Prodiamine Suppresses Spreading Dayflower (*Commelina diffusa*) Facilitating Hand-Weeding in Leatherleaf Fern (*Rumohra adiantiformis*) Ground Beds[1]

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Abstract

Plots in a leatherleaf fernery uniformly infested with spreading dayflower were treated with prodiamine at 0, 2.2, 4.5 or 6.7 kg ai/ha (0, 2, 4 or 6 lb ai/A) to determine if it would suppress spreading dayflower and make weeding easier without adversely affecting leatherleaf fern. Dayflower suppression was determined by visually estimating weed coverage and by measurement of fresh weight, surface area, leaf number and root length. Morphological changes related to ease of removing dayflower were noted by counting the numbers of normal and stubby roots. By 120 days after prodiamine treatment, spreading dayflower coverage was reduced by at least 66%. Also spreading dayflower fresh weight, leaf number, surface area and root length were reduced by prodiamine and were positively correlated with the force required to remove stem segments from the soil. This weeding force declined logarithmically as prodiamine rate increased and was negatively correlated with the number of stubby roots. Less than 18% of the roots were normal in the prodiamine-treated plots and vine breakage during stem segment removal tests occurred only in the untreated plots. Leatherleaf fern frond color, vigor, and vase life were not affected by treatments.

Index words: herbicide, weed control, vase life

Species used in this study: Leatherleaf fern [*Rumohra adiantiformis* (G. Forst.) Ching], spreading dayflower [*Commelina diffusa* Burm. f.].

Significance to the Nursery Industry

Perennial weeds like spreading dayflower can easily become established in plantings of perennial crops like leatherleaf fern. Perennial broadleaf weeds are difficult to control in broadleaf crops and can reduce yield, effectiveness of pesticide treatments and ease of harvesting. Prodiamine reduced spreading dayflower growth by two-thirds or greater and facilitated hand-weeding by preventing effective dayflower rooting. In fact, no dayflower vine breakage occurred in prodiamine-treated plots during stem segment removal tests. This indicates that any spreading dayflower growth that occurred after herbicide application could be completely removed during hand-weeding without the typical breaking at each node. Leatherleaf fern color, vigor and vase life were not adversely affected by prodiamine.

Introduction

Spreading dayflower (*Commelina diffusa* Burm. f.) is a vining herbaceous perennial and a troublesome weed encountered during the production of leatherleaf fern. This weed competes with leatherleaf fern—the most valuable cultivated cut foliage (florists' green) produced in the United States(6)—for light, nutrients and water, and can completely cover the crop canopy thereby interfering with effective application of foliar pesticides. The presence of spreading dayflower stems and leaves on top of the crop makes harvesting of leatherleaf fern fronds uneconomical for cutters paid on a piecework basis. Hand-weeding is expensive, $1200 to $3700/ha/yr ($486 to $1497/A/yr) (5), and fronds can be physically damaged during weeding, especially during the fragile crosier stage. Furthermore, spreading dayflower produces roots from nodes so removal by hand is difficult since stems break at rooted nodes leaving the rest of the plant intact.

Prodiamine is a dinitroaniline herbicide that does not affect yield of leatherleaf fern (3, 4). Although prodiamine has been shown to have postemergence activity against Florida betony (*Stachys floridana* Shuttlew) (3), it is predominantly a preemergence herbicide and is normally applied before weed seed germination and/or after weeding of established weeds. Dinitroaniline herbicides are readily absorbed by roots and interfere with normal mitosis thereby reducing root growth (2). The objective of this study was to determine if prodiamine would suppress spreading dayflower and make weeding easier without adversely affecting leatherleaf fern.

Materials and Methods

Ground beds of leatherleaf fern uniformly infested with spreading dayflower were commercially hand-weeded on December 11, 1987, to reduce spreading dayflower biomass prior to herbicide application. Three days later, 4 × 4 m (13 × 13 ft) plots with established spreading dayflower populations were treated with blank carrier granules (0 rate) or a 1.25% G formulation of prodiamine at 2.2, 4.5 or 6.7 kg ai/ha (2, 4 or 6 lb ai/A). All plots were watered with

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1.3 cm (0.5 in) of water after herbicide application using the solid set irrigation system. The Astatula fine sand soil (hyperthermic, Typic Quartzipsamments) had a pH of 4.3 and 1.5% organic matter. Shade (70%) was provided using polypropylene shade fabric and evergreen oak trees. Weekly fertigation and supplemental irrigation were provided using the solid set irrigation system. The experimental design was a randomized complete block with three replications.

Dayflower suppression was determined by visually estimating weed coverage in whole plots 60 and 120 days after treatment (DAT) and by measurement of dayflower fresh weight, surface area, leaf number and root length from 0.32 × 0.32 m (1 × 1 ft) subplots at 120 DAT. Weeding force required to uproot a stem segment between two nodes was measured on growth developed subsequent to herbicide treatments for three randomly selected internodes per plot using a tension gauge (DPP-30, J. Chatillon & Sons, NY). Additionally, numbers of normal and stubby roots, a morphological change observed to increase ease of removal of dayflower, were determined.

Frond color and visual ratings of crop vigor and phytotoxicity symptoms were made at 60 and 120 DAT. Color (value [lightness or darkness], hue [particular color], chroma [saturation]) was measured in the center of a pinnule in the middle of the center pinna of a recently matured frond in each plot using an electronic chroma meter (Model CR-100, Minolta Corp., Ramsey, NJ). Vigor reduction was based on visible reduction of crop biomass in treated plots compared to untreated plots using a scale of 0 to 100 with 0 = no reduction and 100 = death. Phytotoxicity was rated from 1 to 5 (1 = no damage; 2 = slight damage, fronds still salable; 3 = moderate damage, fronds unsalable; 4 = severe damage; 5 = death). Vase life of three leatherleaf fern fronds harvested from each plot 60 and 120 DAT was determined under stimulated home/office conditions (24 $\mu mol \cdot s^{-1}$/square meter (150 ft-c) 12 hr/day, 24° ± 2°C (40° ± 2°F), and relative humidity of 75% ± 15%) after two weeks of storage at 4°C (40°F) in waxed corrugated fiberboard boxes. Data were analyzed using correlation and regression analysis. Square root or arcsin transformations of percentage data were made prior to analysis (1).

Results and Discussion

At 60 DAT, prodiamine had no effect on spreading dayflower coverage (Figure 1). By 120 DAT, prodiamine (all rates) had reduced spreading dayflower coverage by 66% or more (Figure 1) and had reduced fresh weight, leaf number, surface area, root length, and number of normal roots of spreading dayflower a minimum of 63%, 47%, 64%, 59%, and 85%, respectively (Table 1). Stem segment removal force (in grams) declined logarithmically [$R^2 = 0.94$, $Y = 72 - (23 \times \ln(x))$] as prodiamine rate increased and was positively correlated with root length ($r = 0.88$, $P < 0.0001$) and number of normal roots ($r = 0.77$, $P < 0.01$). This weeding force was negatively correlated with the number of stubby roots ($r = -.60$, $P < 0.05$). Less than 18% of the roots were normal in prodiamine-treated plots and vine breakage during the weeding tests occurred only in the untreated plots. Prodiamine application, at the rates tested, would therefore allow easier and more complete weeding of spreading dayflower. Average leaf size (of leaves still present after commercial weeding and those that developed subsequently) decreased linearly ($P < .05$) with increasing prodiamine rate from an average of 7.7 cm^2 (1.2 in^2) at the 0 kg ai/ha to 5.4 cm^2 (0.8 in^2) at the 6.7 kg ai/ha (6 lb ai/A) rate. Figure 2 illustrates the effect of prodiamine on the size of leaves and length of roots developing after prodiamine was applied.

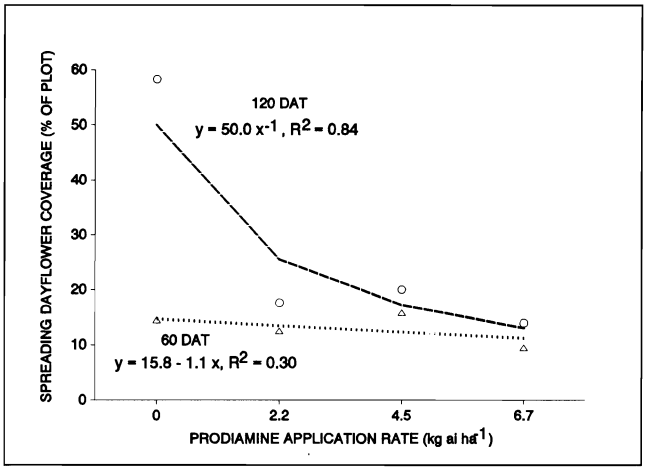

Fig. 1 Effects of prodiamine on spreading dayflower coverage at 60 and 120 DAT.

Phytotoxicity and reductions in vigor of the crop were not observed and differences in frond color were not detected (data not shown). Vase life of fronds was not affected by treatments and averaged 21.2 and 19.7 days, respectively,

Table 1. Effects of prodiamine on growth of spreading dayflower and on the force required to remove dayflower stem segments at 120 DAT.

Prodiamine rate (kg ai/ha)	Fresh wt (g)	Leaf number	Surface area (cm^2)	Root length (cm)	Number of normal roots	Number of stubby roots	Weed removal force (g)
0.0	202	328	2494	7.6	61	0	494
2.2	75	139	834	3.1	7	38	33
4.5	72	175	908	2.1	5	69	35
6.7	67	136	759	2.5	9	43	50
Significance[z]							
Rate linear	65***	59***	63***	68***	57**	52*	57***
Rate quadratic	29**	23**	28***	31**	38*	43^{NS}	36***
Rate cubic	6^{NS}	18*	9**	1^{NS}	5^{NS}	5^{NS}	7*

[z]Given as the percentage of the treatment sum of squares for which each term accounts, all treatment F values highly significant ($P = 0.01$) except for number of stubby roots ($P = 0.05$). NS,*,**,*** Nonsignificant or significant at $P = 0.05$, 0.01 or 0.001, respectively.

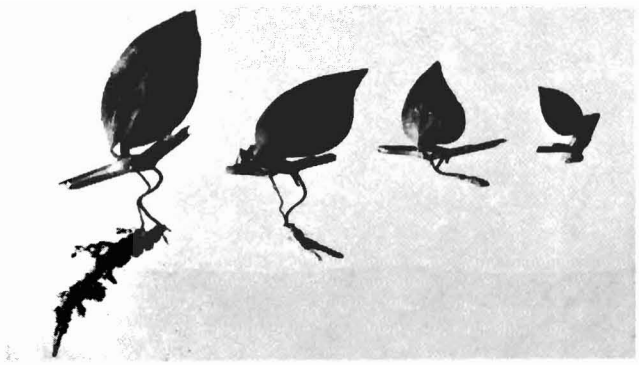

Fig. 2. Effects on new growth of spreading dayflower showing reduction in leaf size and root length 120 days after treatment of leatherleaf fern beds with prodiamine at increasing rates (0, 2.2, 4.5, and 6.7 kg ai/ha from left to right).

for the first and second harvests (data not shown). Similar non-detrimental effects of prodiamine on leatherleaf fern have recently been reported(3).

These results indicate that prodiamine can be used safely in leatherleaf fern plantings to suppress growth of established spreading dayflower and to increase the ease and efficacy with which spreading dayflower can be hand-weeded. Since the effects on spreading dayflower were similar at all prodiamine application rates, use rates in the range tested can be chosen on the basis of what other weed species are present at a given site, economics, and the duration of control desired.

(*Ed. note*: This paper reports the results of research only and does not imply registration of a pesticide under amended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities).

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