

Applying Nitrogen Fertilizer to Alfalfa

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Application of fertilizer nitrogen (N) to alfalfa is a controversial practice. Legumes such as alfalfa can survive without taking N from the soil because of their ability to fix atmospheric N (N_2). This is due to microorganisms living in the nodules of legume roots that convert N_2 into a form useable by legumes.

Though legumes can fix N_2 from the air, some growers still consider N fertilization important because legume seedlings rely on seed and soil N until root nodules form and start fixing N_2 . Research indicates alfalfa may also benefit from N fertilizer during cold periods when biological nitrogen fixation (BNF) is down, after harvest, or if inoculation failure occurs.

Oregon Research

Researchers established plots in western and eastern Oregon to determine whether N fertilizer should be applied to alfalfa.

Western Oregon. Experiments in western Oregon demonstrate that properly inoculated alfalfa does not benefit from preplant N fertilizer application.

Western Oregon research was conducted at the Hyslop Crop Science Field Research Laboratory near Corvallis. Nitrogen was applied preplant to inoculated Apollo alfalfa at nine rates (0, 5, 10, 20, 40, 80, 120, 160, and 200 lb N/acre). Results show there is no benefit to preplant N. Nodule number and N_2 fixation decrease while weed growth increases. Yield and forage quality do not improve with N fertilization. In one year, plant nitrate concentra-

tion increased on high N plots. When seed is not inoculated, ineffective nodules result. In this situation, N fertilizer does not help sustain plants unless 120 lb N/acre or more are applied. Nitrogen fertilization did not speed regrowth after cutting. In fact, recovery of BNF was delayed.

Central Oregon. Experiments in the low N soils of Central Oregon show that yield increase is possible with 20 to 40 lb/acre preplant N. Cool soil and weed control measures are necessary to obtain any benefit from preplant N.

Central Oregon research was conducted at the Central Oregon Experiment Station at Powell Butte. Nitrogen was applied preplant at five rates (0, 20, 40, 60, and 80 lb N/acre) to inoculated Vernema alfalfa. Results show that 20 to 40 lb N/acre increased yield when soil temperatures remained cool after planting. No improvement in yield was observed in warm soil conditions. Weed growth increased with N fertilization.

Other Research

New Stands. Research from other states shows that preplant N fertilization of alfalfa sometimes increases yield in the establishment year. This depends largely on soil N content. Weed control and effective nodulation also are important factors.

Results from studies in Wisconsin suggest that the N supplying capacity of the soil, pH, and weed control are the main factors for determining the response of alfalfa to preplant N. A yield increase of 20 to 40 lb N/acre occurs when soils contain less than 1.5 to 2.0

percent organic matter (less than 0.1 percent total soil N). Greater yield responses occur in low pH (less than 6.2) soils.

Inoculation failures often raise questions of how well N fertilizer can sustain new seedlings. OSU research found that applications of up to 80 lb N/acre are not sufficient to meet the requirements of uninoculated seedlings during first harvest. Yields and the N content of plants the following spring show little benefit from applying N to ineffectively-nodulated plants.

Established Stands. We generally do not recommend N fertilization of established alfalfa stands. Low N rates (20 to 40 lb N/acre) generally do not increase the yield, crude protein, or total digestible nutrients in established stands of alfalfa. Rather than benefitting recovery after harvest, 40 and 80 lb N/acre decrease nitrogen fixation in regrowing plants.

In Michigan, yields of 8.5 tons dry matter/acre were obtained from 0 N plots. Researchers did not find increases in yield with application rates as high as 800 lb N/acre. Nonprotein N, however,

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did increase with high rates of N fertilization. Nitrate-N exceeded 5,000 parts per million (ppm) when alfalfa was fertilized with 400 lb N/acre. Nitrate-N is reported to accumulate in alfalfa where N applications exceed 200 lb N/acre.

Experiments that examine high rates of N fertilization are not the main concern of alfalfa producers. However, high rates of N fertilization are an important consideration in such waste water disposal situations as vegetable processing waste water or dairy lagoon effluent applications. These water sources contain high nitrate levels, and excess application onto alfalfa may result in ground water contamination.

Conclusions

Because N fertilizer has a negative effect on BNF and tends to increase weed growth, fertilizer N is usually not desirable for alfalfa establishment. Most studies show that the yield and quality of alfalfa do not improve with N fertilization.

Regrowth rates after harvest do not increase with fertilization, and rates of BNF slow when N is applied. Applying N fertilizer is not likely to remedy

inoculation failure. Preplant N of less than 90 lb N/acre does not provide enough replacement N to make up for inoculation failure. Higher rates of N (150 to 200 lb N/acre) are necessary to substitute for correctly inoculated and nodulated alfalfa.

In soils with moderate to high N supplying capacity, N fertilization does not raise alfalfa yield or quality. In fact, quality often drops due to the increase in weed growth caused by N fertilization.

In soils of low N supplying capacity, growers may see a yield increase from 20 to 40 lb N/acre if cool soils occur during the 2-week period following planting.

Recommendations

Generally, we do not recommend N fertilization of alfalfa. Only in cool, low N soils is there likely to be an improvement in yield resulting from preplant N application.

An application of 20 to 40 lb N/acre may increase alfalfa yields under the following conditions:

- Soils contain less than 16 ppm nitrate N or 1 percent organic matter.
- Soil temperatures less than 59°F are anticipated for 2 weeks after planting.
- Weeds are controlled.

If preventative weed control measures aren't taken with preplant N, the increased soil N will foster rapid weed growth, suppress alfalfa growth, and lower hay quality.

If you use dairy or vegetable processing waste water to irrigate alfalfa, the yearly application of N should not exceed 250 lb N/acre. If you exceed this amount, we recommend that you analyze the alfalfa for excess tissue nitrate concentration before feeding it to livestock.



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