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USE OF BORON IN CONTROLLING CANKER OF TABLE BEETS

by

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Importance of Beets as a Vegetable Crop

Oregon is among the leading states of the Union in the production of beets for canning, ranking about fourth in total tonnage, but first of all states in tonnage per acre. Beginning in 1919 with a pack of 3,608 cases, the pack for 1937 was over 300,000 cases. It has been estimated that approximately 5,000 tons of beets were canned in 1937 with a total value of approximately $100,000. The Northwest beet pack is conceded to be of unusually high quality.

Beet Canker Defined

This trouble has been affecting certain areas of beets in Oregon for several years, being first photographed and described by the junior author of this circular in 1933. The malady appears as a dark spot on the root, usually on the part of the greatest circumference of the beets. Some roots may be very slightly affected with but one small spot of one-half to one inch in size. Other roots may have several spots to a degree where most of the root is blackened. Sometimes the canker or blackening may not be visible on the surface, but when the beet is sectioned, the darkened areas are plainly seen extending into the fleshy part of the root from depths varying from one-eighth to one-quarter of an inch. As affected roots increase in size, the black spots frequently develop into growth cracks and large, open cankers, extending in extreme cases to a complete girdle of the root.

Prevalence of Canker and Losses Incurred

Beet canker has been identified in plantings growing on Amity, Newberg, Salem, Sauvies, Sifton, Deschutes, and peat soils. On these soil types at one time or another beet canker has been prevalent in varying percentages of roots affected. In some instances the damage has been slight; in extreme cases fields have been so badly affected as to have no beets harvested at all.

There have been evidences, based on field observations, that new land is liable to produce a crop less affected than where beets are grown on the same land year after year, which seemingly results in more severe canker. Both early

and late plantings have been affected. Irrigated fields of beets seem to have suffered less than unirrigated areas, although there have been several instances observed where beets were badly cankered in the presence of ample soil moisture, and conversely, no canker appearing sometimes in fields that have tried out badly and in which the beets were small.

Losses to grower and canner on account of blackened beets occur through dockage of tons of marketable beets, wasted material in handling the affected roots, and extra labor involved in the factory in removing cankered areas. Two rejected fields were observed in 1937 and one large planting in 1938 was docked five dollars a ton or thirty-five dollars an acre for removal of canker at the cannery.

Advices received from a cannery packing beets in 1939 are to the effect that the daily pack of beets was increased 75 per cent because of lessened blackening of the roots due to boron applications and a consequent reduction in handwork in eliminating blackened areas. On the other hand, it was stated that where no boron was used in certain fields supplying another factory the daily pack was reduced some 37 per cent.

Use of Boron in Control of Canker

Greenhouse Experiments. Amity and Newberg soils were collected in November, 1937, from fields where beet canker had been prevalent. These soils were used in greenhouse fertilizer trials which included some four dozen jars of each soil, omitting the major nutritive elements one at a time and then adding trace elements one at a time to a series of jars that had received a general fertilizer containing nitrogen, phosphorus, and potash. Low, medium and high supplies of (1) boron, (2) moisture, and (3) potash were provided. All tests were in duplicate. Only the data bearing on the control of canker are presented, Table I.

Table I. Response of Beets to Boron
1937-38
Oregon Agricultural Experiment Station

Soil Type	Location	Beets: Boric Acid Per Acre	Canker	Average Yield Fresh Wt. Beets: F	Gain	
		lbs.	Per cent	Grams	Grams	Per cent
First crop Nov. '37-June '38						
Amity silty clay loam	Monitor	None	33	9.6	—	—
"	"	10	0	28.4	18.8	195.8
"	"	20	0	36.8	27.2	283.3
"	"	30	0	33.0	23.4	243.8
"	"	(High potash)	83	46.6	37.0	385.4
"	"	(High moisture)	33	33.8	23.4	243.8
"	"	(Limed X)	17	16.8	7.2	75.0
Second crop beets June-November '38						
Amity silty clay loam	"	None	17	18.1	—	—
"	"	10	0	30.2	12.1	66.9
"	"	20	0	29.3	11.2	61.9
"	"	30	0	34.6	16.5	91.2
"	"	(High potash)	33	42.7	24.6	135.9
"	"	(High moisture)	66	27.8	9.7	53.6
"	"	(Limed X)	17	12.8	-5.3	-29.3
Newberg sandy loam	Jefferson	None	50	10.7	—	—
"	"	10	17	12.4	1.7	15.9
"	"	20	0	17.1	6.4	59.8
"	"	30	0	14.1	3.4	31.8
"	"	(High potash)	33	12.5	1.8	16.8
"	"	(Limed X)	33	22.6	11.9	111.2
Second crop						
Newberg sandy loam	"	None	37	5.2	—	—
"	"	10	0	13.9	8.7	167.3
"	"	20	0	16.5	11.3	217.3
"	"	30	0	19.0	13.8	265.4
"	"	(High potash)	0	23.0	17.8	342.3
"	"	(Limed X)	17	17.9	12.7	244.2
Neutral peat	Chemawa	None	17	1.08(T.Ac)	—	—
"	"	40	0	3.00 "	1.92	177.8
"	"	(High potash)	40	4.77 "	3.69	341.7
Acid peat	Warrenton	None	17	2.3	—	—
"	"	40 + lime	33	12.9	10.6	460.9
"	"	(Limed X)	17	4.6	2.3	100.0

Canker developed in untreated beets. It was not prevented by a good supply of moisture or of potash. In fact, a high potash fertilizer seemed to increase the per cent of canker. Liming increased canker or decreased boron availability.

As little as ten pounds of boric acid an acre under controlled conditions prevented canker and caused striking increases in yields.

Field Trials. Field plats were treated June 7, 1938. Following control of canker, probably for the first time by the senior author, in the plant house tests, three rates of application of boric acid were made, as well as treatments with sulfates of other trace elements. The sulfates of copper, manganese, zinc, and calcium were ineffective. There is some indication that sulfur increased availability of soil boron slightly and lessened injury. It has been found that liming to bring the soil reaction to a pH of 6.5 or near neutrality may cause symptoms of boron deficiency, Table II.

Table II. Effect of Boron and Other Minor Elements in Soil Fertility

Table Beets on Newberg Sandy Loam

Chas. Hart's, Jefferson, Oregon

One-tenth Acre Plats

Treated 6-7-38. Dug 7-25-38

Treatment & Rate		Yield			Canker	
		14 Rod Row	1/10 Acre	Per Acre		
	lbs./ac	lbs.	lbs.	tons	per 25	per cent
None		35	1700	8.50	16	64
Boric Acid	10	31	1500	7.50	6	24
Boric Acid	20	24	1200	6.00	3	12
Boric Acid	30	32	1600	8.00	1	4
None		39	1950	9.75	20	80
Copper Sulfate	40	35	1700	8.50	13	52
Manganese Sulfate	40	24	1200	6.00	8	32
Zinc Sulfate	40	31	1500	7.50	11	44
None		21	1050	5.25	19	76
Calcium Sulfate	40	29	1450	7.25	12	48
Sulfur	40	24	1200	6.00	7	28

Fields of beets to which boron has been applied in the form of commercial borax have yielded relatively few cankered beets in comparison with untreated areas.

In the East Farm Experiment Station vegetable gardens at Corvallis, Table III, five individual plots, treated with 20 pounds of borax per acre, yielded 85 per cent of roots free from canker, 10.4 per cent of roots with a very slight canker, with 4.5 per cent having medium to heavy cankering. One of the five treated

areas produced 92 per cent roots with no canker and 8 per cent with a very mild degree of blackening. Most of the roots that were affected in the treated areas had but a slight degree of canker.

In the untreated areas, a mean of 23 per cent of the roots were free from canker, 36.5 had a mild degree, while 40.5 had medium to heavy canker. In two plots, 48 per cent of each were badly cankered, 24 to 28 per cent mildly affected, and 24 to 28 per cent were free from injury.

In the treatment of the plots at Corvallis, the borax was mixed with 500 pounds per acre of a 4-16-8 fertilizer and broadcasted over the area previous to seeding. The beet plants were watered with a Skinner sprinkling system.

Table III. Determination of Usefulness of Boron in Prevention of Beet Canker

O.S.C. East Farm Vegetable Gardens, 1938

Block No.	Treatment	No Canker Per cent	Roots with Mild Canker Per cent	Med. to heavy Canker Per cent	Remarks
A W A L	Boron used in comm. fert.	89.4	8.0	2.6	Little canker present
S W A 2	"	92.0	8.0	-	Extremely free from canker
S W B 2	"	87.0	4.3	8.6	Very few roots cankered
N E A 1	Comm. fert. no boron	24.0	50.0	26.0	Almost two-thirds of this lot cankered.
N E B 1	"	16.0	44.0	40.0	Four-fifths of this lot cankered.
N E A 2	Comm. fert.& boron included	80.0	16.0	4.0	Very mild canker in the 16 per cent
N E B 2	"	76.0	16.0	8.0	Canker very slight to medium
N E A 3	Comm. fert. no boron	28.0	24.0	48.0	Bad canker in the 48 per cent
N E B 3	"	24.0	28.0	48.0	Bad canker in the 48 per cent
Mean	Comm. fert. & boron	85.0	10.4	4.6	
Mean	Comm. fert. no boron	23.0	36.5	40.5	

20# Borax per acre used, mixed with 4 - 16 - 8 commercial fertilizer. Irrigated by Skinner lines.

Availability of boron in soil varies with geological origin and colloidality of soil, its reaction and moisture content, and perhaps with temperature. Liming that increases soil reaction nearly to neutrality (or above pH 6.5) may interfere with boron availability and cause deficiency symptoms.