The Control of Black Rot of Sweet Potatoes by the Use of Fungicide Dips at Various Temperatures

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ABSTRACT

Dips of fleshy sweet potato roots containing Mertect [2-(4-thiazolyl)-benzimidazole] or benomyl are extremely effective in preventing development of *Ceratocystis fimbriata* cankers on sweet potato sprouts produced from these roots. Heated water (44 to 54 C) significantly reduced the number of cankers to develop as compared with an unheated (14-C) dip. Ferbam at 14 C exhibited no protective value, but ferbam at 49 or 54 C provided excellent control of black rot. Sprout production was poor in the treatments where disease control was not achieved. Phytopathology 61:1145-1146.

Black rot, caused by *Ceratocystis fimbriata* (Ell. & Halstad), has long been one of the most destructive fungus-induced diseases of the sweet potato. Heavy losses may occur in the plant bed, the field, in storage, and during transit and marketing. Mercurials (1, 2), until disallowed, were our most effective fungicide dips of the fleshy "seed" roots and sprouts. However, even these fungicides do not offer effective protection against black rot if the fleshy roots are planted and maintained in cool (24-C) beds (1). The incidence of this disease is much less if the sprouts are produced in warm (32-C) beds, or if they are given a heat treatment before bedding (5).

Recent studies (3, 4) have indicated that the temperature of the fungicide dip may influence its effectiveness in disease control. In addition, it has been shown (3, 6) that water dips at elevated temperatures may exert a marked effect on the viability of the pathogen.

Fleshy roots of the yellow Jersey cultivar were rinsed and placed in 25 boxes (25 treatments). The sweet potatoes were then dipped, the contents of one box at a time, into a suspension of *C. fimbriata* spores prepared just before use, by adding the washing from ten 4-week-old petri dish cultures of the sporulating fungus to 10 gal of water. After the sweet potatoes were dipped in the spore suspension, they were placed in a high-humidity room held at 28 C for 18 hr. The sweet potatoes remained moist during this period. After removal from the high humidity room, these sweet potatoes were treated as outlined in the table. The fungicides used were ferbam, benomyl, Mertect [2-(4-thiazolyl)-benzimidazole], and EL273 [*a*-(2,4-Dichlorophenyl)-*a*-phenyl-5-pyrimidinemethanol]. The temperatures employed were tap water temperature, 14 C, 43 C, 49 C, and 54 C, and the dips were of 1- and 5-min duration. After drying, the sweet potatoes were planted in 3.5 ft^2 plots replicated 4 times/treatment, in sand, in electrically heated plant beds. The temperature of these beds was held at 24 ± 2 C throughout the duration of the experiment. When the sprouts were ready for planting in the field they were pulled, counted, and examined for black rot (magnification ×40). The disease data obtained were analyzed for significance, using angles of per cent, while the sprout production analysis considered the total number of sprouts produced.

The performance of benomyl and especially of Mertect in the control of black rot was outstanding. There was some evidence (leaf color) of toxicity from benomyl in the 5-min dip at 49 C. This was not, however, reflected in the number of sprouts produced by sweet potatoes receiving this treatment. The root systems of the plants treated with benomyl and Mertect were white and vigorous. Those from the water and the 2 cooler ferbam treatments, in each time series, showed canker on many of the stems and on the feeder roots. The counts reported here consider only the stem cankers, although many plants were free from stem cankers that exhibited some black feeder roots. The small roots of the plants produced from seed receiving the

TABLE 1. Effects of temperature of water and fungicide dips of fleshy sweet potato roots inoculated with *Ceratocystis fimbriata* on the occurrence of black rot on the resulting sprouts

Materials	Dip: Temp, (C)	Dip: Time (min)	Per cent diseased sprouts[a]	Sprouts[a] avg no./plot
Water	14	5	80.8 h	38 a
Water	43	5	46.3 fg	242 cde
Water	49	5	28.4 e	286 defg
Ferbam[b]	14	5	81.2 h	63 a
Ferbam	43	5	31.9 ef	263 cdef
Ferbam	49	5	11.4 cd	299 defg
Benomyl	14	5	9.2 bc	282 defg
Benomyl	43	5	4.4 abc	261 cdef
Benomyl	49	5	3.4 abc	354 fg
Mertect	14	5	4.9 abc	265 cdef
Mertect	43	5	1.8 ab	340 efg
Mertect	49	5	1.0 ab	316 efg
EL-273	14	5	26.5 e	210 cd
Water	43	1	80.8 h	40 a
Water	49	1	58.2 g	167 bc
Water	54	1	27.4 e	319 efg
Ferbam	43	1	75.6 h	95 ab
Ferbam	49	1	19.8 de	356 fg
Ferbam	54	1	6.1 abc	287 defg
Benomyl	43	1	8.7 bcd	369 g
Benomyl	49	1	4.0 abc	331 efg
Benomyl	54	1	2.5 abc	338 efg
Mertect	43	1	4.8 abc	372 g
Mertect	49	1	2.5 abc	327 efg
Mertect	54	1	1.1 ab	318 efg

[a] Treatments followed by the same letter do not differ at the 1% level of significance, according to Duncan's multiple range test.

[b] Amounts of fungicide per 10 gal dip. Ferbam, ½ lb., benomyl, ⅛ lb., Mertect, ⅛ lb., EL273, 500 ppm product 10% active.

49-C 5-min dip treatment; the 54-C 1-min dip treatment exhibited few black roots, however.

The effect of temperature per se on the control of black rot is shown (Table 1) in the water dip treatment. In each dip duration series, each temperature increase resulted in a highly significant improvement in disease control. Ferbam at 14 C for 5 min, or at 43 C for 1 min, provided no improvement in black rot control over water controls at the same temperatures. However, at the elevated temperatures of 49 and 54 C, the ferbam treatments showed a significant improvement at the 1% level over water dips at the same temperatures. The 5-min ferbam dip at 43 C exhibited significant control of the disease at the 5% level over the water dip at the same temperature. It is of interest to note that the ferbam dips at 49 C for 5 min and 54 C for 1 min proved to be a very effective treatment in the control of black rot of sweet potatoes. It will be noted from the table that these treatments are in the same statistical groupings as many of the benomyl and Mertect treatments.

EL273 as used, while not being particularly outstanding in the control of black rot, would probably have been improved at elevated temperatures or at higher concentrations.

The treatments which did not provide protection, or effected very poor control of black rot, show low sprout production (Table 1). This occurred because the pathogen concerned actually killed many developing sprouts before they emerged from the sand in the plant bed. Hence, the actual sprout destruction by *C. fimbriata* in the poorer treatments was much greater than indicated in Table 1 column labeled "per cent diseased sprouts". The excellent controlling effect of elevated temperatures and the efficiency of benomyl and Mertect in the control of black rot is indicated by the consistent production of large numbers of sprouts in these treatments.

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