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PLACEMENT OF TACHIGAREN ON AND IN PELLETED SUGARBEET SEED

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Aphanomyces damping-off and root rot caused by the "water mold" *Aphanomyces cochlioides* (= *A. cochlioides*) is a common soilborne disease of sugarbeet in Minnesota and North Dakota. Currently, Tachigaren (= hymexazol) is the only seed treatment fungicide available for control of *A. cochlioides*. Tachigaren has been registered in the United States since 1996 for use on pelleted sugarbeet seed at rates of 45 to 90 g per unit (100,000 seed). These rates of Tachigaren can be phytotoxic if applied directly to seed but are safe when applied or "fixed" on the outside of pelleted seed (which then, is sealed with a film coat). Placement of Tachigaren on, or within, the seed pellet at the 45 g rate may result in different benefits when seed is planted in "light" (sandy-type) or "heavy" (clay-type) soils infested with *A. cochlioides*.

OBJECTIVES

Our purpose was to evaluate the effect of treating sugarbeet with 45 g of Tachigaren ("fixed' on the exterior of the pellet, "free" within the pellet, or a combination of fixed + free) on germination and control of *A. cochlioides* when sown in "light" and "heavy" soils.

MATERIALS AND METHODS

Seed was pretreated and provided by ASTEC Inc. Tachigaren seed treatments included: A) 45 g "free" within the pellet, B) 45 g "fixed" on the pellet surface (this is the formulation sold commercially), and C) 45 g (30 g "fixed" within, and 15 g "free" on, the pellet). Seeds were sown in two soils collected from commercial sugarbeet fields and were naturally infested with *A. cochlioides*. One was a sandy loam soil collected near Wolverton, MN (Aphanomyces soil index = 99) and the other was a clay loam soil collected near Moorhead, MN (Aphanomyces soil index = 99). Throughout this report, these soils will be referred to as "light" and "heavy", respectively.

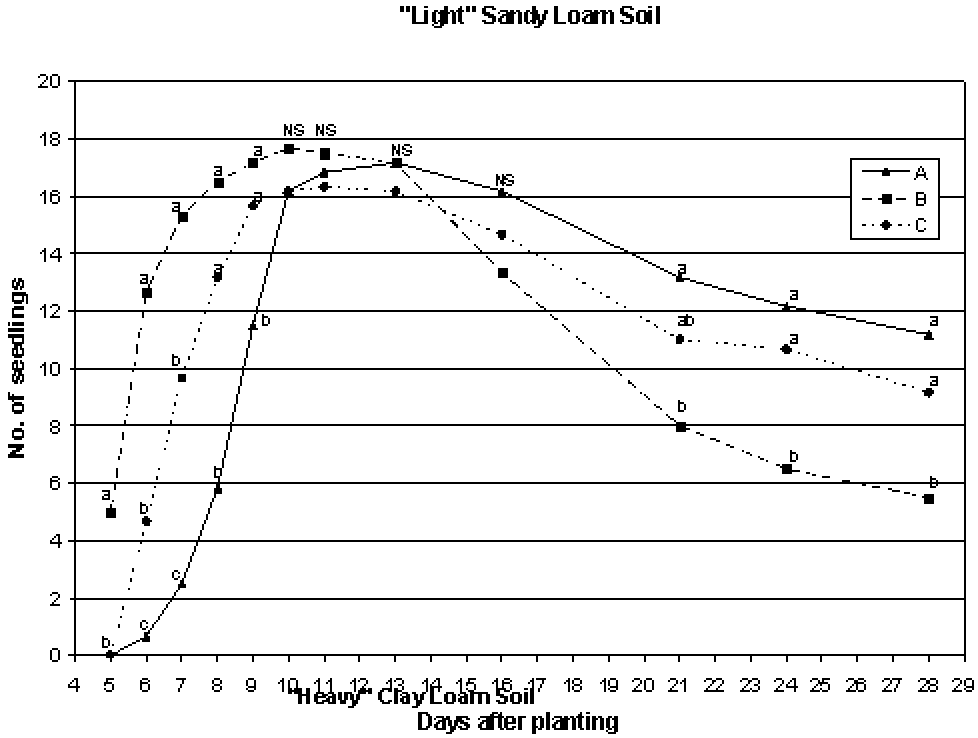
Soil was screened and 1 gallon was dispensed into plastic containers (7 x 12 x 4.5 inches). One replicate of each seed treatment was sown per container (20 seeds per row, seeds 0.6 inch apart, 0.8-inch depth). There were six replicates for each soil source. Containers were arranged in a randomized block design in a controlled environment chamber set at 73 ^{0}F/68 ^{0}F (day/night, 16 hour photoperiod) for 1 week to favor optimal germination and then 82 ^{0}F/77 ^{0}F (day/night, 16 hour photoperiod) to favor disease. Soil was watered daily or as needed, to keep moist.

Stand counts were made at emergence and then at least two or three times per week until 4 weeks after planting. Dying seedlings were removed at each stand count, washed free of soil, surface-treated in 0.5 % NaOCl for 15 sec, rinsed twice in sterile distilled water (SDW), placed in 5 ml SDW, and microscopically examined 24 to 48 hours later for zoosporangia typical of *A. cochlioides*. Four weeks after planting, surviving seedlings were assessed for root rot and then an Aphanomyces root rot index (0 – 100 scale, 0 = healthy, 100 = all seedlings dead) was calculated for each seed treatment. Total emergence, number of dead plants, final stand, and root rot indices were subjected to analysis of variance and if significant (P = 0.05), means were separated by Least Significant Difference (LSD).

RESULTS

Light soil. Seedlings from Tachigaren treatment B (fixed on pellet surface) were first to emerge at 5 days after planting (Fig. 1A). For the next 3 days, treatment B (fixed on pellet surface) continued to have significantly higher stands than the other seed treatments; treatment C (fixed + free in pellet) resulted in an intermediate stand that was significantly higher than treatment A (free in pellet), which had the slowest emerging stand. At 10 to 11 days after planting, emergence was nearly equal and statistically the same among seed treatments (Fig. 1A). Aphanomyces damping-off started about 2 weeks after planting across all seed treatments. By 28 days after planting, final stands

A



B

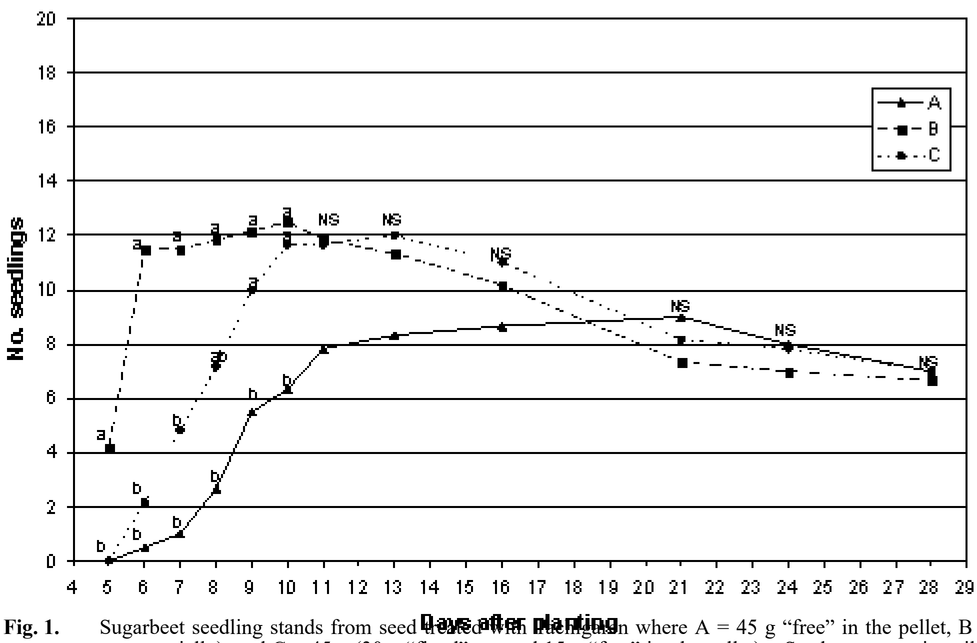


Fig. 1. Sugarbeet seedling stands from seed treated with Tachigaren where A = 45 g "free" in the pellet, B = 45 g "fixed" on the pellet surface (formulation sold commercially), and C = 45 g (30 g "fixed" on, and 15 g "free" in, the pellet). Seed was sown in soil naturally infested with *Aphanomyces cochlioides* from **A)** a "light" sandy loam soil from Wolverton, MN (Aphanomyces soil index = 99) and **B)** a "heavy" clay loam soil from Moorhead, MN (Aphanomyces soil index = 99). For each date, data points followed by the same letter are not significantly different, $P = 0.05$.

Table 1. Total emergence, number of dead seedlings, final stand, and root rot index of seedlings grown in a "light" sandy loam soil collected near Wolverton, MN (Aphanomyces soil index = 99) and a "heavy" clay loam soil from Moorhead, MN (Aphanomyces soil index = 99) that were naturally infested with *Aphanomyces cochlioides*. Seed was treated with three formulation of Tachigaren where A = 45 g "free" in the pellet, B = 45 g "fixed" on the pellet surface (formulation sold commercially), and C = 45 g (30 g "fixed" on, and 15 g "free" in, the pellet).

Tachigaren treatment (45 g)	Total emerged[x]	Number dead[x]	Final stand[x]	Root rot index[xy]
Light soil				
A = Free (in pellet)	18	7	11	72
B = Fixed (on pellet surface)	18	13	6	84
C = Fixed + free	17	8	9	72
LSD (P=0.05)[z]	NS	3	4	NS
Heavy soil				
A = Free (in pellet)	11	4	7	63

B = Fixed (on pellet surface)	14	7	7	73
C = Fixed + free	14	7	7	709
LSD (P=0.05)[z]	NS	NS	NS	NS

[x] Mean of six replicates; 20 seeds sown/treatment/replicate.

[y] Root rot index = 0 – 100 scale, 0 = all plants healthy, 100 = all plants dead.

[z] LSD = Least Significant Difference; if significant, LSD values provided for mean separations; NS = not significantly different, P = 0.05.

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were lowest for Tachigaren seed treatment B (fixed on pellet surface) compared to treatments C (fixed + free) and A (free within pellet), which were statistically the same (Fig. 1A, Table 1). Overall, there were no differences among seed treatments for total emergence (Table 1). Seedlings from seed treatment B (fixed on pellet surface) underwent significantly more stand loss than from treatments A (free in pellet) and C (fixed + free in pellet), which were the same; root rot indices were the same among all seed treatments (Table 1).

Heavy soil. Overall, emergence of sugarbeet seedlings from all seed treatments was lower in heavy soil (Fig. 1B) compared to light soil (Fig. 1A). Seedlings from treatment B (fixed on pellet surface) emerged first, at 5 days after planting (Fig. 1B). The following day, a few seedlings from treatments A (free in pellet) and C (fixed + free) started to emerge. Treatment B (fixed on pellet surface) continued to provide significantly higher stands than the other seed treatments until 8 to 9 days after planting, when stands from seed treatment C (fixed + free) increased substantially. Stands from seed treatments B (fixed on pellet surface) and C (fixed + free) were nearly equal by 10 days after planting and were significantly higher than treatment A (free in pellet). There were no significant differences in stand (P = 0.05) among seed treatments from 11 to 28 days after planting because Aphanomyces damping-off was killing seedlings from treatments B (fixed on pellet surface) and C (fixed + free) and emergence was low for seed treatment A (free in pellet) (Fig. 1B). At 28 days after planting, there were no differences in total emergence, number of seedlings killed by *A. cochlioides*, final stand, or root rot index (Table 1).

DISCUSSION

Aphanomyces damping-off was active in the light and heavy soils. All Tachigaren seed treatments in both soils succumbed to this disease, probably because Tachigaren levels had deteriorated between time of application to seed and planting. Also, both soils provided severe disease pressure and benefits of Tachigaren seed treatments would have been more apparent if non-Tachigaren-treated seed had been included as a control. Emergence was most rapid for seed treated with the fixed formulation of Tachigaren but protection from damping-off was the poorest. This likely occurred because of direct exposure and contact of Tachigaren on the pellet surface with soil moisture (hence, decomposition in soil) compared to formulations of Tachigaren within the pellet. Stand establishment initially was slow for seed treated with the free formulation of Tachigaren (likely because the fungicide was in direct contact with seed), but it eventually “caught up” to the other seed treatments and in light soil, provided the best protection against Aphanomyces damping-off. In heavy soil, overall emergence was poor and by 4 weeks after planting, final stands were the same for all Tachigaren seed treatments.

Ultimately, the most desirable formulation of Tachigaren is one that promotes rapid emergence, optimal stands, and also minimizes seedling stand loss from emergence through 4 to 6 weeks after planting. Although *A. cochlioides* can cause significant damping-off and root rot in light and heavy soils, the latter are more prone to disease because they are poorly drained and hold water longer than light soils.

ACKNOWLEDGEMENTS

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