Growth responses of

Annual Range Forage

to seasonal applications of urea

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To test the efficiency of nitrogen fertilization on California annual rangelands, a three-year study was made of forage yield and nitrogen uptake in relation to the dates of application of urea fertilizer.

Study plots were located on Sutherlin fine sandy loam, at an elevation of about 1,400′ in Mendocino County. Fertilizer was applied by broadcast about the middle of September, November, December, January, February, and March each year. Fertilizer treatments were nitrogen as urea, and urea with phosphorus as treble superphosphate. Nitrogen was applied at the rate of 50 pounds per acre the first two years and 75 pounds per acre the third year. Phosphorus was applied at the rate of 75 pounds per acre for all three years.

A factorial design with four replications was used. The first year individual plot size was 7′×30′. The second year individual plots were split in half to 7′×15′ in size. One half was fertilized and the other half received no fertilizer, so the effect of the carryover could be measured. Half of each check plot was fertilized the second year, to measure the effects on previously unfertilized areas. Plots which received fertilizer the first year but not the second were fertilized again the third year, as no residual effect was measured on any of those plots by the end of the second year.

Forage production was measured by clipping three plats one foot square from each plot, in February and again in May,

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Test plots treated with nitrogen in October at rates of 30 pounds and 100 pounds per acre; photographed in November.

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of pears sold to the cannery and the value of the canned product. This difference includes not only the costs of processing but also any profit made by the canners. Since this entire difference enters into the nonfarm sector of the economy, it can be considered as a contribution from the pear industry.

Pears canned in California in 1959 amounted to 286,700 tons or 5,227,522 cases packed and valued at $32,149,260.

The cause of pear decline is unknown but the severity of the potential economic loss to growers and nongrowers justified a statewide, all-out research program designed to find the cause and control—if any—of the disease. The United States Department of Agriculture, the states of Washington, Oregon, and California have assigned qualified personnel to work with the University of California Agricultural Experiment Station in an effort to find a solution to the problem of the pear decline disease.

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and then determining the nitrogen content of the clipped forage.

The 1956–57 growing season was relatively cool and dry in the fall and warm and wet in the spring, with total rainfall of 29″. The first rains sufficient to germinate annual plants came in late October 1956.

The 1957–58 season began with heavy rain in late September and continued relatively warm and wet through April, with rainfall totaling 60″.

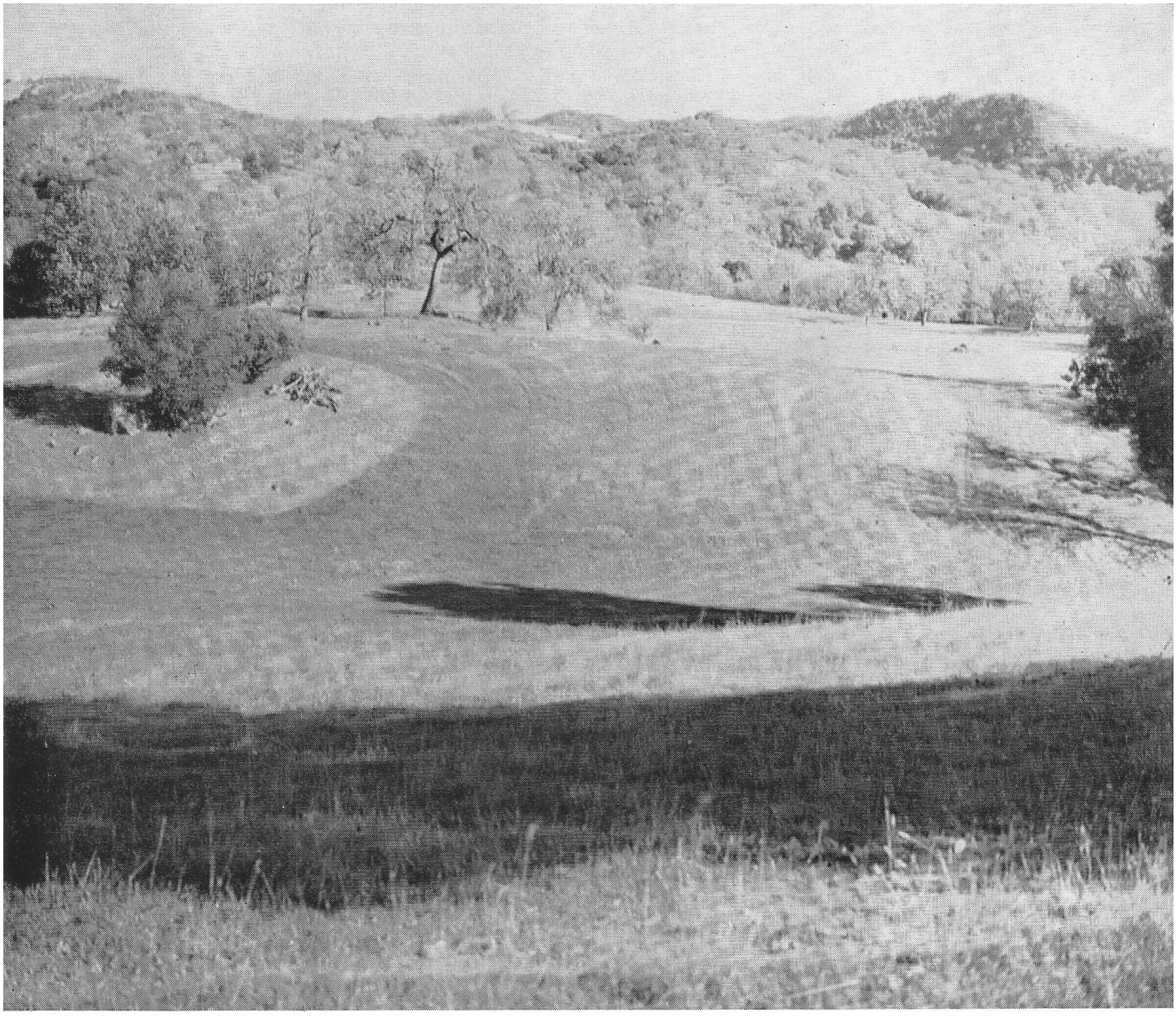
The 1958–59 season was warm throughout. The first rains sufficient to germinate annual plants came in late November. The total seasonal rainfall was 28″ and, except in January, February and March, there was a shortage of soil moisture.

Principal plant species on the plots were soft chess and ripgut—*Bromus mollis* and *B. rigidus;* slender wild oats—*Avena barbata;* fescue—*Festuca* spp.; broadleaf and narrowleaf filaree—*Erodium botrys* and *E. cicutarium;* annual resident clovers—*Trifolium* spp. and *Lotus* spp.; and lupine—*Lupinus* spp. The percentage of each species was estimated.

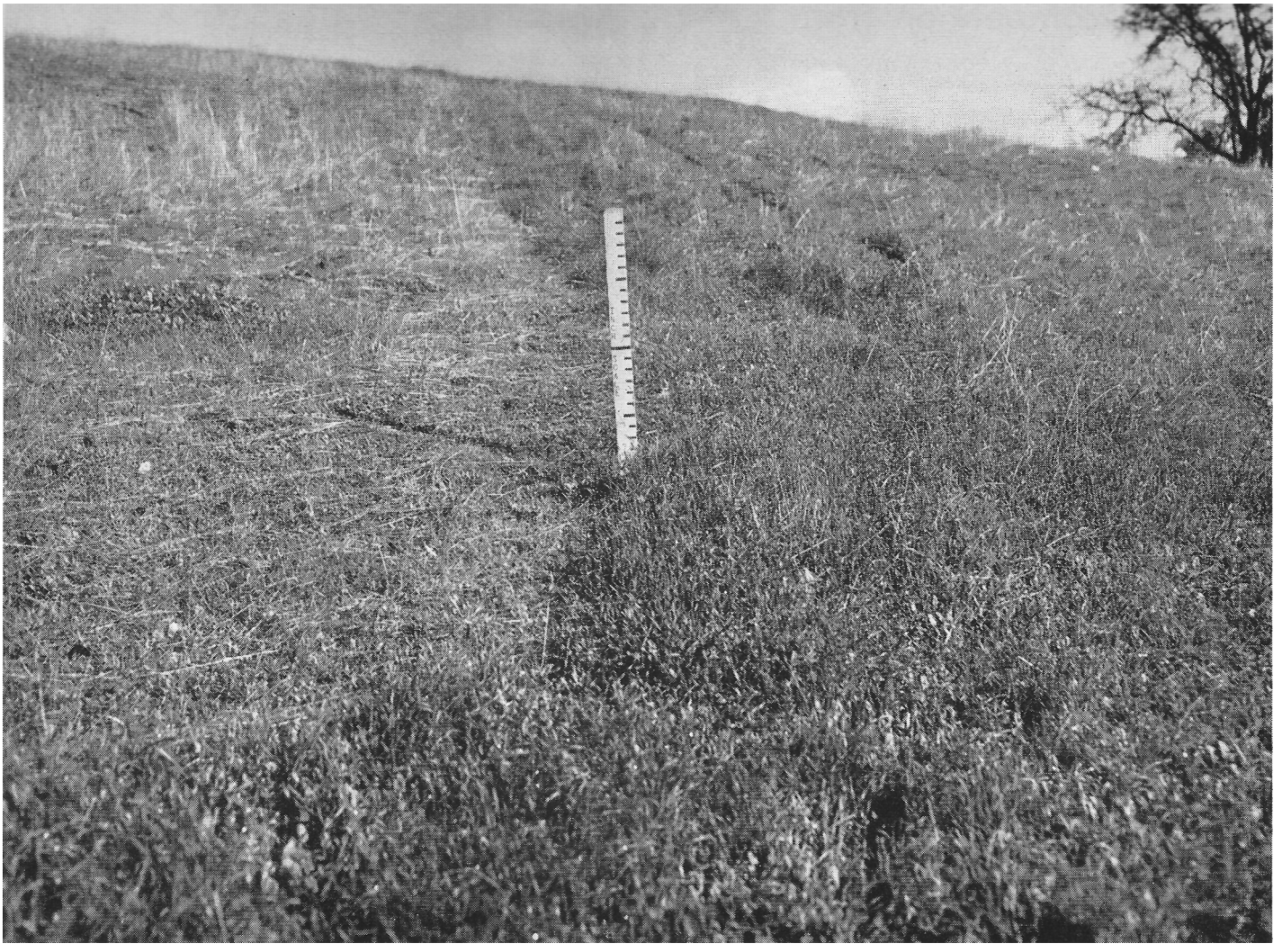
February Forage

Forage production in February was increased most by urea applied in September and least by urea applied in January. Phosphorus application with urea did not increase yield over applications of urea alone. The urea applied in November and December gave intermediate forage yields. The greater response to the September application was consistent for each of the three years.

The nitrogen content—percentage—of the forage clipped in February was progressively higher as the date of application of urea advanced from September to January. Plots fertilized in September—with highest yields of forage—were lowest in percentage of nitrogen, and results were consistent from year to year. Fertilized plants were lower in nitrogen content in the wet year than in the dry years. Increased plant growth, greater leaching of nitrogen from the soil, or differences of plant species could have been contributing factors to cause the lower nitrogen content.



Range fertilization test with nitrogen at Hopland Field Station in Mendocino County.



Fertilization test. *Left*—untreated check plot. *Right*—nitrogen applied at 80 pounds per acre.

Total nitrogen uptake by the plants was increased by urea applications but the date of application did not affect total nitrogen uptake in February.

May Forage

The May production of forage each year was increased by the application of urea fertilizer. The date of application affected May yield significantly in the wet year but not in the dry years. In May 1958, the year of high rainfall, the highest yield came from plots fertilized the previous September.

The March application of urea gave the highest percentage of nitrogen in the May forage each year, and fall applications did not appreciably affect the nitrogen content. In the 1956–57 season, plots which received urea in any month except March had a lower percentage of nitrogen at the May sampling than the unfertilized check plots. However, the percentage of nitrogen in all plots—with or without fertilizer—was significantly higher in 1957 than in 1958 and 1959. In May 1957, clover made up 30% of the forage in the unfertilized check plots but only 6% to 21% of the forage in plots fertilized with urea. In May 1958 and 1959—poor clover years—the percentage of clover was very low on both fertilized and unfertilized plots.

Urea increased the total nitrogen uptake in the May forage each year. In the two dry years, February application of urea gave the highest nitrogen uptake and December application gave the lowest. In 1958, the wettest year during the experiment, the date of applying urea made no significant difference in total nitrogen uptake.

Total nitrogen per acre taken up by plants varied from year to year, and date of sampling the forage determined which year appeared best. At the February sampling, nitrogen uptake was greatest in 1958, after the early fall rains, but at the May sampling the greatest uptake occurred in 1957, the year of high clover production. Part of the difference between the February and May samples reflects the fact that most of the nitrogen fixation by legume bacteria takes place during the warmer spring months. In the two poor clover years, little or no nitrogen was taken up by the plants between February and May.

For producing winter feed, September application of urea was more effective than November application, but for production of spring feed the date of application made no consistent difference, except that March application was too late to produce maximum yields. Application of phosphorus with the urea did not increase either February or May yield more than did urea alone, indicating there was no phosphorus deficiency at the site of the experiment.

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