The Performance of Benzimidazole Fungicides in the Control of Cercospora Leaf Spot of Sugarbeet[1]

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Introduction

Thiabendazole and benomyl are systemic fungicides which were found to be effective in controlling leaf spot of sugarbeet, caused by *Cercospora beticola* Sacc. (1,2,3,6)[3]. Because these fungicides are relatively expensive, the use of minimum doses for obtaining disease control is essential. However, the minimum effective doses are not yet known. Only some of the fungicides deposited on the leaf is absorbed by it (5). An increase in the absorption rate of streptomycin was induced in *Sedum purpureum* when leaves were kept wet after its application (4). Hence, the effect of leaf wetting on fungicide effectiveness was also included in this study.

While no distinction could be made in the field between the residual and the systemic activity of the fungicides, in greenhouse experiments the effect of the studied factors was examined mainly on aspects expressing the systemic activity of the fungicides.

Materials and Methods

The following fungicides were tested:

1) Thiabendazole (TBZ), 2-(4'thiazolyl) benzimidazole (Tecto 90, 90% WP), produced by Merck & Co., Rahway, N.J., U.S.A.

2) A dichloro derivative of TBZ (ClTBZ), 2-(4'thiazolyl) dichlorobenzimidazole, a soluble powder, prepared by T. Staron, I.N.R.A., Versailles, France.

3) Benomyl, methyl 1-(butylcarbamoyl)-2-benzimidazole-carbamate (Benlate, 50% WP), produced by E.I. Du Pont de Nemours & Co. Inc., Wilmington, Delaware, U.S.A.

For comparison, fentin acetate (Brestan 60, 60% WP), produced by Farbwerke Hoechst AG, Frankfurt/Main - Hoechst, W. Germany, a standard fungicide for control of *Cercospora* leaf spot was included.

In greenhouse experiments, leaves of sugarbeet plants, raised singly in pots, were inoculated by evenly stomizing a standard amount of *C. beticola* spore suspension on marked circles (6), after which the plants were transferred to a humid chamber for

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[3] Numbers in parentheses refer to literature cited.

four days. Fungicides were applied to the leaves by spraying to run-off. Severity of the infection was recorded two weeks after removal of the plants from the humid chamber.

The field experiment was conducted at the Bet Dagan Experiment Farm on autumn-sown sugarbeet, cv. Polyrave. The field was divided into two trials (nos. 1 and 2). Each treatment plot consisted of six 8-m long rows, with ten replications in randomized blocks. The fungicides were sprayed with a knapsack mist blower in three applications at intervals of 21 days, commencing on April 21, 1969, when the natural infection was established. Surfactant Triton B-1956, 0.03%, was added to TBZ and benomyl sprays.

Results and Discussion

Greenhouse Experiments

The effect of TBZ dosage on the severity of *Cercospora* leaf spot infection varied according to type of activity (Table 1). The protective activity was almost complete at both concentrations, 40 and 120 ppm, whereas the effectiveness of the therapeutic activity was affected by dosage.

Table 1.—The effect of TBZ dosages, when sprayed at various intervals, on the severity of the infection of sugarbeet leaves inoculated with *Cercospora beticola*.

TBZ Concentration (ppm)	Severity of infection following indicated treatments (% of check)*		
	2 days pre-inoculation	5 days post-inoculation	7 days post-inoculation
40	2.1	31.6	108.1
120	0.2	4.9	42.3

* Calculated from the number of spots per 28mm leaf circle.

For testing the effect of leaf wetting after application on the effectiveness of the fungicidal treatment, a few leaves on each of ten inoculated plants were covered with a polythene bag immediately after being sprayed, and were thus kept wet for 24 hours, whereas other leaves were dried with a stream of dry air. The experiment was carried out on two susceptible sugarbeet cultivars. The results (Table 2) show that, on both cultivars, leaf wetting did not improve the therapeutic effectiveness of either TBZ, which is not water soluble, or ClTBZ, which is water soluble.

Table 2.—The effect of leaf wetting, following fungicidal application 6 days after inoculation, on the severity of sugarbeet infection with *Cercospora beticola*.

Maintenance of leaf wetness	Spots per leaf circle (% of check)*			
	TBZ		ClTBZ	
	Zwaanesse III	Cultivar 60	Zwaanesse III	Cultivar 60
Leaves dried	31.2	31.6	25.1	39.8
Leaves kept wet	26.5	36.2	32.6	51.9

* No significant difference between treatments (P=0.05).

Field Experiments

In trial No. 1 effectiveness of benomyl at two doses was compared with that of fentin acetate or a combination of both fungicides. Two different spray volumes were included in that experiment. The results (Table 3) show that all treatments effectively controlled the disease, benomyl being superior to fentin acetate. The higher dosage of benomyl and the higher spray volume did not affect its effectiveness, because the lower rates were already effective. In trial No. 2 (Table 3), increasing dosages of TBZ were found to increase disease control effectiveness. From the corresponding greenhouse experiment it appears that this effect was due to promotion of the systemic rather than the residual activity. The superior specific activity of benomyl in the field agrees with findings in greenhouse experiments (6).

Table 3.—Incidence of *Cercospora* leaf spot (at harvest time, July 30, 1969) in sugarbeet plots treated with fungicides.

Trial No.	Fungicide	Fungicide, a.i. g/ha./treatment	Spray volume l/ha.	Leaf spot rating+
1	Benomyl	800	300	0.1a ++
	Benomyl	400	300	0.4a
	Benomyl	400	600	0.3a
	Fentin acetate	360	300	1.5b
	Benomyl+ fentin acetate	400+360	300	0.2a
	Check			7.6c
2	Thiabendazole	1000	300	1.5a
	Thiabendazole	400	300	2.5ab
	Thiabendazole	200	300	3.3b
	Check			8.5c

+ Disease incidence was appraised in grades: O=no infection, 10=complete necrosis of the leaves.

++ Values followed by the same letter do not differ significantly from each other (P=0.05).

Summary

Autumn-sown sugarbeet was severely attacked by *Cercospora* leaf spot during the ten weeks preceding harvest. Three benomyl treatments, 400 g a.i./ha. each, at three-week intervals, completely controlled the disease, and were superior to similar TBZ or fentin acetate applications. Increasing dosages of TBZ from 200 to 1000 g a.i./ha. increased disease control. Dosage appears to promote the systemic rather than the residual activity, since in a corresponding greenhouse experiment a higher dose of TBZ (120 ppm in the spray suspension) increased the therapeutic activity over that of the lower dose (40 ppm), but did not affect the residual one. Maintaining wetness of sprayed leaves did not affect the therapeutic activity of either TBZ or its chloric analogue.

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