Evaluation of Sugarbeet Response to Boron (B) on High Organic Matter Soils

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2016-2018 Research Summary Points

- Sugarbeet leaf blade B concentration was seldom impacted by the application of B indicating sufficiency supply of B from the soil on most locations
- Sugarbeet tonnage and recoverable sugar were not increased by B when applied on a fine textured soil with organic matter concentration greater than 4.0% in the top six inches.

***Implications for management* –** The data presented suggests that there should be little concern that B is limiting the sugarbeet grown on high organic matter soils in Minnesota. Growers concerned about boron should target application on sandy soils. Concurrent data collected for corn (not shown) indicated a slight chance corn yield could be impacted on sandy low organic matter soils. A slight decrease in sugarbeet tonnage with increasing rate of B applied at one site should be noted as sugarbeet growers applying B should limit broadcast application rates to no more than 2 lbs per acre. Foliar application of boron was not tested and caution should be exercised when applying foliar boron to crops in order to avoid toxicity issues which can reduce the yield of crops.

Introduction

Reports of low boron concentrations in corn plant tissue have been common in recent years. There are no established guidelines for boron application for corn in Minnesota. With higher crop yield farmers are continually being marketed boron as a way to further increase yield. Plant analysis has become an increasingly larger tool used to promote the sales of boron. Critical plant tissue sufficiency levels can be easily manipulated to ensure B concentration are considered "low". Research identifying crop response as related to soil test and plant tissue boron concentration is needed to identify whether there is a direct correlation to crop yield response to the given variables. On-farm research can be useful for correlation studies to gauge the impacts of fertilizer management across varying soil properties within and across fields.

The objective of this project was to determine if boron application to sugarbeet in Minnesota will increase tonnage and quality of the crop when grown on high organic matter soils.

Materials and Methods

Sugarbeet trials were conducted from 2016 to 2018 (Table 1). Boron rates of 0, 2, 4, and 6 lbs B per acre were hand applied on the soil surface after planting to plots measuring 11' in width (6 rows 22" wide) and 40' in length. The boron source used in the trial was a 10% granular boron fertilizer material. Each treatment was replicated six times. A single composite soil sample was collected at a depth of 0-6" before fertilizer application. Boron concentration in the leaf blade

was measured from each plot by sampling the newest fully developed leaf in early July approximately 60 days after planting.

Table 1 Summary of soil test data collected in 2016, 2017, and 2018 from sugarbeet trials prior to treatment application. Samples were collected from the 0-6" and are a composite of 12 separate cores per location.

			Soil Test†				B‡
Year	Location	Soil Type	P	K	pH	OM	Avg
			--ppm--			-%-	---ppm---
2016	Clara City	Bearden	10	150	7.8	6.4	1.5
2017	Clara City	Bearden	15	316	7.8	7.9	1.1
	Crookston	Wheatville	12	194	7.9	4.4	0.7
	Redwood Falls	Havelock	39	544	7.7	6.7	1.5
2018	Clara City	Bearden	15	189	7.7	6.6	2.1
	Crookston	Wheatville	11	91	8.1	2.9	0.8
	Redwood Falls	Amiret	20	198	5.6	4.1	0.7

† P, Olsen phosphorus; K, ammonium acetate extractable potassium; pH, soil pH; OM, organic matter.

Results and Discussion

Sugarbeet is considered to be more sensitive to a deficiency of B. A majority of sugarbeet acreage is grown on fine textured soils with organic matter concentrations substantial enough where B should be supplied in adequate quantities. A field study was conducted on a soil with a potential to supply a high concentration of B for the crop. The data in Table 2 shows that there was no effect of B on sugarbeet leaf blade B concentration measured in early July in 2016 and 2017 while all sites showed an increase in leaf blade B concentration in 2018. The lack of an increase in leaf B would be a good indicator of sufficient B availability from the soil in 2016 and 2017. The 2018 growing season was relatively wet (not shown) but there was no indication why leaf blade B concentration would be more responsive to B application in 2018 versus earlier growing season.

Table 2. Summary of boron leaf tissue data collected from a sugarbeet boron field study near Clara City, MN conducted in 2016 where 0, 2, 4 or 6 of B was applied after planting. Variables are considered significant at $P \leq 0.05$.

Year	Location	0	2	4	6	Significance
		----------%B----------				*P*>F
2016	Clara City	36.1	35.4	33.2	37.1	0.17
2017	Clara City	23.6	23.5	23.4	24.4	0.44
	Crookston	36.0	35.2	37.1	36.2	0.72
	Redwood Falls	29.2	30.5	31.2	30.5	0.42
2018	Clara City	33b	33b	34b	37a	<0.001
	Crookston	33c	36bc	40b	52a	<0.001
	Redwood Falls	37c	45bc	50b	62a	<0.001

Table 3. Summary of root yield data collected from a sugarbeet boron field study near Clara City, MN conducted in 2016 where 0, 2, 4 or 6 of B was applied after planting. Variables are considered significant at $P \leq 0.05$.

Year	Location	0	2	4	6	Significance
		---------- tons per acre ----------				*P*>F
2016	Clara City	24.6	26.8	25.6	26.4	0.21
2017	Clara City	39.3a	38.2ab	39.6a	37.5b	0.04
	Crookston	24.0	24.4	25.1	25.1	0.37
	Redwood Falls	35.9	36.8	36.9	36.6	0.90
2018	Clara City	21.0	18.0	18.9	19.2	0.22
	Crookston	14.6	15.7	14.0	14.8	0.47
	Redwood Falls	**Site not harvested				

Root yield data are summarized in Table 3. The only difference in sugarbeet root yield occurred at Clara City in 2017 where yield was less for the 6 lb B rate versus 0, 2, or 4 lbs B per acre. Yield decreases due to B have occurred for soybean in Minnesota but it was assumed sugarbeet would be more tolerant of high soil B than soybean. Yield levels varied from around 14 to 39 tons and there was no greater impact of B on high or low yielding situations. Yield was relatively low at Crookston due to a hail event which occurred in the middle of the summer followed by dry weather conditions. Yield data was not collected at the Redwood Falls site in 2018 due to flooding. Crop stand was significantly reduced at Redwood Falls in 2018 to a point which the site was abandoned. Recoverable sucrose was not impacted by the application of B at any location (Table 4).

Table 4. Summary of recoverable sugar data collected from a sugarbeet boron field study near Clara City, MN conducted in 2016 where 0, 2, 4 or 6 of B was applied after planting. Variables are considered significant at $P \leq 0.05$.

Year	Location	0	2	4	6	Significance
		---------- lb per ton ----------				*P*>F
2016	Clara City	266.6	265.0	264.7	270.6	0.32
2017	Clara City	287.9	288.6	286.6	289.1	0.90
	Crookston	347.3	344.4	346.2	341.3	0.89
	Redwood Falls	303.8	304.2	307.8	305.5	0.68
2018	Clara City	249.0	246.6	246.9	244.1	0.87
	Crookston	332.5	326.4	322.1	328.2	0.58
	Redwood Falls	**Site not harvested				

Conclusions

Data indicated that sugarbeet is unlikely to respond to the application of B when grown on higher organic matter soils. Boron may be deficient and may need to be applied for sugarbeet on sandy soils. However, sugarbeet response in sandy soils was not evaluated in this trial. Leaf boron concentration was not increased in two of three years indicating that boron from the fertilizer was either not available or there was enough boron in the soil to satisfy crop needs. The only impact on yield was a yield decrease due to boron application which may indicate over application does have a potential for reducing yield due to boron toxicity.

Acknowledgments

The authors would like to thank the Minnesota Agricultural Fertilizer Research and Education Council for the support of this project. We would also like to thank the Southern Minnesota Beet Sugar Cooperative Research crew and Mark Bloomquist and David Mettler for establishing, maintaining, and harvesting the sugarbeet trials. We also would like to thank the field crew from the Department of Soil, Water, and Climate for their technical support on the research project.