Postemergence Oxalis Control with Diuron: Minimizing Crop Injury with Timely Irrigation©

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INTRODUCTION

Preemergence herbicides and hand weeding are the two primary methods of weed control in container nursery crops. However, supplemental hand weeding is usually required to maintain sufficient control. With increasing labor costs growers are seeking alternatives. Postemergence herbicides could provide a viable option for reducing labor costs. In the past, growers would not consider postemergence herbicides as an "over-the-top" application because of concerns of crop injury. Now many growers are willing to accept some injury if the injury occurs early in the crop cycle, the crop recovers quickly, and the herbicide application controls at least one major weed species. Recent studies have shown isoxaben (Gallery) 1.12 kg ai/ha (1 lb ai/A) to provide effective postemergence control of bittercress (*Cardamine hirsuta*) (Altland et al., 2000); however control was more difficult with increased maturity of bittercress (Altland et al., 2000).

Oxalis (*Oxalis stricta* L.) is a cool season perennial weed common in the southeast. It has been identified as being difficult to control by many growers (Gilliam et al., 1990). Due to the ideal growing conditions provide by container nursery production systems, oxalis can be a problem year round (Cross and Skroch, 1992). Recent studies have shown diuron (Direx 4L) is an excellent postemergence control for oxalis. Minimal injury occurred with dormant crops but there was injury potential when crops were actively growing (Simpson et al., 2004). Ahrens and Barolli (2003) applied diuron to actively growing crops and showed that overhead irrigation applied soon after diuron application reduced crop injury but there research focused mainly on preemergence activity of diuron.

The objectives of this study were to determine the minimum time duration of diuron exposure between application and irrigation to result in postemergence oxalis control and to determine if crop injury could be reduced by timely irrigation after diuron application. This information would be beneficial information to nurserymen if they could apply diuron and then use overhead irrigation to rinse the diuron from the crop thus reducing potential crop injury while maintaining effective postemergence oxalis control.

MATERIALS AND METHODS

Oxalis were seeded and grown in 7.5-cm (3-inch) containers and thinned leaving one uniform sized oxalis per container. Two nursery crops: *Rhododendron* 'G.G. Gerbing' and *Camellia sasanqua* 'Alabama Beauty' were used to evaluate crop injury. The medium was an 6 aged pine bark : 1 sand (v:v) amended with 2.3 kg (5 lb) of dolimitic lime, 6.4 kg (14lb) of Osmocote 18N-2.6P-9.8K (18-6-12, The Scotts Co., Marysville, Ohio), and 0.68 kg (1.5 lb) of Micromax (The Scotts Company). At time

of treatment, approximately 5 weeks after seeding, oxalis plants were 8–12 cm (3–4 inches) wide and 4–6 cm (1–2 inches) tall. The azalea and camellia were in 10.24-cm (4-inch) containers and were actively growing. A solution of Direx 4L (diuron)(1.1 kg ai/ha) (1 lb ai/A) and Agridex [non ionic surfactant, mixed at 0.25% (v/v)] was applied to all plants excluding the non treated controls, using a spray chamber. The chamber was calibrated to deliver 284 $L \cdot ha^{-1}$ (30 gal/A) from an 11002 nozzle. Application was at 7:00 AM. Treatments consisted of irrigation intervals of 0.5, 1, 2, 4, 8, 12, 24, and 48 h after diuron application with 7 replications for each treatment. Plants were irrigated with an impact sprinkler head (Rain Bird 2045PJ) with an application volume of 0.64 cm (0.25 inches). Plants were placed in a greenhouse in random design. Visual ratings on percent injury were taken at 14, 21, and 28 days after treatment (DAT) on a scale of 0 to 100 where 0 = no injury and 100 = dead plants. At 28 DAT shoot fresh and dry weights were taken for oxalis. Crop tolerance was evaluated for azalea and camellia liners. Visual ratings were taken at 14, 21, 28, and 120 DAT. The azaleas and camellias were transplanted into trade gallon containers at 28 DAT and growth indices were taken at 120 DAT. Oxalis experiments were replicated two times while azalea and camellia studies were replicated once. Results were consistent and data were pooled for further analysis and presentation.

Plants similar to ones used in the irrigation timing study were used in the foliar absorption study. In this study, ^{14}C-diuron was added to a 0.5-ml (0.017-oz) subsample of this spray suspension so that the final concentration of diuron and radioactivity was 3,000 mg·L and 0.2 MBq/2 μl, respectively. This suspension was applied in the following manner. For oxalis, a recently formed, fully expanded leaf of an individual plant was selected. A single 2 μl, drop of the radiolabled spray suspension was applied to the middle leaflet of the selected leaf using a microapplicator.

Treated plants were harvested at the same schedule as used in the previously-described timed irrigation study either 0.5, 1, 2, 4, 8, 12, 24, or 48 h after treatment. At harvest, the treated leaflet of the oxalis was removed from the plant and washed to remove any unabsorbed diuron. One milliliter (0.034 oz) of a water/methanol solution [50 : 50 (v/v)] had been placed into a 20-ml (0.68 oz) scintillation vial. The treated leaflet was placed into this vial and agitated with a swirling motion for 30 sec. After removing the leaflet, 10 ml (0.34 of scintillation fluid was added into the vial in preparation for counting. For azalea and camellia a 1-cm (0.39-inches) cork borer was used to remove the site to which the herbicide droplet had been placed. These disks of leaf tissue were treated in a manner identical to that previously described for the treated leaflet of oxalis. Washed plant tissue sections were dried at 45 °C for 24 h, combusted in a biological tissue oxidizer, and recovered radioactivity quantified through scintillation spectrometry. A completely random design with 6 single-plant replicates for each harvest time was used, and the experiment was repeated once. Data were subjected to ANOVA using the general linear model procedure in SAS.

RESULTS AND DISCUSSION

This study showed that irrigating 1/2 h after diuron application controlled oxalis the same as if irrigation was withheld for 2 days. Oxalis injury 28 DAT was 60%–80% among all treatments while the control was 4% injury (Table 1). There was no significant difference among irrigation intervals at anytime throughout the study for oxalis. Camellia tolerance to diuron was excellent no visible injury occurred at any time during the study. Azaleas were actively growing at time of diuron application and served to be a sensitive crop to test the hypothesis that injury could be reduced

Table 1. The influence of irrigation timing after diuron application on postemergence oxalis control.

Irrigation timing (h) after diuron application	*Oxalis stricta*				
	14DAT[z]	21DAT	28DAT	SFW	SDW
0.5	37[y] a[x]	63a	62a	0.70a	0.22a
1	39a	62a	71a	0.48a	0.13a
2	50a	75a	80a	0.23a	0.09a
4	46a	72a	73a	0.46a	0.11a
8	48a	67a	64a	0.62a	0.14a
12	42a	61a	64a	0.58a	0.17a
24	51a	70a	74a	0.36a	0.11a
48	54a	70a	72a	0.37a	0.10a
Nontreated	2b	5b	4b	3.34b	0.93b

[z] DAT = days after treatment, SFW = shoot fresh weight (g), SDW = shoot dry weight(g).

[y] Percent oxalis control, where 0% = no injury and 100% = plant death.

[x] Means within a column followed by the same letter are not significantly different (Duncan's Multiple Range Test: α=0.05).

Table 2. The influence of irrigation timing after diuron application on azalea (*Rhododendron indicum* 'G.G. Gerbing') and camellia (*Camellia sasanqua* 'Alabama Beauty') injury.

Irrigation timing (h) after diuron application	Azalea injury				Growth indices[w]	120 DAT
	14DAT[z]	21 DAT	28DAT	120DAT	Azalea	Camellia
0.5	24[y]de[x]	30cd	29cd	0	A	41a
1	19e	21d	20d	0	A	38a
2	31b-e	36bc	35bc	0	A	39a
4	29cde	37bc	36bc	0	A	40a
8	41abc	41abc	44ab	0	A	36a
12	46ab	46ab	50a	0	A	37a
24	35a-d	45ab	45ab	0	A	39a
48	48a	54a	53a	0	A	40a
Nontreated	3f	1e	2e	0	b	38a

[z] DAT= days after treatment

[y] Percent oxalis control, where 0% = no injury and 100% = plant death.

[x] Means within a column followed by the same letter are not significantly different.

[w] Growth indices = height (cm) + 2 perpendicular widths (cm) divided by 3. (Duncan's Multiple Range Test: α=0.05).

with timely overhead irrigation. Injury occurred on azalea with all diuron applications across all dates; however at 28 DAT the least injury occurred with the azaleas irrigated within 1/2 h of application (20%), gradually increasing with treatments (53%) (Table 2). These data concur with work by Ahrens et al. (2003) and Barolli et al. (2003), which showed overhead irrigation soon after diuron application decreased nursery crop injury.

The ^{14}C-diuron study showed a rapid absorption of diuron by oxalis reaching near maximum of 70% at 8 h after application. Azalea absorption was slightly greater

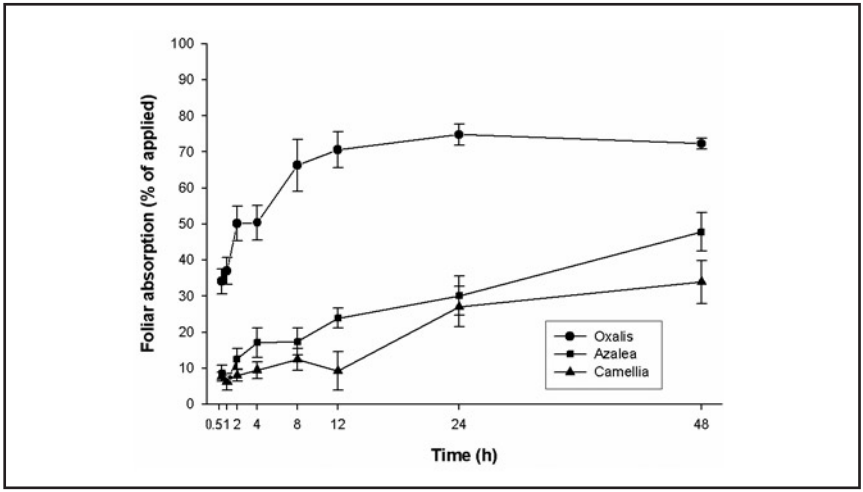

Figure 1. Foliar absorption of ^{14}C diuron by oxalis, azalea, and camellia.

than camellia however crop absorption was more gradual than oxalis absorption (Fig. 1). These findings concur with the previous two tables showing oxalis control is obtained with irrigation soon after diuron application due to rapid absorption. Additional research is needed to evaluate tolerance of diuron and timing of application to nursery crops.

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