

Chemical Control of Sorghum Downy Mildew in India

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ABSTRACT

ANAHOSUR, K. H., and S. H. PATIL. 1980. Chemical control of sorghum downy mildew in India. *Plant Disease* 64:1004-1006.

Metalaxyl (Ridomil) 25 WP applied as a seed treatment at 1 g a.i./kg of seed and sprayed once 40 days after planting at 1 g a.i./L and 750 L/ha completely controlled both systemic infection and local lesions of downy mildew in sorghum. Infected plants sprayed once with metalaxyl 25 WP at 1 g a.i./L 40 days after planting recovered and produced normal heads. Seed treatment alone with metalaxyl 25 WP and 35 SD at 1 and 2 g a.i./kg of seed provided no protection against late systemic infection on main shoots or nodal tillers or against local lesions on leaves.

Downy mildew of sorghum caused by *Peronosclerospora sorghi* (Weston & Uppal) C. G. Shaw is a potentially destructive disease in areas of Karnataka, Tamil Nadu, Andhra Pradesh, and Maharashtra (5,8), where well-distributed rains provide high levels of humidity and temperatures are optimal for disease development. Local lesions develop quickly and cause premature drying of leaves.

Various chemicals have been found to control this disease (1,3,4,6). We tested the efficacy of several new chemicals during the rainy season of 1978 and 1979 at the Agricultural College farm in Dharwad (altitude 678 m). During July–October of 1978 and 1979, rainfall averaged 92 cm, temperature averaged 23 C, and relative humidity averaged 91%. Under these conditions, sorghum downy mildew appears in epiphytotic form under artificial inoculation conditions every year.

MATERIALS AND METHODS

We tested the following fungicides at rates and times given in Table 1: metalaxyl (Ridomil) 25 WP and 35 SD, triadimenol (BAY KWG 0519) (25 WP), KT 19827 (antibiotic obtained from M. M. Payak, I.A.R.I., New Delhi-12, India), and mancozeb (75 WP). A slurry method was used to treat seeds. Foliar sprays were applied with a hand compression sprayer. Checks (untreated controls) were also maintained.

The trial was conducted in randomized block design with 2.7 × 4.5 m plots at 45 × 15 cm spacing with three replications. CSV-2, a sorghum cultivar susceptible to the *P. sorghi* strain in India, was sown

during the second week of July. The infector (spreader) row planting method of inoculation, where plants are exposed to both oospore and conidial inoculum, was followed (2).

Observations of systemic infection of main shoots and nodal tillers and local lesions on leaves were recorded 30 days and 75 days (dough stage) after planting. Local lesions were scored on a scale of 1–5 (7), where 1 = water-soaked spots 0.2–0.6 mm long; 2 = leaf discoloration in yellow area; 3 = spots appearing yellow on the upper surface of the leaf with fungus growth on the lower surface; 4 = spots turning to brown with reduced

white masses; and 5 = dark grayish or brown spots with dried leaf area. The percentage data were transformed ($\sqrt{x+1}$) and analyzed statistically (Tables 2 and 3).

RESULTS

During 1978 (Table 2), metalaxyl (25 WP) seed treatment plus one spray 40 days after planting completely controlled local lesions and systemic infection compared with the check. Metalaxyl (25 WP) seed treatment alone controlled disease symptoms for 30 days, but after 75 days, systemic infection had increased to 1.9% and 19.3% on the main shoot and nodal tillers, respectively, and local lesions had reached grade 3.

BAY KWG 0519, mancozeb, and KT 19827 were ineffective compared with metalaxyl. Hence, during 1979 a second test was made to determine the efficacy of two formulations of metalaxyl (Table 3). Seed treatment plus one spray 40 days after planting was significantly superior to seed treatment alone in controlling the disease. Seed treatment alone with 1 and 2 g metalaxyl (25 WP and 35 SD) controlled local lesions and systemic infection on the main shoot for 30 days

Table 1. Fungicide treatments for control of *Peronosclerospora sorghi* in sorghum

Treatment	Method and rate of application		Time of application
	Seed (slurry) (g a.i./kg)	Foliar spray (g a.i./L)	
Metalaxyl (25 WP)	1	...	Before sowing
Metalaxyl (25 WP)	2	...	Before sowing
Metalaxyl (35 SD)	1	...	Before sowing
Metalaxyl (35 SD)	2	...	Before sowing
BAY KWG 0519 (25 WP)	0.5	...	Before sowing
KT 19827	5	5	Seed treatment before sowing plus three foliar sprays at 10-day intervals beginning 10 days after planting
Metalaxyl (25 WP)	1	1	Seed treatment before sowing plus one spray 40 days after planting
Metalaxyl (25 WP)	2	2	Seed treatment before sowing plus one spray 40 days after planting
Metalaxyl (25 WP)	...	1	One spray 40 days after planting
Metalaxyl (25 WP)	...	2	One spray 40 days after planting
Mancozeb (75 WP)	...	3	Four sprays at 7-day intervals beginning 7 days after planting

Table 2. Effect of fungicides on systemic infection and local lesions of downy mildew in sorghum, 1978

Treatment	30 days after planting		75 days after planting		
	Systemic infection on main shoot ^a (%)	Local lesions (grade)	Systemic infection ^a (%)		Local lesions (grade)
			On main shoot	On nodal tillers	
Seed treatment only					
Metalaxyl (25 WP) 1 g a.i./kg	0.0 (1.0)	1	1.9 (1.7)	19.3 (4.5)	3
BAY KWG 0519 (25 WP) 0.5 g a.i./kg	17.7 (4.3)	3	37.8 (6.2)	22.3 (4.2)	3
Seed treatment plus spray					
KT 19827 5 ml/kg + 5 ml/L	16.2 (4.1)	3	26.2 (5.2)	26.8 (5.3)	3
Metalaxyl (25 WP) 1 g a.i./kg + 1 g a.i./L	0.0 (1.0)	1	0.0 (1.0)	0.0 (1.0)	1
Spray only					
Mancozeb (75 WP) 3 g a.i./L	13.3 (3.7)	3	22.4 (4.8)	22.4 (4.8)	3
Check (untreated control)	37.7 (6.2)	3	84.0 (9.2)	12.7 (3.7)	3
LSD (<i>F</i> test, <i>P</i> = 0.05)	0.8		0.7	0.5	
Standard error of means	±0.2		±0.3	±0.2	

^a Numbers in parentheses are transformed values ($\sqrt{x+1}$).

Table 3. Effect of metalaxyl treatments on systemic infection and local lesions of downy mildew in sorghum, 1979

Treatment	30 days after planting		75 days after planting		
	Systemic infection on main shoot ^a (%)	Local lesions (grade)	Systemic infection ^a (%)		Local lesions (grade)
			On main shoot	On nodal tillers	
Seed treatment only					
35 SD 1 g/kg	0.8 (1.3)	1	14.6 (3.9)	10.8 (3.4)	3
35 SD 2 g/kg	0.4 (1.2)	1	7.3 (2.8)	11.1 (3.5)	3
25 WP 1 g/kg	1.1 (1.4)	1	12.6 (3.7)	4.7 (2.4)	3
25 WP 2 g/kg	0.0 (1.0)	1	7.1 (2.8)	6.2 (2.7)	3
Seed treatment plus spray					
25 WP 1 g/kg + 1 g/L	0.0 (1.0)	1	0.0 (1.0)	0.0 (1.0)	1
25 WP 2 g/kg + 2 g/L	0.0 (1.0)	1	0.0 (1.0)	0.0 (1.0)	1
Spray only					
25 WP 1 g/L	47.1 (6.5)	3	5.8 (2.6)	4.5 (2.3)	1
25 WP 2 g/L	55.0 (7.5)	3	10.2 (3.3)	2.6 (1.9)	1
Check (untreated control)	53.8 (7.4)	3	71.3 (8.5)	25.4 (5.1)	3
LSD (<i>F</i> test, <i>P</i> = 0.05)	0.5		0.9	0.8	
Standard error of means	±0.3		±0.4	±0.4	

^a Numbers in parentheses are transformed values ($\sqrt{x+1}$).

but not 75 days. Spray alone with metalaxyl (25 WP) at 1 and 2 g a.i./L reduced systemic infection on the main shoot from 47.1% to 5.8% and from 55.0% to 10.2%, respectively, and lowered the severity of local lesions from grade 3 to grade 1, indicating recovery of the infected plants.

DISCUSSION

Metalaxyl proved excellent in controlling sorghum downy mildew (6). Our trials indicated that metalaxyl seed treatment alone at 2 g a.i./kg did not provide complete control of systemic infection on main shoots or nodal tillers, late systemic infections, or local lesions. Late-maturing plants developed late

systemic infection after 30 days. In late-maturing cultivars grown near Dharwad, downy mildew generally appears relatively late. A combination of seed treatment and one spray with metalaxyl (25 WP) 40 days after planting therefore controls all symptoms until harvest. Metalaxyl's effectiveness appears to be limited to 3-4 wk, necessitating spraying 40 days after planting.

The reduction in symptoms following one spray of metalaxyl (25 WP) 40 days after planting (Table 3) indicates the curative effects of metalaxyl. Affected plants after recovery produced normal heads (compared with no heads or only sterile heads in unsprayed plants); had considerable thickening of leaves; and

produced no conidia, oogonia, or oospores. Leaves later turned green, compared with browning and shredding in unsprayed plants. We conclude that spraying with metalaxyl (25 WP) at 1 g a.i./L and 750 L of spray mixture per hectare when a disease outbreak is noticed would help to control systemic infection and local lesions.

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