

# RESEARCH NOTES

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## Effects of Carbendazim on the Nematophagous Fungus *Hirsutella rhossiliensis* and the Ring Nematode

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The nematophagous fungus *Hirsutella rhossiliensis* Minter and Brady parasitizes *Cricone-mella xenoplax* (Raski) Luc & Raski in many California stone fruit orchards (5). We assume that the nematode population density would be higher if the fungus were absent, but the suppressive effect of the fungus has not been quantified in the field. Biocides have been used to inhibit antagonists of pests and thus to quantify the suppression caused by the antagonists (2,6). The objective of this study was to determine the suitability of the fungicide carbendazim for selective inhibition of *H. rhossiliensis* in peach orchard soil.

The effect of carbendazim (methyl benzimidazol-2-ylcarbamate; DPX 965-50DF; 50% a.i.; E. I. DuPont DeNemours and Co., Wilmington, DE) on sporulation of *H. rhossiliensis* was examined. *Hirsutella rhossiliensis*-colonized *C. xenoplax* from naturally infested orchard soil were transferred individually to 1.5% water agar amended with 0, 1, 2, 10, or 100 mg a.i. carbendazim/liter and incubated at  $22 \pm 2$  C (the incubation temperature for all experiments). After 5 days, most nematodes on water agar supported sporulation of *H. rhossiliensis*, but no sporulation occurred from nematodes on carbendazim agar (Fig. 1). Carbendazim was fungistatic because sporulation usually occurred if nematodes

were transferred from carbendazim agar to water agar (Fig. 1). This experiment was performed once; similar results were obtained in a related experiment in which colonized *C. xenoplax* were incubated in solutions of carbendazim (data not shown).

To measure the effect of carbendazim on infection of nematodes, uninfected *C. xenoplax* were extracted from orchard soil, inoculated with 10–20 spores of *H. rhossiliensis* (isolate IMI 265748), and incubated in 0, 1, 2, 10, or 100 mg a.i. carbendazim/liter in 0.1 M KCl. After 5 days, infection, as evidenced by the presence of hyphae in the body cavity, was suppressed by carbendazim (Fig. 2). This experiment was performed once.

Germination of *H. rhossiliensis* spores on potato dextrose agar containing 0 and 1 mg a.i. carbendazim/liter was  $86 \pm 5\%$  and  $78 \pm 12\%$ , respectively. Germ tubes developed normally on agar without fungicide but were distorted and failed to elongate on agar with fungicide.

The effect of carbendazim on egg development of *C. xenoplax* was determined. Gravid females of *C. xenoplax* were placed on water agar amended with 200 mg streptomycin/liter and 0, 1, 2, 10, or 100 mg a.i. carbendazim/liter, allowed to deposit eggs for 24 hours, and then removed. Changes in egg development were noted daily for 14 days by examination at  $100\times$ . Treatments were replicated twice with 20 gravid females and a mean  $\pm$  SE of  $40 \pm 9$  eggs per petri dish. The experiment was performed twice. Adult nematodes appeared to be unaffected by carbendazim. In the absence of carbendazim, *C. xenoplax* embryos developed normally, and 86% of

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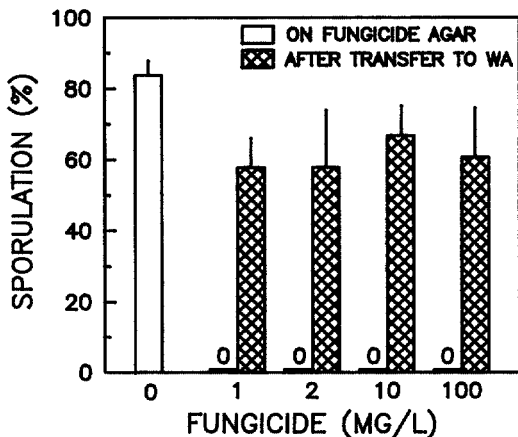


FIG. 1. Sporulation of *Hirsutella rhossiliensis* from colonized *Criconebella xenoplax* on carbendazim agar or after exposure to carbendazim and subsequent transfer to water agar (WA, hatched bars). Each value is the mean of three replications, 10 nematodes per replication. Vertical lines represent one standard deviation.

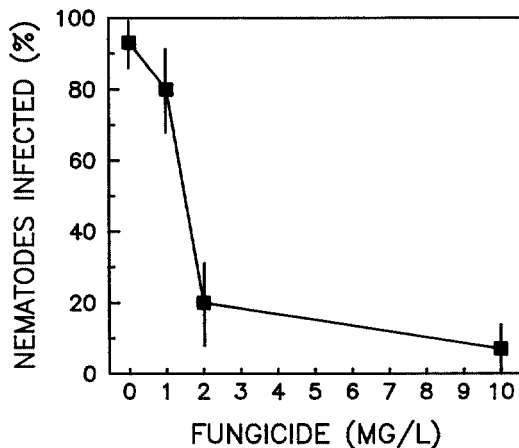


FIG. 2. Infection of *Criconebella xenoplax* by *Hirsutella rhossiliensis* as influenced by concentration of carbendazim in the incubation solution. Each value is the mean  $\pm$  standard deviation of three replications, 10 nematodes per replication.

the eggs hatched in about 14 days. In the presence of 1 mg a.i. carbendazim/liter, egg cleavage did not occur and cytoplasm appeared contracted within the egg; no eggs hatched.

Nematicidal effects of carbendazim and related compounds have been reported by others (1,3,4). Although the chemical is considered a poor soil nematicide, it was at least as inhibitory in vitro to *C. xenoplax* egg development as it was to infection and sporulation by *H. rhossiliensis*. Contrary to our preliminary report (7), carbendazim cannot be used to inhibit *H. rhossiliensis* and thus measure the effect of the fungus on numbers of *C. xenoplax*.

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