Fertilization of Meadow Foxtail

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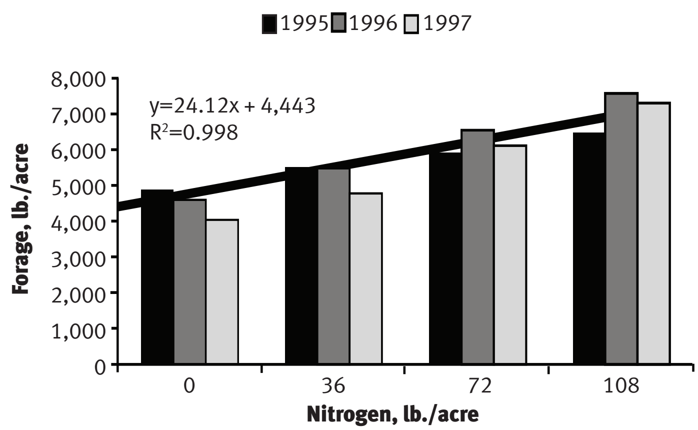
Flood meadows are an extremely important forage resource for beef cattle and hay producers. More than 3 million acres of flood meadows exist in the western United States, with these lands producing the majority of winter feed for beef cattle.

Snowmelt from surrounding mountains provides annual flooding, which typically lasts from April to late June. Initially, these native flood meadows were composed of a mixture of rushes, sedges, grasses, and forbs. Historically, these native plants produced approximately 1.6 tons per acre (Rumburg, 1961), with all of the production occurring during the short flooding period in the spring. Fertilization research with the native meadows suggested that 60 units of nitrogen (N) was the most economical level and could be expected to increase forage yield by approximately ¾ ton per acre (Angell, 1998).

In the earlier work, the source of nitrogen was not critical and the general recommendation was to use the source of nitrogen that gave the lowest cost per pound of nitrogen.

However, in an effort to increase forage yields, an introduced grass species, meadow foxtail, was introduced into many meadows in the western United States. This highly competitive grass has since become the predominant grass species in high-elevation flood meadows throughout the West. Consequently, research was conducted to determine the most appropriate level of nitrogen fertilization to economically increase forage yield.

Fig. 1: DM yield of meadow foxtail*



*Fertilized at 0, 36, 72 and 108 lb. of nitrogen per acre with urea over three years

Experimental procedures

In March of three years (1995, 1996 and 1997), 48 plots within a meadow foxtail-dominated meadow were fertilized with 0, 36, 72 or 108 pounds (lb.) of nitrogen per acre, applied as urea during March of each year. Forage yield was determined at three consecutive weekly intervals, each year beginning as soon as the ground was dry enough for haying equipment. Initial harvest dates were July 17, 1995; July 9, 1996; and July 10, 1997.

On each harvest date, a swather was used to harvest forage. A known length of each windrow was weighed, and dry matter (DM) was determined for estimated forage yield. More specific information concerning the experimental procedures is reported by Angell (1998).

Results and discussion

How much does nitrogen fertilizer increase forage yield?

Meadow foxtail responded to nitrogen fertilization with a linear increase in forage yield in each of the three years (see Fig. 1). On average, the increase in forage production was approximately 24 lb. of forage DM per unit of nitrogen. Therefore, if we fertilized with 60 lb. of nitrogen per acre, we can expect an increase of approximately 1,440 lb. of forage DM (24×60 = 1,440), compared to no fertilization.

However, the magnitude of response to nitrogen fertilization appeared to be related to the previous years' growing conditions. For example, the first year of the study (1995) had a good supply of irrigation water, but this occurred following a period in which four of the previous five years were drier than average and no irrigation water was applied to the meadow during this five-year period.

In 1995, the increase in forage production due to nitrogen fertilization was only about 50% of that seen in 1996 and 1997, both of which followed a wet, or good, irrigation year. In 1995, we observed a 13.6-lb.-per-acre increase in forage production per unit of nitrogen, compared to responses in 1996 and 1997 of 27.8 lb. and 31.0 lb. of forage per acre, respectively, for each pound of supplemental nitrogen.

From this limited data set, it would therefore seem that there is a greater response to nitrogen fertilization following a wet year than following a dry year(s).

Table 1: Increase in forage production that can be expected following a dry year(s), wet year(s), and on average following nitrogen fertilization.

N fertilizer, lb./acre	Forage increase, lb./acre: Following dry year(s)	Following wet year(s)	Average
20	272	588	482
30	408	881	723
40	544	1,175	964
50	681	1,469	1,205
60	817	1,763	1,446
70	953	2,056	1,687
80	1,089	2,350	1,928
90	1,225	2,644	2,169
100	1,361	2,938	2,410
110	1,497	3,231	2,651

Table 1 provides estimates, based on the data available, of the expected increase in forage production at nitrogen fertilization levels of 20 lb. to 110 lb. per acre for fertilization following a dry year, a wet year and the "average" of all (3) years.

However, please keep in mind that the response difference between "dry" and "wet" years is based on information collected over a three-year period, with only one measurement following a dry period. Therefore, there may be significant annual variation in the magnitude of your observed response to nitrogen fertilization.

Nevertheless, we feel that the data does indicate that fertilization with up to approximately 100 lb. of nitrogen per acre will increase forage production in a linear manner, regardless of the previous irrigation season, assuming there is adequate irrigation water.

(Continued on page 2)

Will fertilization enhance hay quality?

Fertilization of Oregon flood meadow did not significantly change the crude protein (CP) content of meadow foxtail hay. The absolute value actually showed a decreasing trend with added nitrogen (see Fig. 2). We attributed this to an increase in the production of stem relative to leaf material. These trends are generally consistent with other studies (reported in Rumberg, 1961), where nitrogen percentage was not increased following nitrogen fertilization. The bottom line seems to be that yield will be significantly increased; however, hay quality will be similar to unfertilized meadow hay.

When is it economical for me to apply nitrogen fertilizer?

This is the question that we all seem to face, especially with high hay, fertilizer, fuel and labor costs. Therefore, based on the information presented above, we have come up with some estimated breakeven costs for fertilization with urea or ammonium sulfate at forage values ranging from $60 to $130 per ton (Table 2). In addition, the breakeven price of the nitrogen fertilizers is provided based on the overall average, following a dry year, and following a wet year. An example of how to use this table is provided.

Let's assume that last year was a wet year with adequate irrigation water. In addition, your local hay market forecast indicates that meadow hay will be selling for $80 per ton. Therefore, the breakeven price for urea would be $1,058 per ton and for ammonium sulfate it would be $494 per ton. This means you could afford to pay up to these amounts for the respective fertilizers (including application costs) and expect to break even. If the fertilizer and application costs are greater than these values, it does not pay to fertilize and it would be cheaper to purchase the additional hay from someone locally.

It is possible to use the three categories in Table 2 to manage the risk/reward status of your fertilizer investment. For instance, if you had used the "average of years" values rather than the "following wet year" values in the example above this would have been a more conservative choice because the breakeven values would have been $868 per ton and $405 per ton for urea and ammonium sulfate, respectively, compared with the $1,058 per ton and $494 per ton. Likewise, you could use the "following dry year" breakeven values as a worst-case scenario ($490 per ton and $228 per ton).

If you would like to discuss this article or simply would like to talk cows, do not hesitate to contact Dave Bohnert at 541-573-8910 or dave.bohnert@oregonstate.edu; Ron Torell at 775-738-1721 or torellr@unce.unr.edu; or Ray Angell at 541-573-8936 or raymond.angell@oregonstate.edu.

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Angell, R. 1998. Working with meadow foxtail: fertilization and livestock grazing. pp. 1-7. In: Meadow Ecology and Management. Range Field Day 1998 – Rangeland Science Series Report #4. Oregon State University, Corvallis.

Rumburg, C. B. 1961. Fertilization of wet meadows – A progress report. Misc. paper 116. Oregon Agricultural Experiment station, Corvallis, OR.

Fig. 2: Crude protein of meadow foxtail fertilized at 0, 36, 72 and 108 lb. of nitrogen/acre with urea over three years

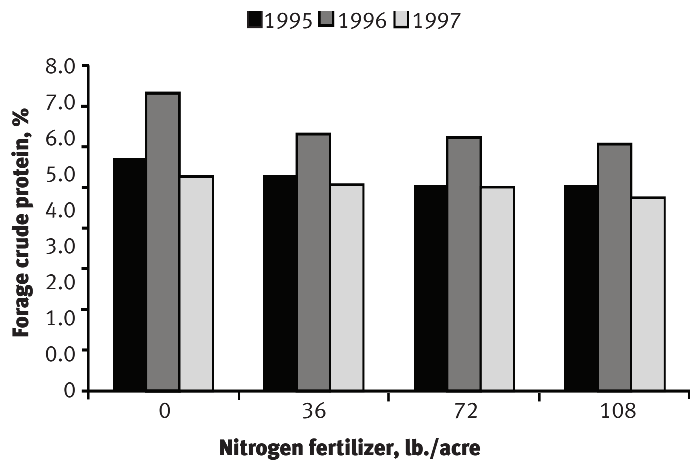

Table 2: Breakeven values associated with nitrogen fertilization with urea or ammonium sulfate*

	Forage value, $/ton							
Fertilizer	60	70	80	90	100	110	120	130
	Breakeven price of nitrogen fertilizer, $/ton							
Average of years								
Urea (45% N) value, $/ton	651	760	868	977	1,085	1,194	1,302	1,411
Ammonium sulfate (21% N) value, $/ton	304	355	405	456	507	557	608	658
Following dry year (1995)								
Urea (45% N) value, $/ton	367	428	490	551	612	673	734	796
Ammonium sulfate (21% N) value, $/ton	171	200	228	257	286	314	343	371
Following wet year (1996-1997)								
Urea (45% N) value, $/ton	794	926	1,058	1,191	1,323	1,455	1,588	1,720
Ammonium sulfate (21% N) value, $/ton	370	432	494	556	617	679	741	803

*At forage values ranging from $60 to $130/ton. If fertilizer cost is greater than the value in the table, the increased forage production from nitrogen fertilization is not economical.