Effect of Pesticides and Nitrogen Fertility on Rhizoctonia Root Rot of Sugarbeet[1]

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Introduction

The presence and incidence of root and crown rot of sugarbeet (*Beta vulgaris* L.), caused by the soil-borne fungus *Rhizoctonia solani* Kühn, has been reported in the United States by numerous authors, first by Pammel (5)[3] in 1891 and most recently by Hecker and Ruppel (3) in 1977. An increasing incidence of the disease was noted by Hecker and Ruppel (3) without attributing a cause, but shorter crop rotations were implicated. Crop rotation currently is the only means of control. Chemical treatments of soil, seed, or plants are not sufficiently effective or are not commercially feasible, and resistant commercial varieties are not yet available.

Potential effects of contemporary pesticide treatments on rhizoctonia root rot in field-grown sugarbeet have not been reported. However, Altman and Campbell (1) and Tisserat et al. (7) have reported increased rhizoctonia damping off of sugarbeet seedlings in greenhouse and growth chamber experiments where the soils were amended with cycloate and aldicarb. The effect of nitrogen fertility on sugarbeet root rot has been tested only to a limited extent. Hills and Axtell (4) in 1950 reported a lower incidence of rhizoctonia root rot on nitrogen fertilized plots than on non-fertilized plots. Schuster and Harris (6) in 1960 reported similar results on plots of continuous beets and in a 2-year rotation, but not in 3, 4, or 6 year rotations.

The purpose of this paper is to report the effects of commonly used pesticides and of nitrogen fertility treatments on rhizoctonia root rot of sugarbeet.

Materials and Methods

Three irrigated field experiments were conducted over 2 years at Fort Collins, Colorado, testing the effect of cycloate (herbicide), aldicarb (systemic insecticide), 1,3-dichloropropene (nematocide

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[3]Numbers in parentheses refer to literature cited.

soil fumigant), and varying nitrogen fertility levels on the incidence of rhizoctonia root rot. A split-split-block design (five replications) was used in 1975 to test for effect of cycloate and nitrogen (N) on the intensity of root rot. Main plots were cycloate [3.4 kg active ingredient (a.i.)/ha] and no cycloate; sub-plots were three nitrogen fertility levels: 1) 202 kg applied N/ha (90 kg/ha preplant and 112 kg/ha side-dressed 45 days post planting), 2) 90 kg applied N/ha, preplant, and 3) no applied N. The N was applied as ammonium nitrate. Soil analysis before treatments showed that there was about 118 kg of residual nitrate nitrogen per ha in the surface 45 cm of the experimental area. Hence, the nitrogen status of the three treatments could be considered excess, optimum, and deficient. Sub-sub-plots (6 m, single row) were three sugarbeet cultivars which were resistant, intermediately resistant, and susceptible to *Rhizoctonia*, respectively. The experiment was planted May 12 and inoculated July 18 using a topical inoculum application as described by Hecker and Ruppel (3).

To simulate commercial conditions, in 1976 two experiments were planted in an area of the 1975 *Rhizoctonia*-inoculated tests. In addition, a preplant broadcast application of ground barley inoculum (56 kg/ha) was incorporated 10 cm deep into the experimental areas. Both experiments were planted April 2 with an adapted commercial hybrid variety (*Rhizoctonia* susceptible). In a randomized complete block experiment (six replications of 6 m 2-row plots), the N treatments of 1975 were repeated. In the other experiment (split plot design, six replications of 6 m 4-row plots), the fumigant (main plots) was injected March 10 at 140 1 (full strength)/ha, and aldicarb (sub-plots at 4.5 kg a.i./ha) was incorporated at planting into a 15 cm band. Seed was planted into the treated zone.

In all experiments, the dry ground barley-grain inoculum was prepared essentially in the manner described by Gaskill (2). The 1975 experimental area had had no beets for at least 3 years; the previous cropping history was not available.

All experiments were evaluated about September 22. The roots (25 per 6 m row) were individually rated for severity of root rot. Disease index (DI) ratings were based on a scale of 0 to 7 (0 = no evidence of infection; 7 = plant dead and extensively decomposed). The percentage of healthy roots (DI ratings of 0 and 1 combined) also was calculated.

Results and Discussion

An analysis of variance of DI and % healthy roots for 1975 showed significant differences only among cultivars. The only significant interaction was cultivars X nitrogen, but from an examination of the means in Table 1, this interaction does not appear biologically important. In 1976, the 90 and 202 kg/ha nitrogen treatments had DI's of 6.0 and 5.5, respectively, and were not significantly different. However, as measured by percentage healthy roots, the nitrogen treatments had a significant effect on the intensity of *Rhizoctonia* infection, with 10.5% and 21.4% healthy roots at 90 and 202 kg applied N/ha, respectively. Hence, these experiments provide evidence that in particular years or environments, the development of rhizoctonia root rot may be slightly inhibited by a more abundant supply of soil nitrogen, but this inhibition does not appear to be great enough or sufficiently consistent to consider nitrogen fertilization as a control measure.

Means from the 1976 pesticide experiment are shown in Table 2. There were no significant effects on disease incidence among treatments as measured by post-thinning death loss (July 21 and September 22) or disease index, and percentage healthy roots at harvest. However, the rank of the treatments was the same in all four measures. The probability is less than 0.001 that the treatment means would be ranked in this manner by chance alone. Therefore, it is likely that the intensity of rhizoctonia root rot was enhanced by separate and combined treatments with nematocide fumigant and aldicarb, especially under the intense disease exposure, but the difference was too small to be of practical importance.

Table 2.—Means for plants lost, disease index (DI), and % healthy roots in 1976 under common pesticide treatments.

	Post thinning death loss (%)			
Treatment	July 21	Sept 22	DI	% healthy
Fumigant + aldicarb	60 a[1]	94 a	6.8 a	0.3 a
Fumigant	52 a	90 a	6.7 a	0.7 a
Aldicarb	50 a	88 a	6.6 a	0.8 a
Control	44 a	86 a	6.5 a	2.6 a

[1]Within column means followed by the same letter are not significantly different (P = 0.05).

Summary

Sugarbeet (*Beta vulgaris* L.) field experiments inoculated with *Rhizoctonia solani* Kühn showed a slight, but practically unimportant, beneficial effect of high rates of nitrogen fertilization on

Table 1.—Means for disease index (DI) and % healthy roots in 1975 rhizoctonia root rot experiment.

Treatment	Cultivar							
	Resistant		Intermediate		Susceptible		Mean	
	(DI)	(% healthy)	(DI)	(% healthy)	(DI)	(% healthy)	(DI)	(% healthy)
Herbicide								
cycloate (3.4 kg/ha)	4.7	14%	5.6	9%	7.0	0%		8%
no cycloate	4.5	20%	5.7	8%	7.0	0%		9%
Nitrogen								
202 kg N/ha	4.6	17%	5.8	6%	7.0	0%	5.8	8%
90 kg N/ha	4.4	18%	5.8	5%	7.0	0%	5.7	8%
0 applied N	4.8	17%	5.3	15%	6.9	0%	5.6	11%
Mean	4.6 a[1]	17.2%	5.6 b	8.4%	7.0 c	0%	5.7	9%
LSD's (0.05)								
Herb. treatment	0.15							
N treatment	0.26							

[1]Means followed by the same letter are not significantly different.

rhizoctonia root rot. The contemporary pesticides cycloate, aldicarb, and a nematocide fumigant had no practical effect on the intensity of root rot. Hence, these contemporary pesticides and nitrogen fertility levels are neither enhancing nor inhibiting development of rhizoctonia root rot in sugarbeet.

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