Influence of Acephate and Oxamyl on *Alternaria panax* and on Alternaria Leaf Spot of Schefflera

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ABSTRACT

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Growth of *Alternaria panax* was reduced significantly on agar media amended with oxamyl but not on that amended with acephate. Acephate or oxamyl sprays applied to leaves of schefflera (*Brassaia actinophylla*) 24 hr before inoculation with conidia of *A. panax* reduced severity of disease. Control of Alternaria leaf spot by oxamyl compared favorably with control by mancozeb, mancozeb + thiophanate-methyl, zineb, or iprodione.

Additional key word: phytotoxicity

Protection of tropical ornamental foliage plants from insects, mites, and pathogens is often accomplished through chemical applications. When pesticides are screened for use, the primary factors evaluated are efficacy to a specific group of pests and phytotoxicity to the host plant. Materials seldom are evaluated for effects on nontarget organisms. Several reports illustrate the influence of fungicides on beneficial arthropods (2,9–11,15) and entomophagous fungi (7), the direct influences of herbicides on soilborne plant pathogens (3,8,14), and the effect of nematicides on weeds (12), but there are only a few studies on the influence of insecticides on plant pathogens and disease (1,4–6,13,16).

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Acephate and oxamyl are commonly used for control of aphids, thrips, and various other insect pests. Research was conducted to determine the effects of these insecticides on Alternaria leaf spot of schefflera (*Brassaia actinophylla* Endl.) and on the causal fungus, *Alternaria panax* Whetz.

MATERIALS AND METHODS

Effect of acephate and oxamyl on *A. panax* in vitro. Potato-dextrose agar (PDA) (filtered extract from 250 g of boiled potatoes, 20 g each of agar and dextrose per liter) was used as the culture medium at 15 ml per 100 × 15 mm plastic petri dish. The appropriate quantity of a stock solution of acephate or oxamyl was added to each treatment while the medium was molten. A single-conidium isolate of *A. panax* from naturally infected schefflera was grown on PDA at 24–26 C with 8 hr of fluorescent light (25 μE m^{-2} sec^{-1}) per day for 10 days. Test plates each received a 7-mm disk cut from the advancing edge of a fungal culture. Five culture plates (tests 1–4), eight plates

(test 5), or seven plates (tests 6 and 7) for each test medium were incubated at 26 C for various times before measurement of colony diameter. Tests 1–4 included at least five of the following seven treatments: PDA nonamended and PDA containing acephate at 149 μg/g (one-half the recommended rate for insect control) and at 1×, 2×, 3×, 4×, and 5× the recommended rate. Tests 5–7 included the following five treatments: PDA nonamended and PDA containing oxamyl at 75 μg/g (the recommended rate for insect control) and at 2×, 4×, and 8× the recommended rate.

Effect of acephate and oxamyl on *A. panax* in vivo. Schefflera seedlings obtained from growers or produced from seed were potted in 10-cm black plastic pots, three plants per pot. The potting medium was composed of Canadian peat, pine bark, and cypress shavings (2:1:1, v/v) and amended with 4.2 kg/m^3 of dolomite, 4.4 kg/m^3 of Osmocote (19:6:12 slow-release fertilizer), and 0.6 kg/m^3 of Micromax (micronutrient source). Plants were grown to heights of 10–15 cm on raised benches in a shaded greenhouse. Incident light at the leaf surface was a maximum of 185 μE m^{-2} sec^{-1}, and temperature and relative humidity were 23–30 C and 80–90%, respectively.

Cultures for inoculum were grown on PDA plates with 8 hr of fluorescent light (25 μE m^{-2} sec^{-1}) per day at 24–26 C for 2 wk before use. A conidial suspension was made by adding sterile deionized water (SDW) to culture plates and gently rubbing the surface with a sterilized glass rod. Inoculum was adjusted to approximately 2 × 10^3 conidia per milliliter with SDW unless otherwise noted. One milliliter of the conidial suspension was sprayed onto the foliage of each inoculated plant and 1 ml of SDW was sprayed onto each control plant. All plants were placed in polyethylene bags for 48 hr immediately after inoculation. Plants were rated for disease severity 7–10 days after inoculation on the following scale: 1 = no lesions; 2 = 1–5 lesions; 3 = 6–15 lesions, one or two leaves abscised; 4 = more than 15 lesions, three or four leaves abscised; and 5 = plant death.

Effect of acephate on Alternaria leaf spot. Three experiments were conducted to determine the effects of acephate (Orthene 75S) on this system. Plants were sprayed 1) with a 1× solution of acephate and water (0.3 g a.i./L) 24 hr before and with water 48 hr after inoculation with *A. panax* conidia (acephate/conidia/H_2O); 2) with water 24 hr before and with a 1× acephate solution 48 hr after inoculation (H_2O/conidia/acephate); 3) with water 24 hr before inoculation, instead of inoculation, and 48 hr after inoculation (H_2O/H_2O/H_2O); and 4) with water 24 hr before and 48 hr after inoculation (H_2O/conidia/H_2O). Each treatment consisted of 15 pots.

Effect of oxamyl on Alternaria leaf spot. Three experiments were conducted to determine the effects of oxamyl (Vydate L) on this system. Plants were sprayed 1) with a 1× solution of oxamyl and water (0.6 g a.i./L) 1 wk before and with water 24 hr before inoculation with conidia (oxamyl/H_2O/conidia), 2) with water 1 wk before and with oxamyl 24 hr before inoculation (H_2O/oxamyl/conidia), and 3) with water 1 wk and 24 hr before inoculation (H_2O/H_2O/conidia).

Comparison of acephate, oxamyl, and some fungicides. Three experiments were conducted to compare efficacy of oxamyl, acephate, and various fungicides in controlling Alternaria leaf spot of schefflera. Each experiment was conducted as previously described. Pesticides were applied at recommended rates: 1) mancozeb (Manzate 200, 80% a.i.), 1.4 g a.i./L; 2) mancozeb + thiophanate-methyl (Zyban 75 WP, 75% a.i.), 1.3 g a.i./L; 3) zineb (Zineb 75 WP, 75% a.i.), 1.3 g a.i./L; 4) iprodione (Chipco 26019 50 WP, 50% a.i.), 0.6 g a.i./L; 5) oxamyl (Vydate L, 24% a.i.), 0.6 g a.i./L; 6) acephate (Orthene 75S, 75% a.i.), 0.3 g a.i./L; 7) water and conidia; and 8) water and no conidia. All treatments except the noninoculated control were inoculated 24 hr after pesticide application with a suspension of *A. panax* containing 1 × 10^4 conidia per milliliter.

RESULTS AND DISCUSSION

Effect of acephate and oxamyl on *A. panax* in vitro. Growth of *A. panax* was slightly inhibited by the addition of acephate to the culture medium. Diameters of colonies on PDA amended with acephate at the 4× rate were 86–95% as great as control values.

Growth of *A. panax* was distinctly inhibited by oxamyl (Table 1). The reduction in colony growth was much greater at the 75 μg/g concentration of oxamyl than at the highest concentrations of acephate. The relationship between the log dose of incorporated oxamyl (X) and colony diameter (Y) can be described by a straight line (Table 1) with a negative slope, indicating an inverse relationship between the rate of pesticide incorporated into the medium and the amount of growth observed.

Effect of acephate and oxamyl on Alternaria leaf spot. Severity of Alternaria leaf spot on schefflera was reduced by acephate and oxamyl sprays. In each of three tests with each insecticide, plants sprayed with insecticide 24 hr before inoculation had significantly ($P = 0.05$) lower disease severity ratings than water-sprayed inoculated plants; acephate ratings were 2.0 and 2.6 and oxamyl ratings were 1.1 and 3.1, respectively. Both the size and the number of lesions were reduced by these treatments. In the acephate studies, there was no significant difference between the 48-hr post-inoculation treatment rating (2.5) and the rating for the inoculated treatment without an acephate spray (2.6). In the oxamyl studies, there was no significant difference between the 1-wk preinoculation treatment rating (3.7) and the rating for the inoculated treatment without an oxamyl spray (3.4). The lowest mean disease severity rating in both the acephate (1.7) and the oxamyl (1.2) studies was obtained for noninoculated control plants.

Although acephate had an effect on the growth of *A. panax* in vitro, the relative reduction obtained at even the 4× rate was insufficient to explain the reduction in disease expression observed in vivo. The interaction among plant, pathogen, and pesticide appeared to be greater than would have been expected from the results of the laboratory studies.

Results of the three tests comparing oxamyl and acephate with four fungicides are presented in Table 2. No significant

Table 1. Effect of oxamyl on growth of *Alternaria panax* in vitro

Oxamyl concentration (μg/g a.i.)	Rate[a]	Mean colony diameter[b] (mm)
0	0	60.4 ± 2.1
75	1	40.5 ± 4.4
150	2	36.9 ± 4.5
300	4	32.3 ± 4.6
600	8	23.0 ± 5.2

[a] The 1× (2.5 ml/L) rate is equivalent to that recommended for use on greenhouse-grown foliage plants.

[b] Values are the mean ± standard deviation for 22 replicates at each rate. By regression, the relationship of log concentration (excluding 0 concentration) to mean colony diameter was Y = −19.0 × +77.3, significant at $P = 0.01$.

Table 2. Effect of two insecticides and four fungicides on severity of Alternaria leaf spot of *Brassaia actinophylla*

Treatments	Rate[x] (g a.i.)/L)	Mean severity rating[y]
Acephate	0.3	2.3 c[z]
Iprodione	0.6	1.1 ab
Mancozeb	1.4	1.1 ab
Mancozeb + thiophanate-methyl	1.3	1.0 a
Oxamyl	0.6	1.3 b
Zineb	1.3	1.0 a
Inoculated control	···	2.9 d
Noninoculated control	···	1.1 ab

[x] Rates recommended for control of pests.

[y] Plants were rated for disease severity 7–10 days after inoculation on the following scale: 1 = no lesions; 2 = 1–5 lesions; 3 = 6–15 lesions, one or two leaves abscised; 4 = more than 15 lesions, three or four leaves abscised; and 5 = plant death.

[z] Values in the same column followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's new multiple range test.

differences in disease severity were observed among noninoculated, oxamyl, iprodione, and mancozeb treatments. However, significant differences were noted between oxamyl and zineb and between oxamyl and mancozeb + thiophanate-methyl. The severity rating for the acephate treatment was significantly higher than that for any of the other chemical treatments, but all pesticides had lower ratings than the inoculated controls.

The effects of acephate and oxamyl on two other host/pathogen systems were studied previously (4,5). In the case of Fusarium leaf spot of *Dracaena marginata* Lam. and a leaf spot disease of areca palm (*Chrysalidocarpus lutescens* H. Wendl.) caused by *Bipolaris setariae* (Saw.) Shoemaker, the effects ranged from negligible to marked increases in disease. Oxamyl increased the severity of Myrothecium leaf spot disease of dieffenbachia and nematanthus. Chase and Osborne (6) showed that insecticidal soap has a variable effect on disease expression. Soap reduced the severity of Alternaria leaf spot of *B. actinophylla* and Bipolaris leaf spot of areca palm but increased the severity of fungal leaf spots in two other pathogen-suscept combinations.

The experiments reported here have established that the insecticides acephate and oxamyl may reduce the severity of leaf spot caused by *A. panax* on *B. actinophylla*. Results with other pathogen-suscept combinations (4–6) have varied greatly, however, and no generalized influence of these insecticides can be assumed. Each pathogen-suscept combination must be evaluated separately. Testing of pathogen-pesticide combinations in vitro was unsatisfactory for predicting the severity of disease. The future success of integrated pest control will, in part, depend on the nature and thoroughness of the research performed.

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