

INTEGRATED MANAGEMENT OF APHANOMYCES ROOT ROT ON SUGARBEET

Carol E. Windels and Jason R. Brantner
Professor of Plant Pathology and Research Fellow, respectively
University of Minnesota, Northwest Research and Outreach Center, Crookston

Aphanomyces cochlioides (= *A. cochlioides*) is a soilborne pathogen that causes damping-off and chronic root rot of sugarbeet when soil is warm and wet. The pathogen produces thick-walled oospores in infected roots, which survive in soil for years, even when a sugarbeet crop is not grown. Consequently, producers with *A. cochlioides*-infested fields are challenged with managing this disease to minimize its impact on sugarbeet stand, yield and quality. Control measures include early planting (to avoid warm, wet soils favorable for infection), seed treatment with Tachigaren, selection of partially resistant varieties, water management (installing tiles or ditches to improve drainage, cultivating to dry soil), and weed control (*A. cochlioides* infects several common weed species, such as, pigweed, lamb's-quarters, kochia). For optimal control of *Aphanomyces* diseases, producers are encouraged to implement all of these disease management options.

Green manure crops suppress several soilborne pathogens and pests on many crops. More specifically, soil-incorporation of a green oat crop has been reported to suppress *Aphanomyces* root rot, caused by *A. euteiches*, on peas in the field. A green oat crop also has been shown to reduce *Aphanomyces* root rot of sugarbeet in the greenhouse in soil collected from infested fields. Integration of a green oat precrop with traditional disease control strategies may enhance suppression of *Aphanomyces* diseases.

OBJECTIVE

The objective of this research was to integrate a green manure oat precrop and co-planted oats and sugarbeet, with traditional disease control options for *A. cochlioides* on sugarbeet and determine effects on stand, root rot, and sugar yield and quality.

MATERIALS AND METHODS

On August 28, 2000 the trial was established in the *Aphanomyces* nursery (soil index value = 31) at the University of Minnesota Northwest Research and Outreach Center, Crookston. Treatments consisted of oats (variety Dane, 2 bu/A), fallow soil designated for co-planting with oats and sugarbeet in 2001 and two controls including wheat (variety 2375, 2 bu/A), and fallow soil. Main plots measured 25 x 30 ft and were arranged in a randomized block design of six replicates. Six weeks later, green residues were incorporated into soil by rototilling two times to a 4-inch depth. Amounts of green residue incorporated into soil averaged 4.2 and 8.1 tons/A for oats and wheat, respectively.

On May 16, 2001, each main plot (soil index value = 65 across plots) established in 2000 was sown with three treatments: sugarbeet variety Crystal 261 (susceptible to *Aphanomyces*) and Crystal 9720 (partially resistant to *Aphanomyces*) treated with Tachigaren (70WP hymexazol, 45g/100,000) and not treated with Tachigaren. All sugarbeet seed was commercially pretreated with Apron and Thiram to prevent seed rot and damping-off caused by *Pythium* spp. and *Rhizoctonia solani*. Seeds (250/row) were sown with a rod-row planter in 4-row plots; rows were 22 inches apart and 30 ft long. In plots where oats was co-planted with sugarbeet, oat seed was hand-broadcast (2 bu/A) and lightly raked into soil on the same day sugarbeet was sown. Co-planted oats were removed by microrate applications of Poast (5.3 oz/A) on June 6, 12 and 18. Counter (1.8 lb/A) was applied at planting for control of the sugarbeet root maggot. Microrate applications of Betanex, UpBeet, Stinger, Poast and methylated seed oil (0.5 pint, 0.125 oz, 1.3 oz, 5.3 oz, and 1.5 pint/A, respectively) were made on June 6, 12 and 18. *Cercospora* control consisted of Eminent (13 oz/A) applied on August 6 and Topsin and Super Tin (0.5 lb and 5.3 oz/A, respectively) on August 20. Plots were irrigated with drip tape as needed to keep soil moist.

Table 1. Early season stand, root rot ratings at harvest, and yield of a susceptible (S) sugarbeet variety and an *Aphanomyces*-resistant (R) variety (treated with Tachigaren, 45 g/100,000 seed) sown in an *Aphanomyces*-infested nursery in 2001 that had been fallow (plots where sugarbeet was co-planted with oats had also been fallow) or planted to a green manure crop of oats or wheat the previous summer.

Treatment	% Stand		Root rot rating ^z	Yield				
	May 31	June 15		T/A	% Sugar	Loss to molasses	Recoverable sugar lb/T	Recoverable sugar lb/A
Precrop Treatment^w								
Fallow	84	76	1.6	23.1	16.5	1.7	297	6854
Oats	85	78	1.6	22.4	16.3	1.7	293	6567
Oats, co-plant	79	74	1.7	22.1	16.4	1.7	294	6486
Wheat	85	76	1.7	21.5	16.4	1.6	295	6361
LSD ($P = 0.05$) ^x	3	3	NS	1.0	NS	NS	NS	NS
Treatment^y								
Crystal 261 (S)	81	74	2.5	20.8	17.0	1.8	291	6364
Crystal 9720 (R)	82	75	1.3	22.9	16.2	1.6	289	6656
Crystal 9720 + Tach (45 g)	86	78	1.3	23.1	16.1	1.6	304	6681
LSD ($P = 0.05$) ^x	2	2	0.1	0.9	0.5	0.17	NS	NS

^w Precrops of oats variety Dane and wheat variety 2375 were planted on August 28 (2 bu/A) and green biomass was incorporated by cultivation on October 4, 2000. Oat seeds were co-planted (2 bu/A) with sugarbeet on May 16, 2001 and oats were removed by microrate applications of Poast (5.3 oz/A on June 6, 12 and 18). Each value is averaged across sugarbeet and Tachigaren seed treatment, six replicates.

^x LSD = Least Significant Difference; if significant, LSD value provided for mean separations; NS = not significant.

^y Sugarbeet planted on May 16 (500 seed/60 ft row); thinned on June 28; and harvested on October 3, 2001. Each value is averaged across precrop treatment, 6 replicates

^z *Aphanomyces* root rot rating at harvest based on a 0-7 scale, 0 = healthy root, 7 = root completely rotted and foliage dead (20 roots/subplot/replicate).

Data were collected in the two center rows of each sugarbeet subplot for early season stand. On June 28, plots were thinned to the equivalent of 150 beets/100 ft of row. The trial was harvested on October 3, 2001. Twenty roots per plot were evaluated for *Aphanomyces* root rot (0-7 scale, 0 = healthy, 7 = root is completely rotted and foliage dead). Root samples (10 per plot) were analyzed for yield and quality by the American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

RESULTS

There were no significant interactions between main treatments (precrop and sugarbeet varieties) for all variables measured, so data are presented only for main treatments. Sugarbeet emergence 2 weeks after planting was very good and nearly the same for plots pretreated with green manure crops of oats and wheat and the fallow control compared to plots co-planted with oats and beets (Table 1). Stands declined slightly (by 5-9%) over the next 2 weeks and were significantly higher in plots pretreated with a green manure crop of oats (78%) compared to plots co-planted with oats and beets (74%), but were equal and intermediate in plots pretreated with a green manure crop of wheat or left fallow. At 2- and 4-weeks after planting, sugarbeet variety Crystal 9720 treated with Tachigaren resulted in stands that were significantly higher compared to Crystal 9720 without Tachigaren and Crystal 261, which were the same.

Aphanomyces root rot ratings of sugarbeet at harvest were low and there was no significant effect of precrop treatment or of co-planting oats with sugarbeet (Table 1). The *Aphanomyces* susceptible variety Crystal 261 had a significantly higher root rot rating (2.5) than the moderately resistant variety Crystal 9720, with or without Tachigaren, which were the same (1.3). A rating of 2.5 represents 5-25% of the root surface rotted or scarred; a rating of 1.5 represents superficial scarring on less than 5% of the root surface.

Sugarbeet yields (tons/A) were significantly higher in plots that previously were fallow (23.1) compared to plots pretreated with a green manure crop of wheat (21.5), but were intermediate for plots pretreated with a green manure crop of oats or co-planted to oats and sugarbeet, which were equal ([Table 1](#)). Precrop treatments had no significant effect on percent sugar, loss to molasses or sugar yield. Pounds of recoverable sugar per acre were highest in plots previously left fallow, followed in descending order by plots pretreated with a green manure crop of oats, oats co-planted with sugarbeet, and a green manure crop of wheat. Sugarbeet yields (tons/A) were equal and significantly higher for Crystal 9720 with and without Tachigaren than for Crystal 261 ([Table 1](#)). Crystal 261 had a significantly higher percent sugar and loss to molasses than Crystal 9720, with and without Tachigaren seed treatment. Sugarbeet variety and Tachigaren seed treatment had no significant affect on recoverable sugars although pounds of sugar per acre were highest for Crystal 9720 treated with Tachigaren, followed in descending order by Crystal 9720 without Tachigaren and Crystal 261.

DISCUSSION

Early season sugarbeet stand was best in plots previously fallowed or precropped to green manure crops of oats or wheat and then sown with Tachigaren-treated seed of a sugarbeet variety with partial resistance to *Aphanomyces*. Stands of sugarbeets co-planted with oats was relatively poor and may be attributed to early-season competition with oats. At harvest, the least amount of root rot and best yields were not affected by precrop treatment but by plant resistance to *A. cochlioides*. Prevalence and severity of *Aphanomyces* damping-off and chronic root rot in these plots, however, were disappointingly low. If more severe disease had occurred, a better assessment of the combined and individual effects of precrop treatments, variety resistance to *Aphanomyces*, and Tachigaren seed treatment on control of *A. cochlioides* would have been attained.

The soil index value of the *Aphanomyces* nursery averaged 31 when precrops were sown in 2000 and 61 when sugarbeet was planted in 2001. It is unknown why index values were higher in the spring of 2001 compared to the previous fall, however, we anticipated severe root rot and plant loss on sugarbeet seedlings and adult plants. Plots also were irrigated regularly to favor root infections by *A. cochlioides* and disease development. Perhaps the isolate of *A. cochlioides* inoculated into the nursery lost pathogenicity. Efforts are underway to determine if disease levels are adequate for further trials, and if not, the nursery will be re-inoculated (probably with a mixture of pathogenic isolates of *A. cochlioides*).

CONCLUSIONS

1. Under conditions of low *Aphanomyces* disease pressure, early season sugarbeet stand was best in plots previously fallowed or precropped to a green manure crop of oat or wheat and then sown with Tachigaren-treated seed of a sugarbeet variety with partial resistance to *Aphanomyces*. Stands of sugarbeet co-planted with oats were relatively poor.
2. At harvest, the least amount of root rot and best yields were not affected by precrop treatment but by plant resistance to *A. cochlioides*.

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