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Chlorothalonil Can Reduce Leatherleaf Fern Vase Life[1]

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Summary: Chlorothalonil fungicides are useful and control a number of fungal pathogens of leatherleaf fern. However, heavy applications of these products can significantly decrease the vase life of leatherleaf fern fronds. Growers should use these fungicides judiciously and in compliance with label directions.

Leatherleaf fern continues to be the predominant cultivated cut foliage produced in the United States, accounting for 55% of sales in 1996 (U.S. Dept. of Agriculture, 1997). Large, dark-green, blemish-free fronds are preferred by florists. This true fern is grown in tropical and subtropical areas that generally have significant rainy seasons. During those wet periods, foliar fungal diseases can cause significant damage to the crop. The primary fungal pathogens include members of the genera *Colletotrichum*, *Cylindrocladium* and *Rhizoctonia* (Stamps, 1992a; Stamps et al., 1994). Anthracnose of leatherleaf fern, caused by *Collectotrichum acutatum* and first identified in the United States in 1993, is impossible to control without intensive fungicide spray programs (Leahy et al., 1995). In the United States, chlorothalonil (Daconil®, Echo®, Thalonil®) and thiophanate-methyl (3336 , Domain®, Fungo®, SysTec 1998) are the only fungicides labeled for controlling all three primary diseases of this crop (Stamps et al., 1995).

Fronds which develop during the rainy seasons are more prone to exhibit reduced postharvest longevity due to rapid water loss (Mathur et al., 1982; Poole et al., 1984), a phenomenon known as frond curl syndrome (Nell et al., 1983). Higher ambient temperatures during frond development have been shown to reduce vase life of mature fronds by increasing the rate of postharvest

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dehydration (Stamps et al., 1989). Yield and postharvest effects of pesticides applied to leatherleaf fern during production have been determined for certain herbicides (Stamps and Poole, 1982; Stamps and Poole, 1987; Stamps, 1992b), but not for fungicides.

The purpose of this experiment was to determine if repeated applications of chlorothalonil and thiophanate-methyl fungicides affect yield and postharvest longevity of leatherleaf fern fronds.

Materials and Methods

The experiment was conducted in an established fernery in Apopka, Florida where the soil was Tavares-Millhopper fine sand. The fernery was covered with 70% shade polypropylene fabric. Irrigation water was supplied to the 4' × 13' [1.2 meter (m) × 4 m] plots as needed using a solid set overhead irrigation system. Nutrients were supplied using an 18 6 8 controlled-release fertilizer containing micronutrients (Nutricote Total Type 180) applied twice a year at a rate of 300 lbs N/acre/yr [334 kg N per ha·yr ^{1}]. Leatherleaf fern anthracnose was not present in this fernery.

All harvestable fronds were removed from plots prior to beginning the experiment, which was a completely randomized block design with six replications. Treatments consisted of spray applications of water alone (control) and labeled concentrations of four formulations of chlorothalonil and one formulation of thiophanate-methyl (see table below).

Spray solutions were thoroughly mixed in ~2-quart [2-liter] bottles prior to application. All treatments were applied with initial and final system pressures of about 60 and 22 pounds/in^2 [400 and 150 kPa], respectively, and with enough volume for thorough foliar coverage (277 gallons/acre [2,587 liters·ha ^{1}]). Sprays were applied using an air-pressurized sprayer with an 80° flat-fan nozzle. Treatments were applied weekly from June through August. During September and October, application rates were lowered and treatment intervals extended to once every two weeks to simulate chemigation rates used in the industry prior to the detection of leatherleaf fern anthracnose.

Phytotoxicity was rated monthly from July through November. Ratings were made on the fronds in a 3' × 12' [0.9 m × 3.4 m] center area of each plot, thereby providing a 2' [0.6 m] buffer between plots. Phytotoxicity ratings were 0=none; 1=slight, fronds salable; 2=moderate damage, some fronds unsalable; 3=severe damage, fronds unsalable; 4=dead.

Monthly vase life determinations were also conducted from July through November. For vase life

Effects of fungicide spray treatments on leatherleaf fern frond yield.[Z]

Treatment	Formulation (% a.i.[Y])	Product per 100 gals [per 100 liters]	Number of fronds	Total fresh weight of fronds	Average frond fresh weight
Water (control)			528 ab[X]	15.4 lbs [7.0 kg] a	0.47 oz [13.3 g] b
3336	4.5 F (46.2)	1.25 pts [156 ml]	485 ab	15.0 lbs [6.8 kg] a	0.50 oz [14.2 g] ab
Daconil 2787®	4.17 F (40.4)	2 pts [250 ml]	510 ab	15.2 lbs [6.9 kg] a	0.48 oz [13.6 g] ab
Daconil Ultrex®	82.5 WDG (82.5)	1.4 lbs [168 g]	539 a	17.4 lbs [7.9 kg] a	0.52 oz [14.8 g] ab
Thalonil	90 DF (90)	1.25 lbs [150 g]	501 ab	16.3 lbs [7.4 kg] a	0.53 oz [14.9 g] ab
Thalonil	4 L (40.4)	2 pts [250 ml]	424 b	14.6 lbs [6.6 kg] a	0.57 oz [16.1 g] a

[Z]Applied weekly with thorough foliar coverage using labeled concentrations for control of anthracnose from June August. In September and October, applications were applied once every two weeks at slightly reduced rates.
[Y]a.i. = active ingredient.
[X]Means within columns followed by any same letter are not significantly different as determined by Duncan s new multiple range test, $P \leq 0.05$.

studies, 10 stems were cut from each plot, weighed and immersed in water for 30 minutes. Excess water was allowed to drain from the fronds and the groups of wet fronds from each plot were placed in individual polyethylene bags and the bags were placed in wax-coated, corrugated fiberboard boxes. The boxes were stored in a cooler maintained at 40°F [4°C] for two to three weeks. Upon removal from the cooler, all fronds were freshly cut to a stipe length of 6" [15 cm] from the first pinna and placed in ~2-quart [2-liter] beakers filled with deionized water. These studies were conducted in a room maintained at 75±4°F [24±2°C], 64±11% relative humidities and light levels of ~106 ft-c [17μmol·s^{-1}·m^{-2}] provided 12 hours a day using cool white fluorescent lamps (simulated home/office conditions). Fronds were discarded when signs of dehydration (desiccation) or yellowing (chlorosis) appeared.

Yields were determined by harvesting all commercially acceptable fronds in December and adding those frond numbers and fresh weights to the ones previously determined from the five vase life harvests.

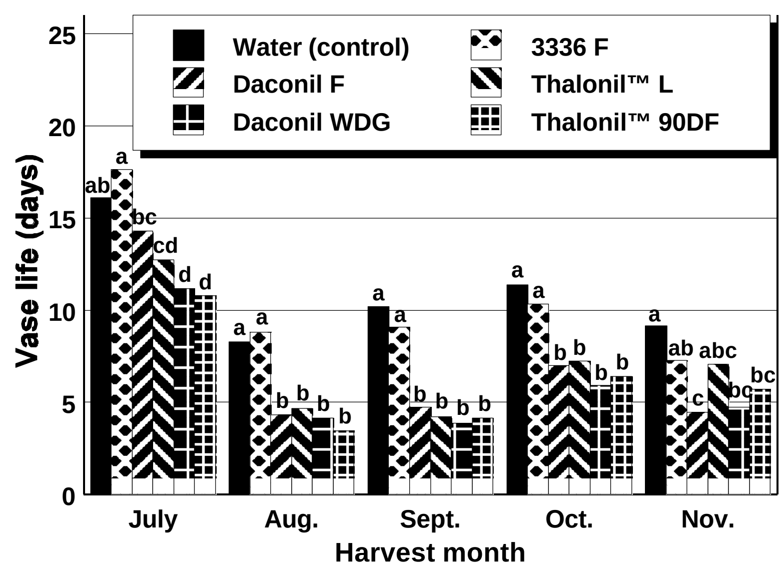
Vase life and yield data analysis was by analysis of variance (ANOVA) with multiple means comparisons made using Duncan s new multiple range test at $P \leq 0.05$. Ratings were analyzed using chi-square.

Results and Discussion

Phytotoxicity. Very little phytotoxicity was observed and it was not treatment related (data not shown).

Vase life. Thiophanate-methyl-treated fronds lasted as long as water-treated fronds in all evaluations (see figure). Vase lives of fronds from chlorothalonil-treated plots were reduced compared to the controls at all harvests except for Daconil 2827® in July and Thalonil 4L in November. Reductions during August, September and October months when postharvest desiccation is greatest (Poole et al., 1984) ranged from 36% to 62%. These vase life reductions were due to more rapid loss of water as evidenced by earlier and more pronounced desiccation for chlorothalonil-treated fronds. For example, 92% of chlorothalonil-treated but only 15% of control fronds were terminated due to desiccation in the first week at the September evaluation. Even after the application rates were reduced and intervals extended, three of the four chlorothalonil treatments caused vase life reductions (November harvest). This is the first report of reduced postharvest longevity caused by pesticide application during the production of leatherleaf fern.

Averaging across the five harvests, vase life durations for the treatments segregated into three groups control and thiophanate-methyl longer than the liquid chlorothalonil formulations which were longer than the dry chlorothalonil formulations. Differences in the amount of vase life reduction by the chlorothalonil formulations was probably related simply to differences in labeled application rates. Further research is needed to determine if the reduction of vase life is due to reduced water uptake and/or impaired stomatal closure and/or effects on cuticle development/integrity or some



Vase life of leatherleaf fern fronds stored for 2 3 weeks. At each harvest, bars topped with any same letter are not significantly different, Duncan s new multiple range test, $P \leq 0.05$.

other reason.

Yield. Despite the deleterious postharvest effects from chlorothalonil, fungicide treatments did not affect yield (frond number and total fresh weight) compared to the control (see table). Fronds from Thalonil 4L-treated plots were heavier than those from control plots and more harvestable fronds were produced in Daconil Ultrex® WDG-treated than Thalonil 4L-treated plots. Previous work has shown that leatherleaf fern frond weight and size are positively correlated (Stamps and Mathur, 1982). Since certain markets demand and pay more for large fronds, a factor that increases frond size would be of interest to some in the industry. Additional testing is needed to confirm these preliminary results. It should be noted that no foliar fungal disease developed in any of the plots during this experiment. If any had developed, yield from the control plots would likely have been reduced compared to the fungicide-treated plots.

Although repeated applications of chlorothalonil fungicides to leatherleaf fern were not phytotoxic from a gross morphological standpoint and had relatively little effect on frond yield, they did create objectionable foliar residues and greatly reduce vase life. Since the cause of the accelerated postharvest desiccation of chlorothalonil-treated fronds is not known and may be due to any of a number of factors affecting water movement into and out of the fronds, until the causes are understood and methods to offset them are developed, chlorothalonil fungicides should not be used repeatedly and/or at high application rates on leatherleaf fern.

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