DO GRASS SEED FIELDS IN THE WILLAMETTE VALLEY NEED BORON FERTILIZER?

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Introduction

Boron (B) is the most widespread of all micronutrient deficiencies in the Pacific Northwest. However, crops vary widely in their B needs. In general, dicotyledons (broadleaf plants) have a greater requirement than monocotyledons (grasses). Legume and brassica crops are the most sensitive of the dicots to insufficient B. Crops with a high B requirement need more than 0.5 ppm soil test B. Some agronomists suggest 0.3 ppm B be used as a sufficiency guideline for crops with a low B requirement. OSU fertilizer guides do not use this guideline and do not recommend B fertilizer application to wheat or grass seed crops in Oregon. However, most grass seed fields in the Willamette Valley do not have a history of B fertilizer application and have soil test values at or below 0.3 ppm B. This study was conducted to determine if grass seed crops in the valley are responsive to B fertilizer.

Methods

To determine if boron fertilizer would increase seed yield of grass crops grown for seed, trials were conducted at nine farm locations on perennial ryegrass, annual ryegrass, and tall fescue fields. Field locations were selected that represented the range of soil types common to seed production in the region, including poorly drained clay loams and well drained river bottom soils. In one set of trials, granular Borate 48 (15% B) was mixed and applied with urea nitrogen (N) fertilizer in late March or early April at a rate of 1.25 lb B/acre. Total spring N application was 135 lb/acre for most sites (one test was at 180 lb N/acre). Plots also received 250 lb/acre of 0-15-20-10 in March.

In a second set of trials, liquid B fertilizer (Solubor 20% B) was applied to two fields of perennial ryegrass at 1.25 lb B/acre on March 21, 2000. Total spring N application in these trials was 140-150 lb N/acre. In both granular and liquid B tests, soil samples and flag leaf samples were taken in May during late boot to early head emergence stage of growth. Both trials were arranged in a randomized complete block design with three replications. Individual plot size was 22 to 24 feet wide x 250 to 400 feet in length to allow swathing and harvest with grower equipment. An OSU weigh wagon (Brent YieldCart) was used to measure combine yields from each plot.

Results

Boron fertilizer increased the soil test levels and flag leaf tissue concentrations at all locations (Table 1 and 2). Soil test levels were increased from an average of 0.2 ppm to an average of 0.7 ppm B. Flag leaf concentrations of B were increased from an average of 12 ppm to 32 ppm. These results were consistent with those observed in similar trials in 1999 (Mellbye and Gingrich, 1999). Both dry granular and foliar methods of B application were effective in getting this micronutrient into the grass plants. However, we have observed a more consistent increase in soil tests levels and plant tissue concentrations from dry than from foliar application of B over the two years of this study.

Boron soil tests and tissue concentrations were not related to soil pH or Ca levels in this study. Boron is most available between a pH of 5 and 7. At high soil pH and Ca levels, or at excessive K concentrations, B availability to plants can be reduced. In B sensitive crops, these nutrient interactions are most common at pH levels above 7, and typically on coarser textured soils low in organic matter. These conditions are rarely observed in grass seed production in Western Oregon. Willamette Valley grass seed fields have fine soil texture (silt and clay loams), are relatively high in organic matter for mineral soils (>4%), and even with an aggressive liming program seldom have pH levels above 6.5. Liming fields for grass seed production is unlikely to produce a B deficiency at normal rates of application.

Flag leaf tissue concentrations ranged from 9 to 16 ppm B on untreated plots (12 to 22 ppm in 1999). No visual symptoms of B or other nutrient deficiencies were observed at these tissue concentration levels. Treated and untreated plots looked the same. A critical level for B on grass seed crops is not established. Normal concentration levels for monocots are 6-18 ppm. Plant or leaf tissue concentrations below 8 to 10 ppm B are considered low for crops in the grass family such as oats, pasture grasses, Timothy, corn, and wheat (Jones, 1991). Flag leaf tissue levels from the fields selected for this study are not in the range considered deficient for other crops in the grass family.

Seed yields above Willamette Valley averages were obtained from most fields in these trials. Of the nine locations, only one showed an increase in seed yield from the B application in 2000 (a 40 lb increase). This location was one of the tall fescue sites that received granular B. In the two years of this study, only two out of fifteen sites have shown a seed yield response to B fertilizer.

Analysis of over 300 Willamette Valley soil samples in the 1950s showed 80% tested low in B, or less than 0.5 ppm of hot water extractable B. Field trials conducted at that time showed dramatic yield responses in clover and sugar beets, but did not show any response in cereal or grass seed crops (T.L. Jackson, 1956 and 1957). Our current work confirms that grass seed fields commonly test below 0.5 ppm B, and often below 0.3 ppm. The lack of seed yield response indicates that B is not a widespread limiting factor on Willamette Valley grass seed fields despite soil test levels considered low for other crops.

Seed yield response from B application was obtained in only 13% of the locations for the two years of this project. Most of the locations in the trial for 2000 had equal or lower soil test B values to the site where seed yield increase was measured. Therefore, we do not recommend application of B fertilizer to grass grown for seed to increase seed yield. If you are uncomfortable with low soil test B, an application of 0.75 to 1.25 lb B/acre every three to five years may be desirable to increase soil test levels and plant content of B on soils that have B test values below 0.3 ppm. Application of granular B with dry fertilizer in the spring is an effective and easy method of applying B on grass seed fields. The range between deficiency and toxicity is narrower for B than for other micronutrients. For this reason, B should only be broadcast. It should not be band applied or put with the seed at planting. Annual applications are not recommended because they may lead to excess B in the soil.

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References

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Table 1. The effect of granular boron fertilizer on soil test values, flag leaf tissue concentrations, and seed yields on grass seed fields, 2000.

Site	Boron fertilizer rate[1]	Crop (Variety)	Site characteristics: Soil series	pH	Ca	Mg	K	OM	Boron (5-24-00): Soil[2]	Flag leaf[3]	Clean seed yield[3]
	(lb/a)				(meq/100g)		(ppm)	(%)	------ (ppm) ------		(lb/a)
1.	0	Perennial ryegrass	Dayton	6.4	13	1.1	134	5.0	0.3	12	1736
	1.25	(SR4200)	silt loam						0.5	29	1618
2.	0	Perennial ryegrass	Concord	5.8	10	0.8	112	5.2	0.1	10a	1595
	1.25	(DLF-1)	silt loam						0.9	37b	1687
3.	0	Tall Fescue	Malabon	5.7	11	3.4	385	7.5	0.2	9a	1117
	1.25	(Duster)	silty clay loam						0.3	32b	1102
4.	0	Tall Fescue	Bashaw	5.4	12	5.7	261	11.2	0.3	12a	1389
	1.25	(Kittyhawk SST)	silty clay						0.7	27b	1402
5.	0	Tall Fescue	Amity	6.4	11	1.7	135	4.8	0.2	14a	2239a
	1.25	(Tomahawk)	silt loam						0.7	30b	2277b
6.	0	Annual Ryegrass	Dayton	5.0	2	0.6	76	7.4	0.2	10a	2143
	1.25	(Gulf)	silt loam						0.5	39b	2123
7.	0	Annual Ryegrass	Awbrig silty	5.4	7	0.8	91	7.8	0.1	9a	2098
	1.25	(Gulf)	clay loam						1.4	42b	1999
	0	Mean		5.7	9	2.0	171	7.0	0.2	11	1760
	1.25								0.7	34	1744

[1]Boron applied as dry granular boron mixed with urea nitrogen fertilizer (March, 2000).
[2]Soil samples taken from each rep and bulked for analysis. No statistics performed.
[3]Paired means in columns followed by different letters are significantly different (p=0.10).

Table 2. The effect of foliar boron fertilizer on soil test values, flag leaf tissue concentrations, and seed yields on perennial rye-grass seed fields, 2000.

Site	Boron fertilizer rate[1]	Crop (Variety)	Site characteristics: Soil series	pH	Ca	Mg	K	OM	Boron (5-24-00): Soil[2]	Flag leaf[3]	Clean seed yield[3]
	(lb/a)				(meq/100g)		(ppm)	(%)	------ (ppm) ------		(lb/a)
8.	0	Perennial ryegrass	Amity	6.7	13	1.3	235	6.5	0.3	13a	1846
	1.25	(Express)	silt loam						0.7	28b	1891
9.	0	Perennial ryegrass	Woodburn	5.9	6	1.3	164	4.3	0.4	16a	1885
	1.25	(Brightstar II)	silt loam						0.7	24b	1938
	0	Mean		6.3	10	1.3	200	5.4	0.4	15	1866
	1.25								0.7	26	1915

[1]Boron applied as Solubor liquid spray (3-21-00).
[2]Soil samples taken from each rep and bulked for analysis. No statistics performed.
[3]Paired means in columns followed by different letters are significantly different (p=0.10).