Control of Brown Stripe Downy Mildew of Maize by Metalaxyl

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ABSTRACT

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Seed treatment with metalaxyl at 4 g/kg controlled brown stripe downy mildew (*Sclerophthora rayssiae* var. *zeae*) of maize up to 30 days after planting. When combined with seed treatment, one foliar application of metalaxyl (225 ppm) on the 30th day after planting resulted in excellent disease control and increased grain yield and 1,000 kernel weight.

Brown stripe downy mildew (BSDM) (*Sclerophthora rayssiae* var. *zeae* Payak and Renfro) on maize occurs in India, Nepal, Thailand, Pakistan, and Bangladesh (3). In India, it has been most severe in Uttar Pradesh, Himachal Pradesh, southern Rajasthan, Punjab, and hilly parts of West Bengal, especially in areas that receive 100–200 cm of precipitation (6,10). It has caused 63% loss in the Tarai area of Uttar Pradesh (9). Although extensive studies have been done on chemical control of maize downy mildews incited by *Sclerospora*, little information is available on BSDM (1,2,6–8,11,13). Its severity has been reduced by six sprays of mancozeb (0.3%) or by three sprays of either triphenyltin chloride or triphenyltin acetate (6,8,9).

Because maize is predominantly a rainy season crop in India and neighboring countries, fungicides are washed off the foliage, rendering the sprays less effective. The present investigation reports for the first time effective control of BSDM by seed treatment and one foliar spray with metalaxyl.

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MATERIALS AND METHODS

Four field experiments were done with metalaxyl (25 WP) to control BSDM at Pantnagar during 1977 and 1978.

In the first experiment 2, 4, 6, 8, 10, and 12 g of metalaxyl slurry was used per kilogram of seed of susceptible hybrid VL-54. Based on the results of the first experiment, in the second experiment, seeds of hybrids VL-54 and Ganga 5 were slurry treated with 4g/kg (Table 1). In the third experiment, one or two foliar sprays were applied 30 and 40 days after planting hybrid VL-54, with or without seed treatment (Table 2). In the fourth experiment, maize cultivars Ganga 5, Ganga 2, J 603, and VL-54 were planted

Table 1. Effect of metalaxyl seed treatment (4 g/kg) on the incidence of brown stripe downy mildew (BSDM)

Cultivar	BSDM incidence[a] Days after planting 30	40	50	60	1,000 grain wt (g)	Yield (kg/ha)
Ganga 5						
Treated	1.0	1.9	2.2	2.5	250.7	5,309
Control	2.0	2.2	2.3	2.5	240.3	4,952
VL-54						
Treated	1.3	2.3	3.0	3.5	239.7	5,019
Control	2.5	3.0	3.2	3.5	212.8	4,503
LSD ($P = 0.05$)	0.8	NS	NS	NS	NS	NS

[a] Scale: 1 = no infection; 2 = light infection, with stripes on lower leaves; 3 = moderate infection abundant stripes on lower leaves and a few on middle leaves; 4 = heavy infection, stripes abundant on lower and middle leaves, extending to upper leaves; and 5 = very heavy infection, stripes abundant on all leaves, no cob formation, premature death of plants.

with metalaxyl-treated seed alone or combined with one foliar spray (Table 3).

The randomized block design consisted of 15 m^2 plots, with four replications. The row-to-row and plant-to-plant distance was 0.75 and 0.25 m, respectively. Untreated seeds and unsprayed plants served as controls. Other agricultural operations were those recommended for maize cultivation. Check rows of resistant variety Tarun were planted lengthwise around each plot to minimize interplot spread of disease and to avoid chemical drift from one plot to another.

Artificial epiphytotic conditions were created by placing 2–3 cm pieces of freshly infected leaves containing sporangia of *S. rayssiae* var. *zeae* in the whorls of seedlings; this was done during cloudy weather between 5 and 7 p.m. 17, 24, and 30 days after planting.

Twenty plants from each plot were selected randomly and rated individually on a 0-5 scale 30, 40, 50, and 60 days after planting. Grain weight and 1,000 kernel weight were recorded from the same 20 plants. The values were averaged and analyzed statistically.

RESULTS AND DISCUSSION

Treatment with a metalaxyl slurry at 4–12 g/kg significantly checked the disease up to 30 days after planting; a 2 g/kg treatment was not effective. In plots planted with VL-54 and Ganga 5 seeds treated with 4 g/kg metalaxyl slurry, disease intensity was significantly reduced for 30 days after planting (Table 1). In VL-54, initial symptoms were observed 26 days after planting in treated plots and 14 days after planting in control plots. The disease was present in traces on the 30th day and then increased rapidly, but the differences in disease intensity became insignificant after 40 days. Grain yield and 1,000 kernel weight were greater in treated than in control plots, but the differences were insignificant. These observations indicate that a 4 g/kg metalaxyl slurry treatment controlled BSDM for only 30 days after planting.

Up to 8 g/kg metalaxyl in slurry had no effect on seed germination, seedling vigor, or flowering time. Treatment with 10 g/kg or more had a slight adverse effect on seed germination and seedling growth, but this depressive effect on plant growth disappeared 2 wk after planting. Recently, seed, foliar, or soil application of metalaxyl has been found to control downy mildews incited by species of *Sclerospora, Pseudoperonospora humili, Peronospora tabacina, P. parasitica,* and *Plasmopara viticola* (2,4,11,12,14). Seed treatment alone sometimes completely controls *Sclerospora*-incited downy mildews of maize. Sclerospora downy mildews occur during the early stage of seedling growth, up to 4 wk after planting (then plants become resistant), whereas maize plants remain susceptible to *S. rayssiae* var. *zeae* up to the flowering stage (5,10). Apparently this is why seed treatment could not protect the maize crop from BSDM for such a long period.

Metalaxyl slurry treatment at 4 g/kg, combined with one or two sprays, significantly reduced the intensity of BSDM throughout the crop season (Table 2). Seed treatment combined with one foliar spray also effectively controlled the disease and increased grain yield and 1,000 kernel weight in the three susceptible cultivars, VL-54, J 603, and Ganga 2 (Table 3).

There were insignificant differences between the slurry treatment and one or two sprays. One or two foliar sprays without seed treatments did not effectively control BSDM. There was only insignificant disease control and increase in yield and kernel weight in the comparatively resistant hybrid Ganga 5. Grain yield and kernel weight were comparatively greater in highly susceptible cultivars VL-54 and J 603 than in moderately susceptible Ganga 2.

Based on the results of these experiments, we conclude that metalaxyl slurry treatment (4 g/kg) and one foliar spray (225 ppm, a.i.) about the 30th day after planting could control BSDM of maize and significantly increase yield.

Table 2. Effect of metalaxyl seed treatment (4 g/kg) and foliar spray (225 ppm) on brown stripe downy mildew (BSDM) in maize hybrid VL-54

Treatment	BSDM incidence[a] Days after planting 30	40	50	60	1,000 grain wt (g)	Yield (kg/ha)
Seed	1.2	2.2	2.9	3.5	225.2	4,252
+ one spray[b]	1.2	1.3	1.5	1.8	254.1	5,190
+ two sprays[c]	1.2	1.3	1.4	1.6	255.2	5,308
One spray[b]	2.5	2.7	3.0	3.4	192.4	4,187
Two sprays[c]	2.4	2.7	2.8	3.0	230.6	4,296
Control	2.5	3.0	3.2	3.5	190.7	3,875
LSD ($P = 0.05$)	0.8	0.9	0.9	1.1	38.9	508

[a] Scale 1 = no infection; 2 = light infection, with stripes on lower leaves; 3 = moderate infection, abundant stripes on lower leaves and a few on middle leaves; 4 = heavy infection, stripes abundant on lower and middle leaves, extending to upper leaves; and 5 = very heavy infection, stripes abundant on all leaves, no cob formation, premature death of plants.
[b] Plots sprayed 30 days after planting.
[c] Plots sprayed 30 and 40 days after planting.

Table 3. Effect of seed treatment (4 g/kg) and one foliar spray of metalaxyl on brown stripe downy mildew (BSDM) in four maize cultivars

Cultivar Treatment	BSDM[a]	1,000 grain wt (g)	Yield (kg/ha)
Ganga 5			
Seed treatment	2.5	248.2	5,008
Seed and foliage treatment	1.2	265.9	5,242
Control	2.5	226.5	4,874
Ganga 2			
Seed	2.7	249.3	5,018
Seed and foliage	1.3	270.8	6,159
Control	2.8	253.1	4,659
J 603			
Seed	3.4	201.5	4,157
Seed and foliage	1.5	258.2	5,013
Control	3.5	195.0	3,742
VL-54			
Seed	3.6	205.8	4,359
Seed and foliage	1.7	249.2	5,328
Control	3.8	182.1	4,019
LSD ($P = 0.05$)	0.9	43.4	635

[a] Scale: 1 = no infection; 2 = light infection, with stripes on lower leaves; 3 = moderate infection, abundant stripes on lower leaves and a few on middle leaves; 4 = heavy infection, stripes abundant on lower and middle leaves, extending to upper leaves; and 5 = very heavy infection, stripes abundant on all leaves, no cob formation, premature death of plants.

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