Answering the question: does fertilizer applied give yield increase?

Omission plot design employed to show farmer whether or not there is a yield increase response.

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Summary: *We designed and conducted a simple fertilizer response trial using an omission technique. We applied fertilizer to the research plots on April 14, 2008, a couple of days before the rest of the field was custom applied by Interior Seed and Fertilizer Ltd.'s floater applicator. We flagged the experimental site so it was fertilized when the rest of the field was fertilized. We took the forage yield samples off the research plots twice. The results clearly showed that there was a response to nitrogen (N). All other nutrients did not show as clear a response when compared to the complete blend or the no-fertilizer treatment. However, even though we were not able to show statistically the yield increasing effect of each of the other nutrients besides N, there was a slight yield decrease when each nutrient was omitted, compared to the complete blend, so each nutrient did contribute to a yield increase.*

Does the fertilizer you apply always give the result you expect? Farm customers want to know that the fertilizer they apply is resulting in a yield increase. Of all fertilized crops, it is my observation that we have more questions about whether or not the fertilizer works when it is applied to forage stands. I'm not certain why this is but perhaps it is because whether a forage crop is grown for grazing, hay, or silage, it is difficult to measure yield increases due to fertilizer when compared to grain crops, especially when the stand is grazed. Soil testing is often used as a first step in deciding which nutrients apply and at what rate of application for each nutrient. These recommendations are usually based on regional fertilizer response trials, targeting normal yields for the area. I can remember a little over ten years ago, while working as an agronomist out of Calgary, I received a phone call from the manager of Interior Seed Fertilizer Ltd. in Cranbrook, BC. He asked me to consider conducting a fertilizer response trial on an irrigated forage field of a ranch customer. Having the time and resources that spring to assist, I obliged.

Assessing

The ranch customer thought that fertilizer response was disappointing on fields used for a combination of hay and grazing. They usually fertilized in early spring, took the first cut as hay, and grazed the regrowth in late summer or early fall. The ranch owner said, "I just don't think the fertilizer you apply for us really results in much increase in forage growth. How can you show me that your fertilizer works?" In the past he had soil tested at least every few years. The soil test results taken the previous year (2007), on the field where the study was proposed, are shown in Table 1. The irrigated field was estimated at having a 25 percent alfalfa and 75 percent forage grass stand. The target forage yield was 3 tons/A. The fertilizer blend generated using the soil test results for the field in 2007 and used again in 2008 (the year of the fertilizer trial) was 230 lbs/A with a blend analysis of 17-13-17-6.5 sulfur (S). The actual nutrients applied totaled approximately 40 lbs N, 30 lbs phosphorus (P_2O_5), 40 lbs potassium (K_2O), and 15 lbs S per acre.

Omission plot. We designed and conducted a simple fertilizer trial using an omission technique. This is accomplished by having a plot where each one of the nutrients being evaluated is missed or omitted on a plot, while at all the other plots nutrients are applied. There is one plot that receives all the nutrients. If there is no decrease in yield when a nutrient is omitted, compared to an all-nutrient plot, it is assumed that there is a sufficient amount of that nutrient being supplied from the soil and there is no measurable additional response to that particular nutrient. We also employed a no-fertilizer or check plot. This is useful to determine whether or not there is any fertilizer response. We repeated each 6.5-ft by 13-ft plot four times, using a randomized block design so we could analyze the results statistically. We evaluated forage yield response to the following nutrients: N, P, K, S, and boron (B). The NPKS was applied at the per-

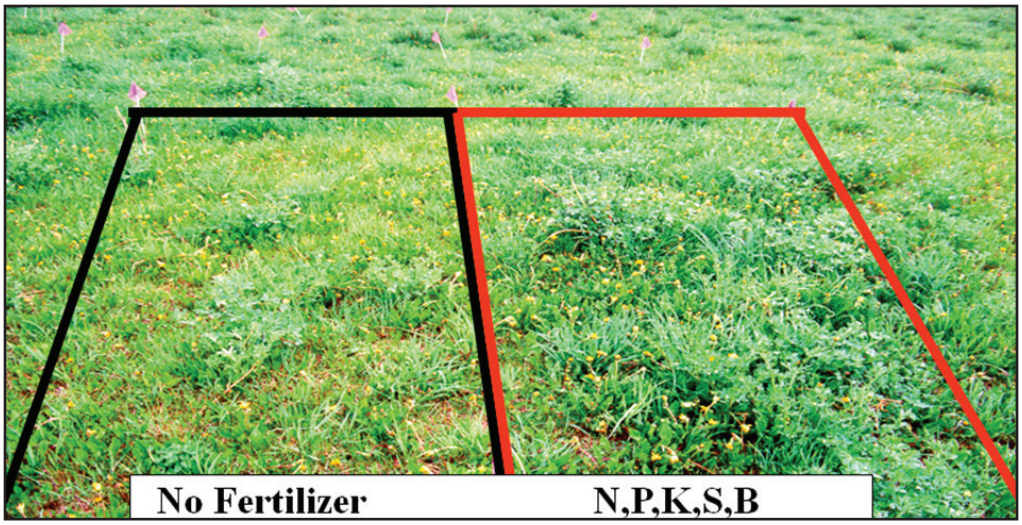

Figure 1. *Forage growth response to fertilizer on right compared to the zero-fertilizer plot on the left one month after application.*

Table 1. Soil test result of selected measurements and rating of nutrient availability, sampled fall 2006.

Measurement	pH	% organic matter	EC (salinity)	N	P	K	S	B
				----------lb/A----------				ppm
Analysis result	7.2	5.4	0.5	14	23	230	63	2
Soil level rating	normal	normal	non-saline	deficient	marginal		adequate	

Table 2. Two-cut total forage yields from fertilizer response trial, 1998.

Treatment		Nutrient applied		Yield-tons/A
7		NPKSB		4.40
4		NP, 0-K, SB		4.18
6		NPKS, 0-B		4.13
3		N, 0-P, KSB		3.98
5		NPK, 0-S, B		3.93
2		O-N, PKSB		3.72
1		Check		2.93

acre rate of 50 lbs N, 40 lbs P, 100 lbs K, 20 lbs S, plus 1 lb B. The treatments totaled seven:

1. Check
2. 0-N, PKSB
3. N, 0-P, KSB
4. NP, 0-K, SB
5. NPK, 0-S, B
6. NPKS, 0-B
7. NPKSB

We fertilized the research plots on April 14, 2008, a couple of days before the rest of the field received a fertilizer custom applied by Interior Seed and Fertilizer Ltd.'s floater applicator. We flagged the experimental site so it was not fertilized when the rest of the field was completed. We took forage yield samples off the research plots twice, one at the end of June before the rancher did a silage cut on the field and the other in the middle of September just before cattle were allowed to graze the field. The two-cut total forage yield results are shown in Table 2. The Table clearly shows there was a response to N. All other nutrients did not show as clear a response compared to the complete blend or the no-fertilizer treatment.

> *"We showed him the benefit of using fertilizer."*

Final analysis

After the study was complete, we sent a final report to the customer. In that report, we could definitely conclude that there was a response to fertilizer. We felt we had "showed him" there was benefit from using fertilizer (see example in Figure 1). When we considered the regular 40 lbs N, 30 lbs P, 40 lbs K, and 15 lbs S/A application he used, there was excellent response to N. We suggested that he consider continuing the PKS applications just to maintain their availability for future crops. We recommended from our research that he not add B but that he should continue to monitor his soil by having soil samples analyzed regularly.

> *"We conclude our recommendation system is cost effective."*

We wouldn't recommend running this type of trial for every customer who questioned whether or not they are getting a response to fertilizer.

Costs. I did a rough comparison of the cost of conducting this trial compared to just relying on regular soil testing to basically come up with the same recommendation. A soil sampling, soil analysis, and recommendation performed by a retail fertilizer dealer probably costs around $300, if you consider retail staff time involved, equipment, and laboratory analysis charges. The field trial we conducted cost close to $3,000 when all my time, Interior Seed and Fertilizer's time, and a research technician's time was taken into account, plus travel costs taking research equipment to the ranch. So, in this case, it cost ten times as much to conduct a "show me" field demonstration. Fortunately, there has been past investment in regional fertilizer trials in most agricultural regions that we can refer to in order to estimate the yield response for most crops from added nutrients. Based on this, I would conclude that the soil testing and recommendation system we have available to us is very cost effective.

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