to orchardgrass, and still others to a mixture of three pounds of ladino clover and 10 pounds of orchardgrass per acre. The clover was not as productive as desired in the early part of the following spring, but increased as the season advanced.

Nitrogen was applied to the test plots as ammonium sulfate at rates of 80, 120, and 160 pounds of elemental nitrogen per acre. A check plot was not treated. Only 40 pounds was applied at any single application so 2, 3, and 4 applications were spaced throughout the first and second growing seasons.

Nitrogen Fertilization of Experimental Irrigated Pastures

Year	Nitrogen in pounds per acre		
	80	120	160
1st	March 9	March 9	March 9
		May 10	May 10
			July 24
	Sept. 18	Sept. 18	Sept. 18
2nd	April 26	April 26	April 26
		May 30	May 30
			July 17
	Sept. 17	Sept. 17	Sept. 17

The plots were mowed at approximately 28-day intervals and because they were not grazed, no animal droppings or urine were returned to the soil. Also the influence of grazing and trampling was absent but the results of the experiment —which can not be related directly to pasture conditions—are believed to be indicative of field results.

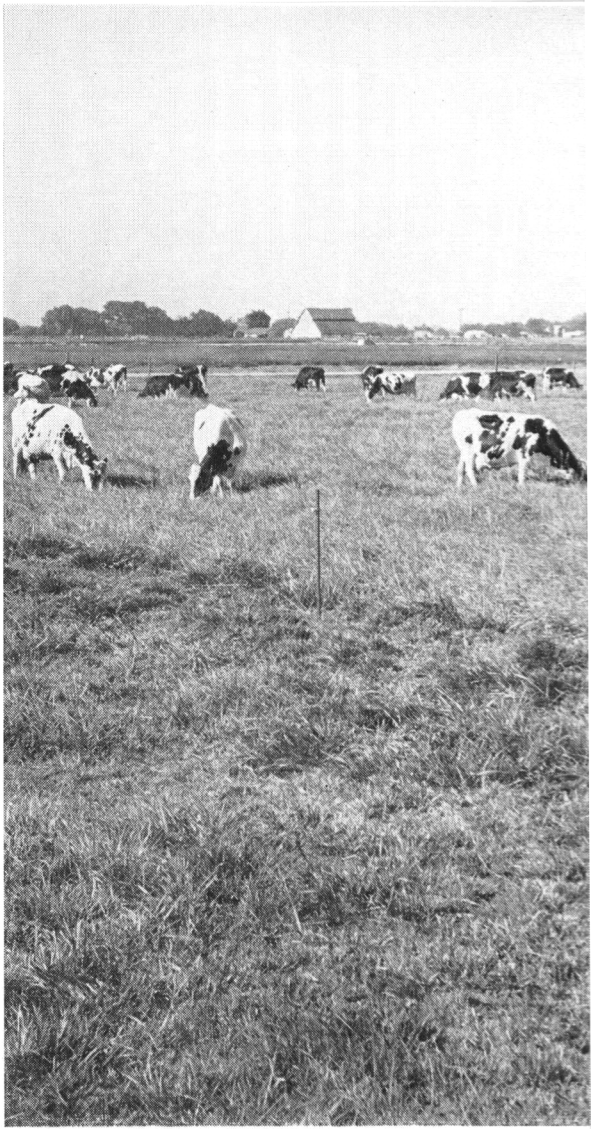
The stands in the ladino clover plots were more productive than the stands in the plots seeded to ladino clover and orchardgrass but the mixture planted plots yielded more than the orchardgrass plots. However, mixtures do not always yield less than ladino clover grown alone. In other experiments, mixtures were more productive.

The results from nitrogen fertilization of mixtures in these experiments establish certain principles which seem to apply to most, if not all, situations. Rates of nitrogen had no influence upon ladino clover yields but the mixture responded to increasing rates of nitrogen in the first growing season of the test, when the grass portion of the mixture predominated. In the following year the mixture did not show significantly increased yields from nitrogen but the plot with orchardgrass alone was benefited in both years.

Yields in Tons per Acre at 12% Moisture

Crop species	Year	Nitrogen in pounds per acre			
		0	80	120	160
Ladino Clover	1st	5.76	6.26	6.43	6.19
	2nd	4.51	4.58	4.68	4.70
	Total	10.27	10.84	11.11	10.89
Ladino-Orchardgrass Mixture	1st	2.84	3.70	3.94	4.79
	2nd	4.12	4.04	4.31	3.98
	Total	6.96	7.74	8.25	8.77
Orchardgrass	1st	1.71	2.96	3.65	4.37
	2nd	0.61	1.22	2.06	2.42
	Total	2.32	4.18	5.71	6.79

It is evident from the results of the test, that nitrogen fertilization of orchardgrass alone produced poor yields compared with ladino clover alone or with the mixture. Even the heaviest rate of fertilization produced unsatisfactory yields of orchardgrass; during the second year—irrespective of nitrogen rates —production was only about half that of the first year. The reason for the decline may be an inadequate supply of nitrogen following utilization, or the tying up of the nitrogen initially available in the soil. During the first year, the orchardgrass plot treated with the 160 pound rate of nitrogen produced 155% more than the untreated check. With the lower yield level in the second year, the plots treated with the high rate produced four times as much as the unfertilized check plots.



Irrigated pasture seeded to mixture of legumes and grasses to improve yield.

Apparently, extremely high rates of nitrogen fertilization are required to produce satisfactory yields of orchardgrass grown alone. The graph to the left on the next page represents the seasonal distribution of production from orchardgrass grown alone during the second year of the trials. In almost every instance, yields for the period following the one during which nitrogen was applied were decreased approximately 50%. Thus most of the 40 pounds of nitrogen applied was utilized or leached within about a month after application. Had the heaviest rate of application also included June and August treatments, the seasonal growth curve might have crested—as would be expected with normal growth —in mid-June, coinciding with the longest number of hours of daily sunlight. The poor response from mid-September

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applications is believed to be more the effect of short days than of cooler weather.

Composition of Pasture

The influence of nitrogen on the grass and the clover components of the mixture reflects the plant responses to nitrogen fertilization. In the first year of the experiments the percentage—by weight—of ladino clover was small and response to nitrogen was similar to the plots of orchardgrass alone but the yield level was somewhat higher, especially with no nitrogen or in the plot where only 80 pounds was applied. The unfertilized plots had 35% clover and those which received 80 pounds of nitrogen per acre contained only 19.6% clover. The clover significantly influenced yields in both plots. However, as the nitrogen rates increased, clover percentage declined and the yield advantage of the mixture over orchardgrass alone diminished.

The percentage of clover in the mixture improved in the second year, as expected, because initial stands of clover were poor. Without fertilization, clover comprised 61.4% of the forage and the higher yielding advantage of clover over orchardgrass resulted in a fairly respectable yield for the check plot. However, where nitrogen was applied at the 80-pound rate, the percentage of clover declined to 45.7%, to 34.2% at the 120-pound rate and dropped to 26.7% at the 160-pound rate. Any benefits from the nitrogen to the grass were cancelled by a decline in clover, as far as yield is concerned. The yields from the orchardgrass components of the mixture actually exceeded the yields of orchardgrass grown alone at all nitrogen levels. In the mixtures, added nitrogen benefits were obtained by the grass from the clover through the nitrogen fixing bacteria associated with the nodules on the roots.

Ladino Clover in a Ladino-Orchardgrass Mixture
(As influenced by rates of nitrogen fertilization)

Nitrogen rate	Year		
	1st	2nd	Av.
0	35.0%	61.4%	48.2%
80	19.6	45.7	32.7
120	10.0	34.2	22.1
160	6.6	26.7	16.7

The graph on the right illustrates the clover-grass mixture response to nitrogen. The plots with the 160-pound rate of nitrogen fertilization climbed rapidly in grass percentage following the first application and remained at a level near 80% throughout the remainder of the season. When the July application was omitted from the 120-pound rate, the percent of grass declined rapidly in July and August.

The start of the decline was advanced to mid-May when the second application of the 80-pound rate was omitted. At the zero nitrogen rate—the check plot—the percent of grass gradually declined from May 21 to the end of the season. In every case, the September application sharply increased the percentage of grass. The natural balance between legumes and grasses is sensitive and quickly responsive to available nitrogen.

In general, protein percentages followed yields but there was a natural seasonal decline in midsummer with increases in the autumn and again in May. Even the lowest protein percentages recorded in the trials were more than adequate for most classes of livestock. However, protein may be inversely correlated with crude fiber which in turn influences palatability and digestibility. Forages which are too high in protein may also be unpalatable.

Ladino clover exhibited no response to nitrogen fertilization—as measured by protein percentage—when grown alone or where mixed with orchardgrass. Orchardgrass grown alone showed an increase in protein associated with increased rates of nitrogen fertilization but the extent of improvement—even at the highest rate over the unfertilized plots—was only a little over 2%.

Fertilization is only one of several important and interrelated management practices—seed mixture sown, irrigation, length of growing periods between grazings, intensity of grazing—which must be kept in balance to achieve maximum carrying capacity of irrigated pastures.

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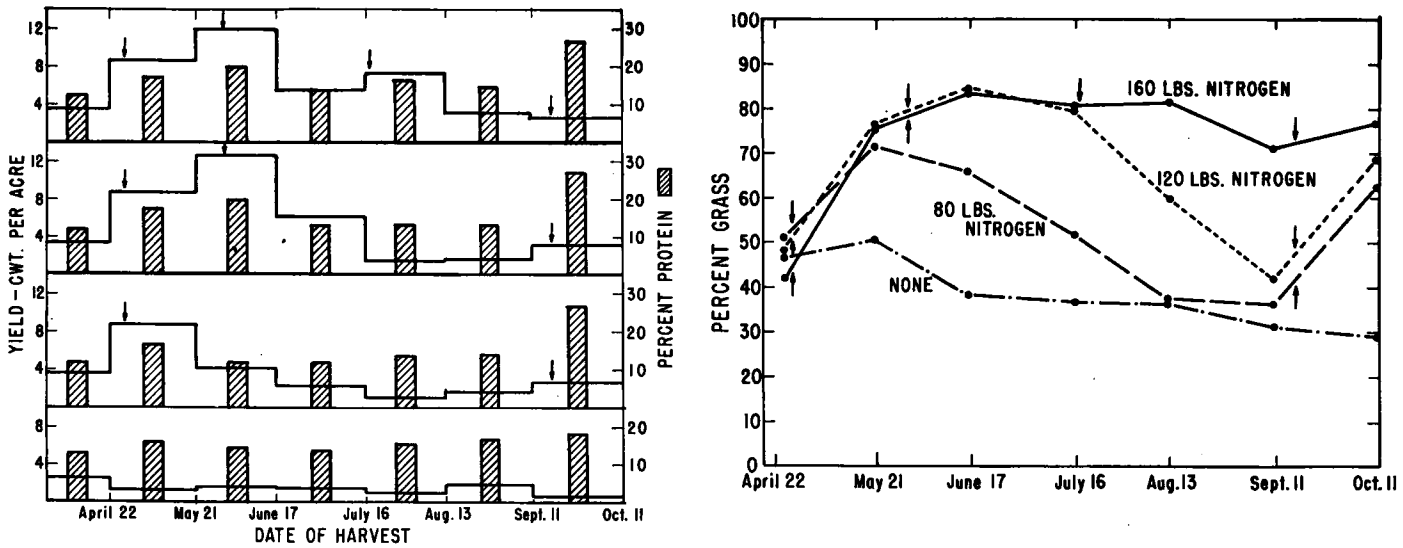

***Left*—Seasonal distribution of yields and protein percentage as influenced by the time and rate of nitrogen fertilization. Vertical arrows indicate times of application of each 40-pound increment. *Right*—Percentage grass in an orchardgrass-ladino clover mixture as influenced by fertilizer rates and times of application. Vertical arrows indicate times of application of each 40-pound increment.**