Efficacy of Metalaxyl in Controlling Phytophthora Root and Stalk Rot of Soybean Cultivars Differing in Field Tolerance

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ABSTRACT

Chemical control of root and stalk rot of soybean caused by Phytophthora megasperma Drechs. f. sp. glycinea (Hildebr.) Kuan and Erwin was tested under field conditions with four soybean cultivars differing in field tolerance to the disease. The systemic fungicide metalaxyl was used as an in-furrow treatment at 0.25, 0.5, and 0.75 kg a.i./ha applied with the seed at planting. Metalaxyl did not affect emergence. Metalaxyl treatments reduced plant losses during the season in extremely susceptible and susceptible cultivars but not in moderately susceptible and tolerant soybean cultivars. Rates of metalaxyl up to 0.75 kg a.i./ha did not reduce percent of plant loss in extremely susceptible cultivar plots of the level equivalent to plant loss in the tolerant cultivar plots. Yield was increased and plant loss decreased in the extremely susceptible OX20-8 by metalaxyl treatments ranging from 0.5 to 1.5 kg a.i./ha.

The development and introduction of soybean (Glycine max (L.) Merr.) cultivars that exhibit tolerance to root rot caused by Phytophthora megasperma Drechs. f. sp. glycinea (Hildebr.) Kuan and Erwin (6) (Pmg) has resulted in low plant losses in commercial fields in southwestern Ontario (2).

Tolerance to root and stalk rot caused by Pmg is defined as a relative characteristic determined by the degree of plant loss or reduction in growth or yield in the presence of Pmg races for which a soybean cultivar lacks specific genes for resistance. At present, the planting of tolerant cultivars, e.g., Harcor (4), provides the most effective method of disease control in Ontario. However, additional methods of control should be investigated because the extent of plant loss or stunting of tolerant cultivars may be more severe on compacted or waterlogged soils. In addition, cultivars susceptible to Pmg may have valuable agronomic characteristics such as seed quality, high yield, or resistance to other diseases, which could not be exploited with the present method of control.

Vaartaja et al (9) reported that in-furrow application of the systemic fungicide CGA-48988 (metalaxyl) at planting significantly decreased stand loss from Pmg root rot and increased yields of a susceptible soybean cultivar (Steele). Recently, Abney and Scott (1) reported the efficacy of metalaxyl in reducing Pmg root rot in Indiana. Papavizas et al (7) reported that metalaxyl reduced disease but did not increase plant stands or yields in Kansas.

Few studies have been made on plant losses in tolerant cultivars treated with metalaxyl. Stands and yields of tolerant cultivars were improved more than those of nontolerant cultivars by treatment with metalaxyl (8).

The purpose of this research was to establish minimum rates of metalaxyl required to reduce Pmg infection of susceptible and tolerant soybean cultivars under field conditions and to determine the yield response of an extremely susceptible cultivar to metalaxyl treatments.

MATERIALS AND METHODS
Four cultivars representing a range of field tolerance to root and stalk rot caused by Pmg were chosen from preliminary test results (3). The four cultivars react with specific resistance to hypocotyl inoculation using Pmg race 1, but they are susceptible to the races that are currently predominant in Ontario. OX20-8 (a Harrow line), Steele, Amsoy 71, and Harcor were rated as extremely susceptible, susceptible, moderately susceptible, and tolerant, respectively, in the field tests.

Experiments were conducted at Woodlee in southwestern Ontario in an area consisting of Brookston clay loam with a history of root rot. The area was fall-plowed in 1978 and fall-plowed and leveled in 1979; spring tillage consisted of disking prior to planting. Fertilizer (8-32-16) was applied at the rate of 500 kg/ha, and chloramben was applied as a pre-emergence herbicide at 4.5 kg a.i./ha.

Field plots were planted in 4-m rows at a planting rate of 100 seeds per row with a row width of 50 cm. Metalaxyl was applied as a 5% granular formulation in the furrow with the seed at planting. Experiments were planted 5 June 1978 and 23 May 1979. Percentage of plant loss was calculated from differences in plant stands between 5 July and 20 September in 1978 and between 27 June and 30 August in 1979. The plots were examined periodically to determine that plant losses were caused by root and stalk rot. Pmg was isolated from a random sample of dying plants with characteristic symptoms of the disease during both seasons.

In a four-replicate, split-plot experiment conducted in 1978 and 1979, four cultivars were planted in four-row, randomized main plots with metalaxyl applied at rates of 0.00, 0.25, 0.50, and 0.75 kg a.i./ha on single-row, randomized subplots of each cultivar.

The effect of metalaxyl treatments on yield of OX20-8 was evaluated in a nine-replicate, randomized block experiment conducted in 1979. Four-row plots were treated with metalaxyl at 0.0, 0.5, 1.0, or 1.5 kg a.i./ha applied in-furrow with the seed at planting. Dead plants were counted and removed from plot rows at 1-2 wk intervals from seedling emergence until 30 August. Yield was determined at maturity by harvesting 2.5 m from each of the two center rows of each plot.

Unless otherwise indicated, significant differences are based on a 5% level of probability.

RESULTS
Averaged over 2 yr, metalaxyl treatments did not significantly increase or decrease seedling emergence in any of the four cultivars compared with the untreated controls. Seedling emergence was significantly different between 1978 (85%) and 1979 (64%). In 1978, plant emergence proceeded normally; in 1979, however, emergence was delayed 1-2 wk by cool, wet weather following planting. There was a significant cultivar × year interaction for emergence, and cultivars did not differ when averaged over both years.

The efficacy of metalaxyl in reducing Pmg root and stalk rot varied with the susceptibility of each soybean cultivar (Table 1). Plant losses of OX20-8 were significantly higher in all treatments compared with losses of the other
OX20-8 increased with a metalaxyl treatment of 0.5 kg a.i./ha, and plant loss was reduced by 24% compared with the control plot. In addition, yield was increased and plant loss was reduced an additional 10% by a treatment of metalaxyl at 1.0 kg a.i./ha compared with treatment at the 0.5 kg a.i./ha. The results suggest that soybean plant losses of 10–24% during the growing season reduce soybean yields. These results are in agreement with those of Vaartaja et al. (9).

OX20-8 is extremely susceptible and has shown high plant losses in other tests (3) where conditions favored development of disease. In this study, each increment of metalaxyl significantly reduced plant loss. Increments of metalaxyl from 0.0 to 0.5 and from 0.5 to 1.0 kg a.i./ha significantly increased the yield of OX20-8, and there was an upward trend at 1.5 kg a.i./ha. We conclude that, under conditions favorable for the development of Pmg root rot, high rates of metalaxyl would have to be applied to extremely susceptible cultivars to provide control equivalent to that provided by tolerant cultivars.

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LITERATURE CITED