

EFFECT OF STORAGE OF METALAXYL TREATED SEED ON DOWNY MILDEW OF PEARL MILLET

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ABSTRACT

Two formulations of the systemic fungicide metalaxyl were used as seed treatment for the control of pearl millet downy mildew in seven field experiments with downy mildew susceptible pearl millet hybrid NHB-3. The treated seeds were stored at 5, 12, 25-30, 40 and 45°C and sown after 7, 60, 120, 180, 240, 300 and 360 days storage. Significant reduction in downy mildew was obtained with all fungicide treatments under severe downy mildew pressure. Storage temperatures for 7, 60, 120, 180, 240, 300 and 360 days did not affect seed germination. The plots sown with metalaxyl 35 SD (2 g a.i./kg) treated seeds stored at 12, 28-30 and 40°C for a period of 7 days developed significantly less downy mildew than check plots. There were no significant differences among the plots sown with treated seed. The grain yields from the treated plots were also significant. Downy mildew incidence in the plots sown with metalaxyl 25 WP (2 g a.i./kg) treated seeds stored at 5, 12, 25-30 and 45°C for 60, 120, 180, 240, 300 and 360 days was significantly less than the untreated plots with consequent increase in grain yield. However, plots sown with treated seeds stored at 45°C had more downy mildew than plots sown with treated seeds stored at other temperatures.

INTRODUCTION

Downy mildew, caused by *Sclerospora graminicola* (Sacc.) Schroet., is the most widespread and destructive disease of pearl millet (*Pennisetum americanum* (L.) Leeke) in India. The systemic fungicide metalaxyl, methyl N-(Z-methoxyacetyl) N-(2, 6-Xylyl)-DL-alaninate (Ridomil, Apron, Ciba Geigy Ltd.), has been reported to be very effective for the control of downy mildew of sorghum, maize and pearl millet as seed dressing (Venugopal and Safeulla, 1978; Siradhana *et al.*, 1979; Sangam Lal *et al.*, 1980; Anahosur and Patil, 1980; Muthusamy and Narayanasamy, 1981; Williams and Singh, 1981; Singh, 1983; Subramanya *et al.*, 1982; Dang *et al.*, 1983). In the present study the effect of temperatures and storage duration on the efficacy of metalaxyl in controlling downy mildew of

pearl millet was investigated and the results are reported in this paper.

MATERIALS AND METHODS

The experiments were conducted at the College Farm of the Andhra Pradesh Agricultural University (APAU), Rajendranagar (Expt. 1, metalaxyl 35 SD trial) and at the ICRISAT Centre during the rainy seasons of 1980 (Expt. 1, metalaxyl 35 SD trial) and 1981 (Expts. 2 to 4, metalaxyl 25 WP trials) and in the post-rainy season of 1981 (Expts. 5 to 7, metalaxyl 25 WP trials).

The downy mildew susceptible hybrid NHB-3 was used. In experiment 1, the plot size was 4.5 m × 2.7 m with a spacing of 45 cm × 15 cm and each treatment was repeated in three replications in a randomized block design (RBD)

The experiments 2 to 7 were conducted in four 4 m row plots, with 75 cm × 5 cm and each treatment was repeated in four replications in RBD.

Metalaxyl (Apron 35 SD) formulation was applied to seeds by thoroughly shaking dry seeds with the fungicide (6 g product/kg seed). The treated seeds were stored at 12, 28.3 and 40°C for 7 days. It was not tested for other storage durations because of the limited availability of the product.

Metalaxyl (Ridomil 25 WP) formulation was thoroughly shaken with dry seeds (8 g product/kg seed) and the treated seeds were stored at 5, 12, 25-30 and 45°C for periods of 2, 4, 6, 8, 10 and 12 months in experiments 2 to 7. Untreated seed stored at these temperatures were used to plant check plots.

The sick plot at the College Farm (APAU) and a part of the ICRISAT downy mildew nursery, where the trials were conducted, contained unknown numbers of oospores. Sporangial inoculum was continually provided throughout the period of crop growth by planting infector rows early. At ICRISAT Centre, mist irrigation was provided for 30 min in the late evenings, three times a week, which is necessary for the process of dissemination and infection. In expt. 1, downy mildew incidence was recorded at weekly intervals beginning 30 days after planting (DAP) and in all other experiments, the incidence was recorded 25, 45 and 75 DAP. At the first two records, small, red topped bamboo pegs were placed beside infected plants, so that plants died (due to heavy infection at early stage) could still be counted at later rating. At the final recording at 75 DAP, each plant was

rated following the scale given by Singh (1983). In experiments conducted during the post-rainy season with metalaxyl WP treated seeds stored at different temperatures for periods of 8, 10 and 12 months, incidence and severity were recorded separately in each row.

In experiments conducted with metalaxyl SD and metalaxyl WP during 1981 rainy season, whole plot grain yield was recorded. In experiments conducted during the 1981 post-rainy season, the grain yield was recorded from each row of the test plot separately.

RESULTS AND DISCUSSION

There appeared to be no adverse effect of storage temperatures on seed germination as is evident from Tables 1 and 2.

Plots sown with metalaxyl SD seeds stored at 12, 28-30 and 40°C developed less than 5 per cent downy mildew until 44 DAP. Though all the treated plots had significantly less downy mildew than the untreated check on all scoring dates, disease incidence greatly increased in all plots after 58 DAP. The grain yields of the plots planted with treated seeds were inversely related to the infection indices, but the differences among the plots were not significant. Mean grain yield of the treated plots was 286 per cent of the grain yield of the check plot (Table 3).

The effects of storing metalaxyl WP treated seeds at 5, 12, 25-30 and 45°C for 2, 4, 6, 8, 10 and 12 months on the incidence, severity, green ear production and yield are presented in tables 4 and 5. Increase in temperatures and crop age were associated with increase in downy mildew incidence. Plots sown with

TABLE 1. Percentage germination of NHB-3 seeds treated with metalaxyl (Apron 35 SD) after 7 days of storage

Storage temperature (°C)	Germination (%)
12	98.00 (82.05)
28-30	97.67 (81.53)
40	97.67 (81.26)
Check	98.67 (83.46)
'F' test	NS
S.Em ±	1.17
C.D. at 5%	—

TABLE 2. Percentage germination of NHB-3 seeds treated with metalaxyl (Ridomil 25 WP) after 2, 4, 6, 8, 10 and 12 months after storage

Storage temp. (°C)	Germination (%)					
	2 MAS	4 MAS	6 MAS	8 MAS	10 MAS	12 MAS
5	97.00 (80.12)	98.57 (83.46)	97.00 (80.12)	98.00 (81.87)	98.00 (81.87)	98.67 (83.98)
12	97.00 (80.12)	98.00 (81.87)	97.67 (81.26)	99.83 (86.08)	98.33 (83.98)	98.67 (83.98)
25-30	97.67 (81.26)	98.67 (83.64)	98.33 (82.67)	98.33 (82.76)	97.67 (81.26)	98.00 (81.87)
45	98.67 (83.46)	98.67 (83.46)	98.67 (83.46)	99.33 (86.08)	99.33 (86.08)	99.33 (86.08)
Check	98.67 (83.46)	98.67 (83.46)	98.67 (83.46)	100.00 (88.19)	100.00 (88.19)	100.00 (88.19)
'F' test	NS	NS	NS	NS	NS	NS
S.Em ±	1.12	0.77	0.68	2.52	2.57	1.55
C.D. at 5%	—	—	—	—	—	—

Mean of three replications MAS : Months after storage
Data in parenthesis are arcsin transformed values

TABLE 3. Effect of storage of metalaxyl (Apron 35 SD) treated seeds at different temperatures for a period of 7 days on downy mildew incidence, infection index (INFINDX) and grain yield of NHB-3

Storage temperature (°C)	Incidence (%)	INFINDX (%)	Grain yield (kg/ha)
12	29.82 (32.99)	13.28 (21.69)	1360.66
28-30	31.12 (13.87)	14.66 (22.49)	1185.00
40	34.54 (35.97)	16.95 (24.26)	1173.00
Check	53.92 (47.25)	34.09 (35.71)	527.00
'F' test	*	**	**
S.Em ±	2.29	1.19	69.75
C.D. at 5%	7.95	4.12	241.43

Data in parenthesis are arcsin transformed values

treated seeds stored at 5, 12 and 25-30°C for all durations developed significantly less downy mildew than plots sown with untreated seeds and plots sown with treated seeds stored at 45°C. Severity was related to incidence and with a few exceptions it was more than 10 per cent in all the treatments. Similar to incidence, severity in 5, 12, and 25-30°C treatments was significantly less than untreated check and 45°C treatment. Production of green earheads was recorded in 8, 10 and 12 months storage treatments. The green ear incidence in 5, 12 and 25-30°C treatments was significantly less than check plots and plots sown with treated seed stored at 45°C. The results also reveal that there was no influence of the infector rows on the test rows nearer to them with respect to incidence, severity, green ear incidence and grain yield. Irrespective of disease incidence, severity and green ear production, plots planted

with treated seed stored at 5°C for all durations gave the highest yield and it was significantly higher than un-treated plot yield and yield from plots planted with treated seed stored at 45°C. Kothari *et al.* (1980) also reported that there was no negative effect of metalaxyl (Apron 36 SD) on the germination of Ganga-5 maize seeds after one year of storage and that the effectiveness of this fungicide in controlling *Personospora* downy mildew of maize remained unchanged even after more than an year of storage. However, Singh (1983) observed that the toxicity of the fungicide greatly varied with cultivar and rate of seed treatment.

The results from this study show that if treated seeds are to be stored for a short period (about a week), they can be stored at as high a temperature as 40°C. In case treated seeds are to be stored for more than 2 months, it is ad-

TABLE 4. Effect of storage of metalaxyl (Ridomil 25 WP) treated seeds at different temperatures for periods of 2, 5 and 6 months on downy mildew incidence, infection index (INFINDX) and grain yield of NHB-3.

Storage temperature (°C)	2 months after storage			4 months after storage			6 months after storage		
	Incidence (%)	INFINDX (%)	Grain yield(kg/ha)	Incidence (%)	INFINDX (%)	Grain yield(kg/ha)	Incidence (%)	INFINDX (%)	Grain yield(kg/ha)
5	17.37 (24.54)	8.77 (17.10)	1170.75	18.69 (24.63)	10.05 (17.56)	1253.50	25.81 (30.44)	15.81 (23.23)	1183.50
12	19.19 (25.96)	10.19 (18.48)	1093.50	25.78 (29.93)	12.57 (20.33)	1180.00	30.37 (33.38)	16.14 (23.64)	1133.50
25-30	26.37 (30.83)	14.92 (22.68)	1068.25	31.74 (34.09)	15.57 (23.08)	1176.50	34.03 (35.67)	17.97 (24.99)	1038.25
45	31.13 (33.86)	19.60 (26.26)	1045.75	62.58 (52.34)	52.07 (46.20)	950.00	69.89 (56.88)	56.73 (48.91)	626.75
Check	93.25 (75.49)	87.55 (69.54)	440.00	94.61 (76.73)	90.40 (72.20)	449.00	95.46 (77.97)	90.57 (72.35)	442.50
'F' test	**	**	**	**	**	**	**	**	**
S. Em ±	1.74	1.54	32.98	2.77	2.46	62.15	1.66	1.69	35.55
C.D. at 5%	5.37	4.77	101.60	8.54	7.60	191.49	5.21	5.12	109.51

Data in parenthesis are arcsin transformed values

TABLE 5. Effect of storage of metalaxyl (Ridomil 25 WP) treated seeds at different temperatures for periods of 8, 10 and 12 months on downy mildew incidence, infection index (INFINDX), Green ear incidence and grain yield of NHB-3.

TREATMENT	8 months after storage				10 months after storage				12 months after storage			
	Incidence (%)	INFINDX (%)	Green ear incidence (%)	Grain yield (kg/ha)	Incidence (%)	INFINDX (%)	Green ear incidence (%)	Grain yield (kg/ha)	Incidence (%)	INFINDX (%)	Green ear incidence (%)	Grain yield (kg/ha)
<i>Storage temperature (°C)</i>												
5	26.51 (30.17)	15.06 (21.90)	3.68 (10.94)	1295.00	35.60 (36.14)	19.52 (25.71)	3.90 (11.08)	1265.00	34.62 (35.89)	19.84 (26.19)	4.09 (11.48)	1226.69
12	36.63 (37.12)	18.89 (25.51)	4.56 (12.13)	1180.00	29.05 (31.97)	14.30 (21.70)	3.69 (10.94)	1270.10	34.74 (36.00)	17.85 (24.74)	4.89 (12.60)	1213.44
25-30	36.64 (37.11)	19.13 (25.70)	4.13 (11.57)	1253.31	32.39 (34.37)	17.41 (24.24)	4.34 (11.71)	1231.56	31.04 (33.65)	16.05 (23.32)	4.40 (11.87)	1295.00
45	69.69 (53.24)	40.82 (39.55)	15.35 (23.02)	876.50	73.46 (59.13)	51.97 (46.16)	15.64 (23.27)	881.69	81.01 (64.56)	59.35 (50.43)	17.03 (24.34)	826.63
Check	78.30 (62.52)	59.65 (50.59)	18.81 (25.58)	546.63	84.83 (67.63)	66.67 (54.83)	23.95 (29.24)	571.62	86.57 (69.30)	66.41 (54.71)	25.40 (30.23)	545.00
'F' test	**	**	**	**	**	**	**	**	**	**	**	**
S.Em. ±	1.24	2.10	0.56	35.57	1.06	1.15	1.33	28.85	1.44	1.14	0.50	48.77
C.D. at 5%	3.43	5.80	1.54	98.56	2.92	3.17	3.68	80.22	3.97	3.15	1.37	135.16
<i>Rows</i>												
I	48.47 (44.14)	30.97 (32.96)	9.19 (16.42)	1020.10	49.65 (44.64)	32.19 (33.25)	10.52 (17.07)	1024.25	52.36 (47.01)	35.46 (35.57)	11.82 (18.65)	1070.55
II	45.71 (42.44)	29.80 (32.47)	9.63 (16.68)	1035.90	51.64 (46.27)	34.97 (35.15)	10.00 (16.99)	1040.00	55.68 (49.19)	37.34 (37.05)	10.86 (17.92)	99.205
III	49.17 (44.58)	30.10 (32.27)	8.71 (16.24)	1047.80	51.91 (46.44)	34.39 (35.05)	10.57 (17.54)	1061.30	54.23 (48.33)	35.31 (35.35)	11.13 (18.22)	1008.05
IV	50.07 (44.98)	31.98 (33.33)	9.68 (17.25)	1117.30	51.07 (46.04)	34.36 (34.67)	10.16 (17.39)	1050.65	52.11 (46.99)	35.49 (35.56)	10.84 (17.63)	1014.75
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S. Em ±	1.11	1.87	0.50	31.82	0.94	1.03	1.19	25.89	1.29	1.01	0.44	43.62
C.D. at 5%	—	—	—	—	—	—	—	—	—	—	—	—

Figures in parenthesis are arcsin transformed values

visible to store seeds at temperatures less than 25°C. The least increase in the disease incidence was obtained in plots planted with treated seed stored at 5°C. These are the plots that produced the highest grain yield in almost all the trials. This shows that for better activity of the fungicide the treated seed should be stored at 5°C.

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