Benomyl-Induced Growth of Ustilago striiformis in vitro

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ABSTRACT

Ustilago striiformis grown in vitro on media containing benomyl at 2×10^{-7} to 2×10^{-4} M produced dry matter in excess of controls. Greater concentrations prevented or inhibited growth. Previous research has shown that dry-matter production of stripe-smutted *Agrostis palustris* increases following applications of benomyl. The present study suggests that concentrations of benomyl which stimulate growth of *U. striiformis* might temporarily exist in treated plants and that the pathogen, prior to its eradication, might briefly stimulate the growth of *A. palustris*. Phytopathology 63:1074-1075.

Additional key words: systemic fungicides, disease control.

Little information is available on the potential ability of microorganisms to adapt to, or be stimulated by, systemic fungicides. Of the newer systemic compounds, benomyl [methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate] has been most widely examined for its influence on various organisms. An isolate of *Sphaerotheca fulignea* has been found which develops profusely on a powdery mildew resistant selection of *Cucumis sativus* treated with benomyl; the same isolate developed only sparsely on untreated plants (12). Such observations suggest that in addition to the pathogen's probable resistance to benomyl, it might also be dependent on the fungicide for pathogencity. Conidial isolates of *Fusarium oxysporum* f. sp. *melonis* have shown both stable and unstable tolerance to benomyl (1). Benomyl stimulation of an unidentified Basidiomycete also has been reported to result in damage to turf (13).

The control of *Ustilago striiformis* (West.) Niessl with benomyl is well documented (2, 5, 6, 9, 11, 14). A recent study, however, indicated a possible temporary stimulation of *U. striiformis* in *Agrostis palustris* before eradication of the pathogen (11). To obtain additional information on the nature of this interaction, benomyl at several concentrations was tested to determine its effect on growth and dry-matter production of *U. striiformis* in vitro.

Ustilago striiformis was isolated from *A. palustris* by streaking teliospores on 3.0% Bacto agar supplemented with 0.01% streptomycin sulfate. Stock cultures of the pathogen were then maintained on Fischer's medium (4). Influence of benomyl on in vitro growth of *U. striiformis* was tested at molar concentrations ranging from 2×10^{-10} to 2×10^{-1} in 20 ml of Fischer's medium, in disposable 100 × 15 mm plastic petri dishes. The medium was autoclaved and the appropriate dilution of benomyl was added to the cooled medium which was dispensed to petri dishes and allowed to solidify. One 10-mm disc of *U. striiformis* was cut from the thallus of a stock culture and placed on the agar at the center of the dish. Twenty plates were prepared for each concentration of benomyl. Controls were established on Fischer's medium without benomyl. All cultures were incubated at 24 ± 2 C and received 12-14 hr of light (400 ft-c). After 30 days, the leatherlike thallus of each culture was peeled from the surface of the agar, dried 48 hr (55 C), and weighed. The data presented are averaged values of two separate experiments.

Growth of *U. striiformis* increased as the concentration of benomyl decreased from 2×10^{-1} to 2×10^{-7} M (Fig. 1). At 2×10^{-1} M of benomyl, the pathogen did not grow; some growth occurred at 2×10^{-2} and 2×10^{-3} M, but was markedly inhibited relative to growth of the pathogen in the absence of benomyl. Benomyl at 2×10^{-4} to 2×10^{-7} M stimulated growth of *U. striiformis* and dry-matter production by the pathogen was greater than that of control cultures (Fig. 1). Dry-matter production for benomyl concentrations of 2×10^{-5} to 2×10^{-7} M was significantly greater ($> .01$, Tukey's test) than that for controls and for all other concentrations of benomyl. Dry-matter production by cultures on benomyl concentrations of 2×10^{-8} to 2×10^{-10} M equaled that of control cultures.

Growth of *U. striiformis* is stimulated by some sublethal concentrations of benomyl. Several Basidiomycetes have been shown to be moderately sensitive to insensitive to benomyl; *Ustilago maydis*, however, is highly sensitive to benomyl (3). Stimulation of *U. striiformis* by benomyl has several implications. Previous research has shown that the total dry weight of healthy and of stripe-smutted *A. palustris* treated with benomyl is reduced relative to that of healthy, untreated plants; the dry-matter

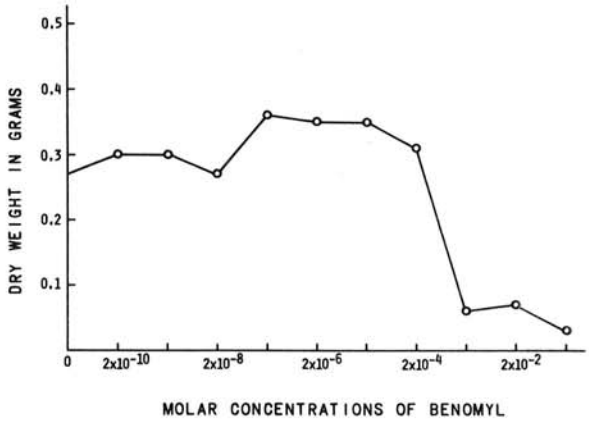

Fig. 1. Dry matter produced by *Ustilago striiformis* in vitro on Fischer's medium (4) containing benomyl.

production of the stripe-smutted plants treated with benomyl, however, was consistently greater than that of healthy, treated plants (11). This response may indicate a temporary stimulation of *U. striiformis* by benomyl between initial uptake of the fungicide and eradication of the pathogen (11). Previous studies show that benomyl is translocated upwards and concentrated in growing points and leaves of *A. palustris* (10). It is also known that mycelium of *U. striiformis* concentrates in nodes of *A. palustris* and can stimulate stolon proliferation (7, 8). If the initial concentration of benomyl in the nodes were sufficiently low, it is conceivable that *U. striiformis* might be stimulated briefly within the stolons; such stimulation might be reflected by increased growth and dry weight of plants.

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