Fertilization of Northern Great Plains Rangelands: A Review

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**Grazing Season**

Lengthening the grazing season on our native ranges is an important factor in getting the maximum feed production and utilization. While introduced grasses such as crested wheatgrass and Russian wildrye (Elymus junceus) have been very instrumental in lengthening the time animals can remain on grass, many ranch operations do not have or cannot afford the land to seed these "tame grasses." Goetz (6) in southwest North Dakota found that the application of 67 and 100 lb N per acre maintained the protein level of blue grama at or near the 10% level until September. On a Manning silt loam site, the 100 lb N per acre treatment showed an increase of 1.5 months of forage above 10% protein when compared to the check plots. Fertilization of native range has shown the ability to hasten the "turn out" date in the spring. Lorenz and Rogler (11) found that the yield of native range receiving 40 lb N per acre averaged 100 lb per acre on May 15, while range receiving fertilizer did not reach this level until June 1. Southeast Alberta ranges fertilized with medium to high rates of nitrogen and nitrogen plus phosphorus became green 7 to 10 days earlier in the spring and remained green longer in the fall. (Johnson et al. 8).

**Species Composition**

Much of the increase in production and earlier range readiness found in the studies mentioned above can be attributed to an increase in high producing cool-season grasses. When N fertilizer is placed within the range ecosystem, those plants which begin their growth early are able to make use of these added nutrients. Plants occurring in adequate numbers, gain a distinct advantage. The increased growth uses up a larger portion of the water stored within the soil and roots are more vigorous, thus occupying a larger portion of the soil. Top growth is more rapid and if not grazed shades the slower developing warm-season plants a distinct competitive edge when given added nitrogen fertilizer. Many investigators (1) (3) (5) (10) (16) (17) (18) throughout the Northern Great Plains have reported species composition changes brought about by N fertilization.

While there are distinct advantages in having more forage production earlier, there are reasons for not wanting to convert a native range completely to cool-season species. Western wheatgrass is a very aggressive cool-season grass in the Northern Great Plains, which often grows in association with blue grama, a less productive warm-season grass. The growth habits of these two species are such that total forage production is greater when they are growing in association than when either of them is grown alone. While western wheatgrass is an early producer, blue grama makes its growth later, furnishing green forage for the grazing animals during July and August. Thus it is desirable to maintain a mixture of these two species in order to obtain maximum dry matter production from the mixed prairie and to provide desirable forage for the grazing animals. Lorenz and Rogler (10) found that with 80 and 160 lb of N per acre, blue grama vigor was drastically reduced, but at the 40 lb rate, only a slight decrease in its basal cover was observed. This may explain why 30 to 40 lb N per acre gave the most efficient returns in studies on similar range sites.

Another more serious problem can occur on areas where cool-season weeds are present. The same competitive advantage afforded the desirable cool-season grasses is also given to these undesirable weeds. In areas where the weedy annual brooms have invaded native range, N fertilization can greatly aid in the increase of these weeds. Wilson, Harris, and Gates (23) found that fertilization of a cheatgrass (Bromus tectorum)-bluebunch wheatgrass (Agropyron spicatum) range greatly increased the cheatgrass at the expense of the perennial bunchgrass.

**Improving Overgrazed Range**

Fertilization of overgrazed or poor condition range can be instrumental in bringing about permanent range rehabilitation. Addition of N to a range ecosystem can cause a change in the species composition. Species which are most palatable and accessible to the animals will be depleted first on poor condition range. In many cases there are the early season grasses which will rapidly respond to nitrogen fertilizer if a few plants remain. Recovery will be much slower if the desirable plants are completely eliminated from the range because they will have to start from seed and their seedlings will have to compete with the less desirable plants which now occupy the site. In the latter case nitrogen fertilizer may slow recovery by increasing the competition from existing plants.

On an overgrazed range near Mandan, N.D., Rogler and Lorenz (16) found that 2 years of fertilization with 90 lb N per acre did more to improve range condition and production than 6 years of complete isolation from grazing. Cosper et al. (3) in eastern Wyoming found that a single application of nitrogen fertilizer to a deteriorated range site changed the botanical composition from predominantly forbs and shortgrasses to one of western wheatgrass and short grasses.

On overgrazed ranges where the invasion of weeds has occurred, the addition of a herbicide treatment with fertilizer application can speed recovery by removing the competition of the weeds. Nichols and McMurphy (13) found that applications of N and 2,4-D to a depleted range site in western South Dakota significantly increased the percent frequency and production of perennial grass. They found that the combination treatments were more effective than either 2,4-D or fertilization alone.
The discussion up to this point has been primarily concerned with nitrogen fertilizers. While this is the nutrient most limiting to plant growth on rangelands in the Northern Great Plains, the role of phosphorus (P) should not be overlooked.

Under normal circumstances, the response of native range to applications of P is small or nonexistent. However, when large amounts of N are applied, the increased growth of the vegetation can cause an increased demand for P. When small amounts of N are applied annually for a number of years, responses to P have been reported. Lorenz and Roger (12) found in an 8-year study that P alone did not produce significant yield increases. When 80 lb N per acre was applied with 18 lb P per acre, no added response was observed the first 2 years. In the following 6 years of the study, however, the 80N + 18P treatment did yield significantly more forage than 80 lb of N alone. The authors also found that the plots receiving 80N + 18P yielded significantly more than did the plots which received 160N.
Summary

Fertilization of Northern Great Plains ranges can increase forage production several times. While high rates generally give the greatest yield increases, low to medium rates have been shown by most researchers to give more efficient returns. Moderate rates of fertilizer have been shown to improve the condition of overgrazed range more economically than revegetation or protection from grazing. Increases in crude protein and total digestible nutrients are also obtained with applications of N.

Spring and fall applications have been shown to increase cool-season grasses. Much of the added production from fertilization of Northern Great Plains ranges is due to this increase in high producing cool-season species. Late spring applications of nitrogen fertilizer are best on warm-season grasses because at this time, the cool-season plants have made some of their growth and are less able to take advantage of the added N.

Palatability and utilization are also improved by nitrogen fertilization. Research has shown that the distribution of range livestock can be improved by fertilizing low use areas. The number of “wolf” plants is decreased due to better utilization of the more palatable forage.

Phosphorus fertilization can also improve forage yields. While not as limiting as N, it has been shown that when large amounts of N are applied, the addition of P can further improve yields. If small amounts of N are applied to ranges over a period of years, P can become limiting to growth.

Ammonium nitrate is by far the most widely used source of N in range fertilization. Urea is a lower cost form of N, but because of its volatility cannot be broadcast without the danger of some loss. Fertilization of our rangelands is a management tool, and because it is a tool it must be used wisely in order to be effective. No one management tool can be expected to solve our problems. They must be integrated in the total management program in such a way as to maximize the benefit of each one. Each manager must make the decision where, when, and to what extent to use each of these tools under his circumstances in order to receive the maximum benefits. The disadvantages of cost, increase in cool-season weeds, and the decrease in warm-season grasses must be weighed against the advantages of increasing forage quality, lengthening the grazing season, increased palatability, increases in high producing cool-season grasses, better plant vigor, and more efficient use of soil moisture by larger healthier roots.

Literature Cited