

A SYSTEMIC FUNGICIDE FOR CONTROL OF VERTICILLIUM WILT IN STRAWBERRIES¹

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Abstract

The systemic fungicide Benlate controlled wilt of strawberry caused by *Verticillium dahliae* when applied to the planting hole at planting time. It was less effective when plant roots were dipped in the fungicide solution prior to planting, and it was ineffective as a foliar spray. Soil applications of the fungicides Lanstan and Lannate did not control verticillium wilt, and Lannate was phytotoxic.

Introduction

In Nova Scotia epidemics of verticillium wilt occur occasionally in strawberry plantings. In 1964 Gourley and MacNab (2) reported that *Verticillium dahliae* Klebahn attacked new plantings of strawberries in the late summer and fall. In 1966 verticillium wilt killed 50% of the strawberry plants in a new planting. Because Benlate was found to have systemic properties which protected cotton plants from verticillium wilt (1), experiments were made with Benlate and with the fungicides Lannate and Lanstan⁵ to control verticillium wilt in strawberry plants.

Materials and methods

A greenhouse trial with 'Redcoat' strawberry plants was made to evaluate methods of applying Benlate (1-[butylcarbonyl]-2-benzimidazole carbamic acid, methyl ester) to control verticillium wilt. The experiment was repeated four times. Each of seven treatments was applied to five strawberry plants, each of which was in a 4-inch clay pot. Soil inoculum consisted of potting mixture (1 part soil, 2 parts peat, 1 part sand) infested with cornmeal-

sand cultures of *V. dahliae* prior to planting. Benlate at the rate of 4 lb 50% WP/100 Imp. gal water plus Surfactant F at 4 oz/100 Imp. gal were applied as follows:

Soil drench - 8 fluid oz added to the surface of the soil in each pot at planting;

Soil drench - 8 oz added to the surface of the soil in each pot 7 days after planting;

Foliar spray - plants sprayed to run-off at planting;

Foliar spray - plants sprayed to run-off 7 days after planting;

Root dip - roots dipped in the fungicide solution prior to planting;

Soil mix - 8 oz mixed with the soil of each pot prior to planting;

Control - no fungicide.

Three months after planting, the plants were examined for symptoms of verticillium wilt and two sections of one petiole from each plant were plated on potato dextrose agar (PDA).

In 1967 three fungicide chemicals were evaluated in a field trial for the control of verticillium wilt in 'Redcoat' strawberry. In this particular field 50% of the plants had been killed by *Verticillium* in 1966. The experiment was laid out with 100 plants/plot, with the plants 2 ft apart and the rows 5 ft apart, using a randomized block of four replicates. The following treatments were applied on June 12 and 13, 1967:

Lanstan 20% G (1-chloro-2-nitropropane) at the rate of 45 lb active ingredient/acre

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⁵ Benlate and Lannate were obtained from Dupont of Canada Ltd., Toronto, Ontario, and Lanstan from Niagara Brand Chemicals, Burlington, Ontario.

broadcast on a 2-ft-wide strip down the center of the row and rototilled to a depth of 6 inches the day before planting:

Benlate 4 lb 50% WP/100 Imp. gal plus Surfactant F, 4 oz/100 Imp. gal, using 8 oz in each planting hole immediately prior to setting the plant:

Lannate, 90% (methyl-[methylcarbonyl]thiolacetylhydroxamate), at 1.0 lb 90%/acre, using 8 oz/plant in the planting hole at planting;

Control - no treatment.

On October 13, the plants were examined for symptoms of verticillium wilt, and petiole sections from 30 mother plants from each treatment in each block were plated on PDA. On October 23, counts were made of the number of runner plants on all mother plants.

In 1968, Benlate was used in a field trial on randomized plots of the same size as those used in 1967. Benlate was applied at rates of 1, 2, and 4 lb 50% WP/100 Imp. gal, plus Surfactant F at rates of 1, 2, and 4 oz/100 Imp. gal, respectively. Eight ounces of fungicide solution were added to the planting hole at planting on May 29, 1968. Control plants received 8 oz of water per plant. On October 2 the plants were examined for wilt, the number of runners was counted, and sections of the petioles were plated, as previously described.

Results and discussion

Benlate was effective in controlling verticillium wilt when applied to the soil but was not effective as a foliar spray (Table 1-3). In the greenhouse Benlate applied as a soil drench up to 7 days after planting controlled verticillium wilt. In the field it was more effective in 1967 than in 1968 in controlling wilt. During the 1967 test period there was above-normal rainfall and the fungicide may have been more active than in the abnormally dry summer of 1968. In 1967 plants treated with Benlate produced more runner plants than the controls (Table 2), but this difference was not evident in the 1968 test (Table 3).

Lanstan and Lannate were not effective in controlling verticillium wilt, and Lannate was phytotoxic at the rate used.

Because infected strawberry plants do not always show wilt symptoms (Tables 2 and 3), diagnosis should be based on isolation of the pathogen from the petioles.

Table 1. Effect of Benlate on control of verticillium wilt of 'Redcoat' strawberry plants in the greenhouse

Treatment*	Visible symptoms (%)	Pathogen isolated (%)
Soil drench at planting	0	0
Soil drench 7 days after planting	0	0
Foliar spray at planting	10	25
Foliar spray 7 days after planting	5	20
Preplant root dip	0	10
Mixed with potting soil before planting	0	0
Control	10	30

* Benlate was used at 4 lb 50% WP/100 Imp. gal with Surfactant F at 4 oz/100 Imp. gal; soil applications were made using 8 fluid oz of formulation/pot.

Table 2. Effect of three fungicide treatments on control of verticillium wilt of 'Redcoat' strawberry plants in the field - 1967

Treatment*	Visible symptoms (%)	Pathogen isolated (%)	No. of runner plants/100 mother plants
Benlate	0	0	668
Lanstan	5.8	13.3	487
Lannate	0.4	17.5	108
Control	10.5	10.8	334

* Benlate, 4 lb 50% WP/acre, 8 oz added to planting hole; Lanstan, 45 lb active ingredient/acre, tilled into 2 ft wide row; Lannate, 1.0 lb 90%/acre, 8 oz added to planting hole.

Table 3. Effect of Benlate on control of verticillium wilt of 'Redcoat' strawberry plants in the field - 1968

Benlate (lb 50% WP /acre)	Visible symptoms	Pathogen isolated	No. of runner plants/100 mother plants
4	0	11.7a*	457
2	0	44.5b	472
1	0	41.4b	459
Control	0	48.4b	446

* Means not followed by the same letter are significantly different at the 5% level (Duncan's Multiple Range Test).

The results suggest that it may be feasible to control verticillium wilt of strawberries by adding Benlate to the planting water.

Literature cited

1. Erwin, D. C., Henry Mee, and J. J. Sims. 1968. The systemic effect of 1-(butylcarbamoyl)-2-benzimidazole carbamic acid, methyl ester, on verticillium wilt of cotton. *Phytopathology* 58:528-529.
2. Gourley, C. O., and A. A. MacNab. 1964. Verticillium dahliae and Gliocladium roseum isolation from strawberries in Nova Scotia. *Can. J. Plant Sci.* 44:544-549.