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# LOW RATES OF TACHIGAREN ON MINIMUM BUILD-UP PELLETED SEED

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Aphanomyces damping-off and root rot are caused by the "water mold" *Aphanomyces cochlioides* (= *A. cochlioides*). This soilborne pathogen is increasing in severity and prevalence in Minnesota and North Dakota. Tachigaren 70WP (= hymexazol) is the only seed treatment fungicide available for early-season control of *A. cochlioides.* Tachigaren has been registered in the Untied States since 1996 for use on pelleted sugarbeet seed at rates of 45 to 90 grams (g) per unit (100,000 seed). These rates of Tachigaren can be phytotoxic if applied directly to seed but are safe when applied to the surface of pelleted seed (and then are sealed with a film coat). Adoption of Tachigaren-pelleted sugarbeet seed has been excellent in southern Minnesota where *A. cochlioides* has been a long-standing, economic pathogen. Most Red River Valley (RRV) sugarbeet producers, however, have been reluctant to plant Tachigaren-treated seed unless they have a history of severe Aphanomyces damping-off. Although fields in the RRV historically are more prone to Aphanomyces root rot on older plants, these fields have potential for early-season damping-off in a warm, wet spring.

In 2003, Sankyo Agro Co., Ltd., Tokyo, Japan (manufacturer of Tachigaren) and Sumitomo Corp. of America (U.S. distributor) applied for an amendment label to allow lower rates of Tachigaren on minimum build-up pelleted sugarbeet seed. The Environmental Protection Agency approved this request in November, 2003. The new label allows application of Tachigaren at 20 or 30 g on minimum build-up pellets. Lower rates of Tachigaren reduce the risk of phytotoxicity, as well as the cost, of Tachigaren-treated seed. Producers have raised questions about where this new option can be most effectively utilized.

## OBJECTIVES

To evaluate efficacy and phytotoxicity of low levels of Tachigaren (hymexazol) on minimum build-up pellets of sugarbeet seed sown in soil with low to moderate disease caused by *A. cochlioides*.

## MATERIALS AND METHODS

Sugarbeet seed was treated with standard rates of Apron + Thiram and supplemented with 20 or 30 g of Tachigaren/unit on minimum build-up pellets or 45 g of Tachigaren/unit on regular pellets. The control consisted of seed treated with Apron + Thiram and no Tachigaren. Seed treatments were evaluated in controlled environment chambers in soil collected from eight locations including two fields each in Nebraska, Michigan, North Dakota, and Minnesota. Cooperators in Nebraska (R. Harveson, University of Nebraska), Michigan (L. Hubbel, Monitor Sugar Company), and North Dakota (J. Giles, North Dakota State University) sent us soil from their research plots (where the same seed treatments were being evaluated). We also collected soil from two fields in Minnesota. Each cooperator provided seed of a local variety that had been treated, as described above. Seed from Nebraska was variety Beta 4546; Michigan was HM E-17; and from North Dakota and Minnesota was ACH 999. ASTEC, Inc. treated seed provided to Nebraska and Seed Systems treated seed for the other locations.

Field sites were selected for low to moderate disease pressure caused by *A. cochlioides.* We determined the Aphanomyces index value for each field with a soil bioassay. Aphanomyces soil index values range from 0 to 100 (0 = no disease, 100 = severe disease) and are based on seedling death and root rot. The eight fields (followed by the Aphanomyces soil index value in parenthesis) include: Kochel, Michigan (= 15); Wegener, Michigan (= 14); Mitchell, Nebraska (= 2); Scott, Nebraska (= 11); Watt, North Dakota (= 4); Rosenfeldt, North Dakota (= 5); Nielsville, Minnesota (= 82); and Eldred, Minnesota (= 0). *Aphanomyces* was isolated in seven of the eight fields, but was not detected in soil collected in the field from Eldred, Minnesota. Most of the soils had lower Aphanomyces soil index values than anticipated for the trial.

Each soil was evaluated concurrently in a walk-in controlled environment chamber. Soil (about 20,000 $cm^3$) was dispensed into plastic containers (15 x 20.5 x 5.5 inches); each container was large enough for two replicates. Rows were 2.5 inches apart and 20 seeds were planted per row (0.6 inch spacing and 0.8 inch depth). Treatments were arranged in a randomized block design with six replicates per soil source, except for the soil from Eldred, Minnesota (one replicate was discarded because of a planting error). Containers were place in a controlled environment chamber set at 70 $\pm$ 2 ºF for 1 week to favor optimal emergence and then raised to 79 $\pm$ 2 ºF (16 hour photoperiod) to favor disease. Soil was watered daily to keep moist.

Stand counts were made at emergence, then daily until 10 to 11 days after planting, and then two to three times weekly until 28 days after planting when the experiment ended. Dying seedling 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 *A. cochlioides* and other fungal pathogens. Twenty-eight days after planting, surviving seedlings were rated for disease and then a root rot index (0 to 100 scale) was calculated for each seed treatment. Plant stands and root rot indices were subjected to analysis of variance and if significant ($P < 0.05$), means were separated by Least Significant Difference.

**RESULTS**

Soils collected in Nebraska, Michigan, and North Dakota showed similar patterns in early emergence and no differences in final stand 4 weeks after planting, so data from these six fields were combined (Fig. 1). At 4 days after planting, stand was equal for all seed treatments except for the 45 g rate of Tachigaren, which delayed emergence (Fig. 1). This trend continued until 8 days after planting when stands for all seed treatments were excellent and not statistically different. Aphanomyces occurred in the six soils (Aphanomyces soil index value averaged 6 and ranged from 2 to 15), but damping-off was minimal and final stand was not affected by seed treatment, Stands shown for these combined fields (Fig. 1) are very similar to stands in the soil from Eldred, Minnesota, which had an Aphanomyces soil index value of 0 (Fig. 2). In the Eldred soil, emergence was delayed at 4 days after planting when seed was treated with Tachigaren (all rates) compared to no Tachigaren, but there were no differences in stand among seed treatments for the remainder of the trial.

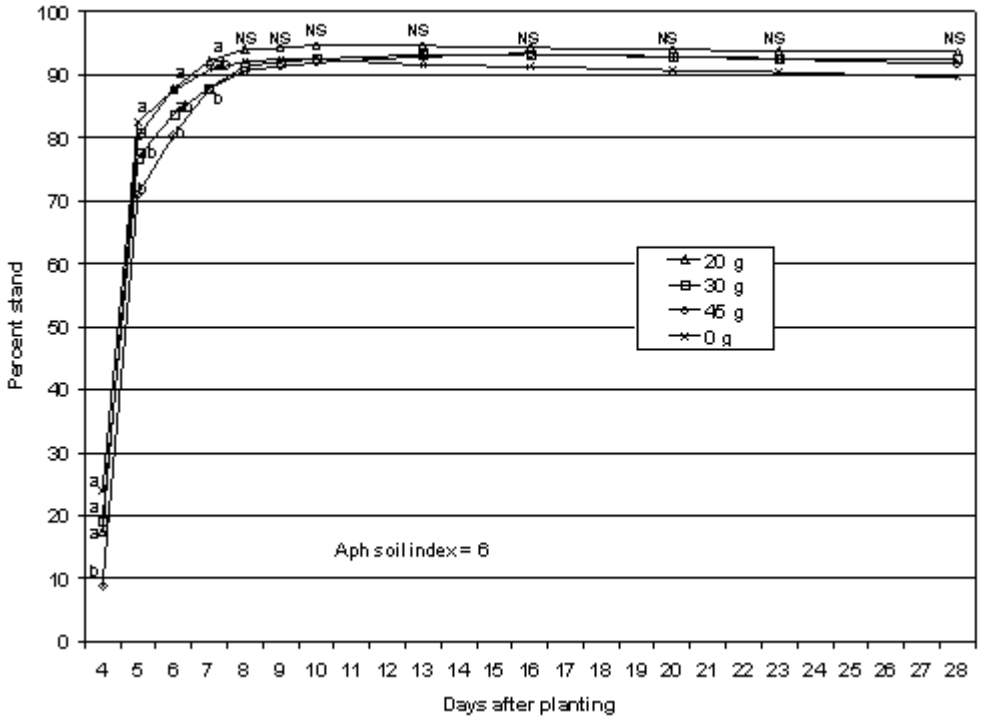


**Fig. 1.** Percent stand of sugarbeet from seed treated with Apron + Thiram and supplemented with 0, 20, or 30 g of Tachigaren/unit on minimum build-up pellets or 45 g of Tachigaren/unit on regular pellets after planting seed in soil from six locations. The combined soils had an average Aphanomyces soil index of 6 (range: 2 – 15). Each data point is averaged across the six soils and is based on planting a total of 720 seeds. For each stand count, data points followed by the same letter are not statistically different ($P = 0.05$); NS = not significant.

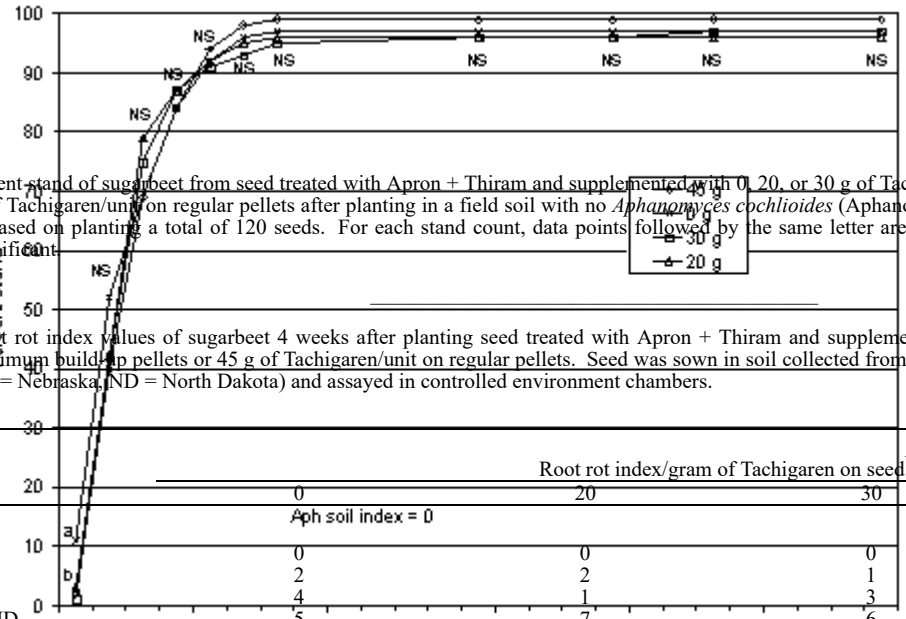


**Fig. 2.** Percent stand of sugarbeet from seed treated with Apron + Thiram and supplemented with 0, 20, or 30 g of Tachigaren/unit on minimum build-up pellets or 45 g of Tachigaren/unit on regular pellets after planting in a field soil with no *Aphanomyces cochlioides* (Aphanomyces soil index value = 0). Each data point is based on planting a total of 120 seeds. For each stand count, data points followed by the same letter are not statistically different ($P$ = 0.05); NS = not significant.

**Table 1.** Root rot index values of sugarbeet 4 weeks after planting seed treated with Apron + Thiram and supplemented with 0, 20, or 30 g of Tachigaren/unit on minimum build-up pellets or 45 g of Tachigaren/unit on regular pellets. Seed was sown in soil collected from eight fields (MI = Michigan, MN = Minnesota, NE = Nebraska, ND = North Dakota) and assayed in controlled environment chambers.

| Soil Source | Root rot index/gram of Tachigaren on seed[Y] | | | |
|---|---|---|---|---|
| | 0 | 20 | 30 | 45 |
| | Aph soil index = 0 | | | |
| Eldred, MN | 0 | 0 | 0 | 0 |
| Mitchell, NE | 2 | 2 | 1 | 1 |
| Watt, ND | 4 | 1 | 3 | 2 |
| Rosenfeldt, ND | 5 | 7 | 6 | 5 |
| Scott, NE | 11 | 8 | 5 | 15 |
| Wegener, MI[Z] | 14 a | 3 b | 2 b | 3 b |
| Knochel, MI | 15 | 11 | 22 | 15 |
| Nielsville, MN[Z] | 82 a | 79 a | 56 b | 60 b |

Y Each root rot value (0 – 100 scale, 0 = healthy, 100 = all seedlings dead) is based on planting 20 seeds/each of six replicates.

Z Values followed by the same letters are not statistically different (values for the remaining six fields show no significant differences among seed treatments ($P$ = 0.05).

At 4 weeks after planting, seedlings in soils from Nebraska, Michigan, and North Dakota were assessed for root rot. Overall, root rot severity was minimal. Never the less, there was a significant and equal reduction in root rot in the soil from Wegener, MI (Aphanomyces soil index = 14) when seed was treated with 20, 30, or 45 g of Tachigaren compared to no Tachigaren (Table 1). For the other five soils, including the soil from Knochel, MI (Aphanomyces soil index = 15), there were no differences in root rot indices for seedlings from seeds treated with Tachigaren compared to no Tachigaren (Table 1).

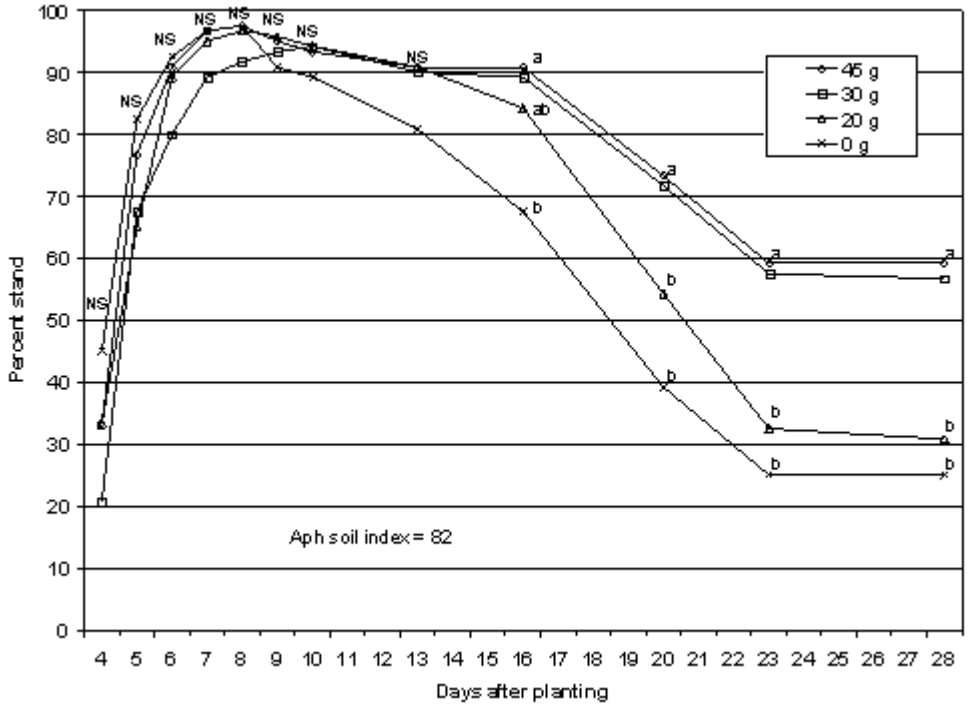


**Fig. 3.** Percent stand of sugarbeet from seed treated with Apron + Thiram and supplemented with 0, 20, or 30 g of Tachigaren/unit on minimum build-up pellets or 45 g of Tachigaren/unit on regular pellets after planting in a field soil with an Aphanomyces soil index of 82. Each data point is based on planting a total of 100 seeds. For each stand count, data points followed by the same letter are not statistically different ($P$ = 0.05); NS = not significant.

In the Nielsville, Minnesota soil, there were no significant differences in early emergence among seed treatments (Fig. 3). The Aphanomyces soil index was high (=82) and damping-off started to occur by 9 days after planting. Stand losses continued to occur across all seed treatments for the remainder of the experiment. Final stands from seed treated with 30 or 45 g of Tachigaren were equal and statistically higher then stands from seed treated with 20 g of Tachigaren or no Tachigaren, which were equally low. Disease ratings of remaining plants also showed that root rot was equally reduced when seed was treated with 30 or 45 g of Tachigaren compared to 20 g or no Tachigaren (Table 1).

**DISCUSSION**

The 20 g rate of Tachigaren on minimum build-up pelleted seed was not phytotoxic in soils with low Aphanomyces soil index values (less than 15) and did not protect seedlings in soils with a high Aphanomyces soil index value (= 82). A significant reduction in root rot, but not final stand, was measured with the 20 g rate of Tachigaren in only one of six fields with low Aphanomyces soil index values. This field had a soil index value of 14, but in another field with a similar index value of 15, Tachigaren seed treatment at all rates did not reduce root rot. When the Aphanomyces soil index value was high (= 82), 20 g of Tachigaren on seed resulted in poor stands and high root rot ratings similar to no Tachigaren, while 30 or 45 g of Tachigaren resulted in significantly higher and equal stands.

Inconsistent results (for stand and root rot ratings) also were noted with the 20 g rate of Tachigaren (on minimum build-up and regular pellets) in 2002 trials (2002 Sugarbeet Research and Extension Reports 33:196-205) and in 2001 trials (*unpublished*) in soils where Aphanomyces soil index values were between 54 and 65. For example, in two of four soils planted with minimum build-up pellets, 20 g of Tachigaren resulted in stands similar to the 30 g rate and these stands were significantly better than no Tachigaren; in one of four soils, 20 g of Tachigaren resulted in stands intermediate between the 30 g rate and no Tachigaren; and in 1 of 4 soils, 20 g of Tachigaren resulted in low stands equal to no Tachigaren and these stands were lower than attained with the 30 g rate. Similarly, in one of four soils planted with regular pellets, 20 g of Tachigaren resulted in stands similar to 30 and 45 g, which were significantly better than no Tachigaren; in 1 of 4 soils, 20 g of Tachigaren resulted in stands intermediate between higher rates and no Tachigaren; and in 2 of 4 soils, 20 g of Tachigaren resulted in low stands equal to no Tachigaren and these stands were considerably lower than attained with 30 and 45 g rates.

In general, the lower the amount of Tachigaren on seed, the lower the level of protection and the shorter the duration of that protection. The 45 g rate provides protection for 3 to 4 weeks, while 75 g extends protection to about 5 to 6 weeks after planting. In moderately infested fields, the 20 g rate of Tachigaren provides inconsistent, minimal (or no) protection; effectiveness of 30 g is generally somewhere between 20 and 45 g; and the best results are attained with the 45 g rate.

The recent registration of 20 and 30 g of Tachigaren on minimum build-up pellets offers new options to sugarbeet producers, however, questions have been raised regarding where these rates can be used to best advantage. The 20 g rate may be most applicable in fields with no history of Aphanomyces that are located in a region where the disease occurs or in fields with very low Aphanomyces soil index values. For producers who want to be proactive, this minimum rate offers some protection in minimizing disease potential. In fields with moderate Aphanomyces soil index values, 30 g of Tachigaren offers reasonably good protection of seedlings similar to, but not consistently as good as, that attained with 45 g of Tachigaren. Fields with moderate to high Aphanomyces soil index values will benefit most when sown with seed treated with 45 g of Tachigaren. When soil is warm and wet during the first month after planting and *A. cochlioides* infects seedlings, the 45 g rate will maintain higher stands than lower rates of Tachigaren and for stand that remains, there will be less root rot.

The greatest risk of early-season damping-off in the RRV occurs in mid to late May when planting is delayed or in replant situations. In southern Minnesota, however, warm and wet soil conditions more typically occur shortly after planting. Fields where Aphanomyces diseases have not been seen early in the season but where they occur later in the season, however, are at risk for seedling disease problems in warm, wet springs.

**CONCLUSIONS AND RECOMMENDATIONS**

1. Producers interested in planting Tachigaren-treated seed should consider the Aphanomyces history of individual fields, soil and weather conditions, and the cost of this seed treatment verses benefits.

2. The 20 g rate of Tachigaren/unit of seed did not delay initial emergence; the 45 g rate initially slowed emergence slightly compared to lower rates of Tachigaren and the non-treated control but within an additional 1 to 3 days, stand was excellent and equal for all seed treatments.

3. The 20 g rate of Tachigaren may be most applicable in fields with no history of Aphanomyces that are located in a region where the disease occurs and, in fields with very low Aphanomyces soil index values.

4. The 30 g rate of Tachigaren offers reasonably good protection of seedlings similar to, but not consistently as good as, that attained with 45 g of Tachigaren in fields with moderate Aphanomyces soil index values.

5. The 45 g rate of Tachigaren provides better and more consistent protection than 30 g in fields with moderate Aphanomyces soil index values.

6. The 45 g rate of Tachigaren (or higher rates) are necessary in fields with high Aphanomyces soil index values and ideally, these fields should not be planted to sugarbeet in wet growing seasons.

7. Tachigaren should be applied to varieties with partial resistance to Aphanomyce*s*.

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