Interrelationship of Penicillium digitatum and P. italicum in Thiabendazole - Treated Oranges

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Series of 1973 Contribution No. 332-E from the Agricultural Research Organization, The Volcani Center, P.O. Box 6, Bet Dagan 50200, Israel.

ABSTRACT

The decay of Shamouti and Valencia oranges by *Penicillium italicum* increased substantially as a result of thiabendazole treatments that reduced *P. digitatum*, but remained low with treatments that had no marked effect on *P. digitatum*. The interrelationship between the decays by the two molds on oranges indicates a build-up of resistant strains and the need to use fungicides other than benzimidazoles in the post harvest treatment of orange fruit.

Phytopathology 65:498-499

Additional key words: green mold, blue mold, *Citrus sinensis*.

For many years *Penicillium digitatum* Sacc., the causal agent of green mold was the dominant postharvest pathogen of citrus fruits in Israel; the blue mold, caused by *Penicillium italicum* Wehmer, was of minor importance. During the past three seasons, the occurrence of *P. italicum* has become increasingly frequent, the trend being clearly associated with the introduction of benzimidazoles as standard packinghouse fungicides.

The object of this study was to determine, under packinghouse conditions, the relative incidence of decay caused by the two molds on orange fruit subjected to various thiabendazole treatments.

Oranges (*Citrus sinensis* [L.] Osbeck) 'Shamouti' and 'Valencia', were inoculated by inserting pins loaded with dry spores of *P.digitatum* on opposite sides of the fruit to a depth of 1.0 - 1.5 mm. After incubation for 24 hours at 18 C, the fruit was transferred to the packinghouse, where it was washed with water, brushed, freed of excess water by means of brass and sponge rollers, and finally treated with 2-(4'thiazolyl)-benzimidazole, thiabendazole (supplied by S. Riesel, Tel Aviv, agent for Merck & Co., Inc., Rahway, New Jersey). Treatments included three modes of application and three concentrations. The modes of application were: (i) Spraying with a water suspension of thiabendazole, (ii) same followed by waxing, and (iii) application of wax into which the fungicide was incorporated. The concentrations employed were 250, 1,000 and 4,000 μg active ingredient (a.i.) of thiabendazole per ml of water. The water suspensions of thiabendazole were prepared with a 60% a.i. wettable powder formulation (Tecto 60), and a 100% wettable powder was incorporated into the water-emulsion wax formulation (Zivdar, a local brand of the Citrashine wax). The fruits were wrapped in plain wrappers, packed in cartons, and stored at 18 C. Four replicates of 50 fruits each were used for each treatment combination. Controls consisted of fruit handled similarly, but not treated with thiabendazole. The incidence of decay caused by *P.digitatum* and *P.italicum* was determined on three successive dates.

The results obtained for Shamouti and Valencia oranges are given in Fig. 1. Since the results of treatment A did not differ significantly from those of treatment B, they have not been included in the figure.

The results show that, in spite of the inoculation with spores of *P. digitatum*, thiabendazole reduced the decay caused by this mold, at least when applied at the higher concentrations. There was, however, a striking decrease in the effectiveness of thiabendazole in controlling decay by *P.digitatum* when incorporated in wax, as observed in earlier work (2). The incidence data indicate a close interrelationship between the two mold species. With treatments that produced a substantial reduction in the incidence of *P.digitatum* decay, there was a great rise in the incidence of decay caused by *P.italicum*; this rise was particularly marked on the later inspection dates. On the other hand, there was very little *P.italicum* development with treatments that were ineffective against *P.digitatum*. This interrelationship is evident since comparison between the different treatment combinations shows remarkably little variation in the cumulative incidence of the two molds.

The interrelationship of the development of the two mold species on the fruit is most readily explained by a progressive build-up of strains resistant to benzimidazole fungicides, as reported by Eckert and Kolbezen (1), and Harding (3). Such reports are confirmed by our findings,

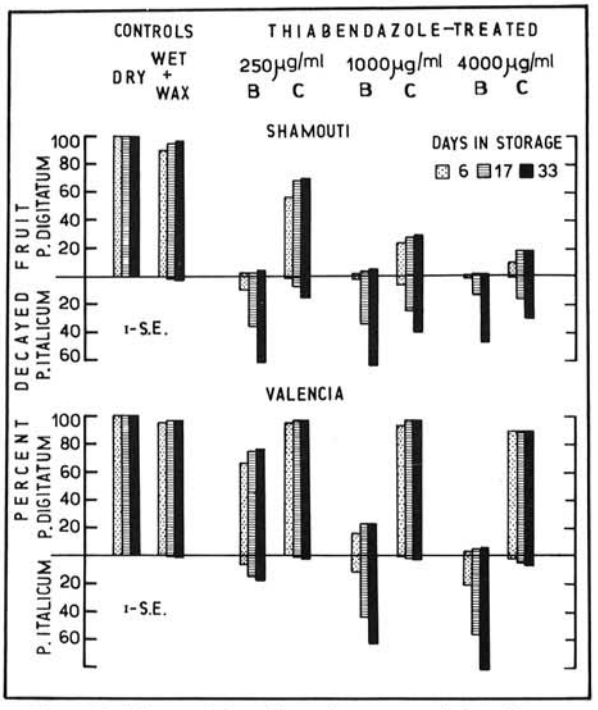

Fig. 1. Incidence of *Pencillium digitatum* and *P. italicum* on thiabendazole-treated oranges. Treatments: B-thiabendazole suspended in water, C-thiabendazole incorporated in wax.

which show a much more frequent occurrence of benzimidazole-resistant strains among isolates of *P.italicum*, than among those of *P.digitatum*.

The close interrelationship between green- and blue molds, that becomes apparent with use of thiabendazole, accentuates the potential danger involved in the build-up of resistant strains, notably in the case of *P.italicum*. It appears that successful control of postharvest rots of citrus fruit will have to include fungicides other than benzimidazoles.

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