

Can Roundup Be Safely Used over the Top of Nursery Crops? ©

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Nine species of woody ornamentals in containers were treated over-the-top with Roundup Pro® at 4 rates 0.29, 0.52, 1.2 and 2.3 kg/hectare (0.25, 0.5, 1.0 and 2.0 lbs ai/a) either once in June, 2007, August, 2007, or February 2008. A fourth group was treated on all three dates. Injury ratings were taken at multiple times after treatment. Dwarf mondo grass (*Ophiopogon japonicus* ‘Nana’), lirioppe (*Liriope muscari* ‘Cleopatra’), and variegated lirioppe (*Liriope muscari*) were tolerant to all rates and application dates. Mondo grass (*Ophiopogon japonicus*) showed no injury except for 139 days after treating (DAT) after the February application. Blue Pacific juniper (*Juniperus conferta*) was also injured by February applications, but soon recovered. Asiatic jasmine (*Trachelospermum asiaticum*) and dwarf yaupon (*Ilex vomitoria* ‘Stoke’s Dwarf’) showed injury 31 DAT after the June application, but showed no injury at the next evaluation. At 139 DAT after the February application, Asiatic jasmine and dwarf yaupon suffered considerable injury. Blue rug juniper (*Juniperus horizontalis*) was tolerant in August but injured at ≥ 1.2 kg/hectare (≥ 1 lb ai/a) for all other dates. Pink gumpo azalea (*Rhododendron x Satsuki* ‘Gumpo Pink’) was injured at all rates and application dates. Growth indices were taken on 3 March and 13 June 2008. Mondo grass, dwarf mondo grass, lirioppe, variegated lirioppe and Blue Pacific were not affected by over-the-top Roundup Pro® applications except at 2.3 kg/hectare (2 lbs

ai/a) applied 3 times. The remainder of the species had reduced growth as Roundup Pro[®] rates increased.

INTRODUCTION

Nursery crops must be weed-free when pre-emergent herbicides are applied. Such herbicides are typically applied 3-6 times per year, which means that the crops must be weeded 3-6 times as well. With labor shortages and higher costs, growers may face the prospect of spending more on hand weeding than what the plant is worth. Landscape companies may find themselves in a similar situation. With contracts signed a year in advance, they may not be able to find the laborers to fulfill their obligations.

Postemergence weed control in container-grown nursery crops is becoming more critical for economic profitability in the nursery industry. Roundup over the top of woody ornamental nursery crops is showing promise as a post-emergent weed control. Between 1975 and 1980, Roundup was evaluated over the top of numerous container-grown crops. Self (1978) applied single, double, and triple treatments of Roundup at 0.5, 0.75, 1.0, and 1.5 lb ai/a on April 7, 14, and 21, 1978 over 18 ornamentals. Total amounts of glyphosate applied ranged from 0.5 to 4.5 lb ai/a. Of the 18 species tested, eight were not injured, including Blue Pacific juniper. Of the remaining species, 'Hinodegiri' and 'Fashion' azaleas were the most sensitive, with injury occurring from as little as 2 applications of the .5 lb rate.

Perry and Knowles (1979) sprayed glyphosate at 0, 0.25, 0.75, and 1.0 lb ai/a over the top of ten species once on August 3, and again on August 17, 1978. Following two applications, no phytotoxicity was observed on *Berberis mentorensis*, *Camellia japonica*, *Forsythia intermedia* and *Ligustrum vicari* at all rates. Temporary slight yellowing was observed on *Berberis julianae*, *Euonymus japonica* and *Ilex cornuta* 'Burfordi nana' regardless of rate. Damage was more

severe on the remaining species at ≥ 0.75 lb ai/a. All species overwintered well, but evaluation of root systems in late February indicated slightly less root density with 1.0 lbs ai/a.

Neal and Skroch (1985) studied rates and timing of Roundup applications on 13 species of woody ornamentals. They applied Roundup at 0.73, 1.33, and 2.67 lbs ai/a at six different times throughout the season. They divided the plants and their responses to Roundup into 4 groups. Group 1 species: ajuga (*Ajuga reptans*), azalea (*Rhododendron obtusum* 'Coral Bells') and variegated liriopie were injured by all application times and rates. Group 2, 3, and 4 species showed tolerance to fall applications. Group 2; dwarf yaupon, English ivy (*Hedera helix*), Helliery holly (*Ilex crenata* 'Helliery') and ligustrum (*Ligustrum japonicum*) sustained the most injury from spring applications. Group 3; Andorra juniper (*Juniperus horizontalis*), compacta holly (*Ilex crenata* 'Compacta'), Fraser's photinia (*Photinia x fraseri*) and green liriopie (*Liriope spicata*) were most injured by summer applications. Group 4; Blue Pacific juniper and Blue Rug juniper (*Juniperus horizontalis* 'Wiltonii') tolerated all but the highest rates with acceptable damage, which was considered to be $\leq 15\%$.

In a separate study, Neal et al. (1985) reported that ligustrum showed a linear decrease in susceptibility from March to November, while Blue Pacific juniper sustained only a temporary tip chlorosis from summer applications at high rates. Both species recovered by the end of the growing season. Neal stated that except for ligustrum treated on young expanding leaves, the time required for absorption of detectable levels of ^{14}C - glyphosate into ligustrum and juniper was slow when compared to absorption rates for herbaceous weeds, but the time was similar for absorption rates for other woody species. Research by Ferreira and Reddy (2000) on *Erythroxylum coca* and *E. novogranatense* indicated the role of the leaf cuticle in the slow uptake of glyphosate by woody plants. This indicates a degree of selectivity with glyphosate

applied over woody ornamentals and weeds growing in beds or pots. Under field conditions, timely rain or irrigation could remove unabsorbed herbicide and increase tolerance. Richardson et al. (2006) demonstrated the benefits of timely irrigation with their work on diuron for control of *Oxalis stricta*.

Altland et al. (2002) showed that Roundup at ≥ 0.4 lb ai/a could be safely used as a cleanup treatment for control of spurge in *Liriope muscari* 'Big Blue' and 'Variegata.' Walsworth et al. (2006) showed that Roundup applied on September 6, 2005 in a 1% solution (4 lbs ai/a in 100 gallons) caused no injury on lirioppe and *Asiatic jasmine*.

Recent work by Czarnota (2008) showed that minimal injury occurred on 'Blue Pacific' shore juniper, 'Blue Star' juniper, and 'Parsoni' juniper (*Juniperus davurica*) when Roundup Pro was applied at up to 2.5 lb/acre on May 29, 2004 and May 13, 2005. Walsworth et al. (2006) reported Roundup applied in a 1% solution (4 lbs ai/100 gal) on Sept 6, 2005 caused no injury to Asiatic jasmine.

The objective of this research is to further evaluate the tolerances of individual container-grown species to various rates and application times of Roundup.

METHODS AND MATERIALS

Blue rug juniper, Blue Pacific juniper, mondo grass, dwarf mondo grass, lirioppe, variegated lirioppe, Asiatic jasmine, Pink Gumpo azalea, and 'Stokes dwarf' yaupon were potted in 3:1 pinebark : peat moss (v/v) amended with 8.5 kg/m³ (14 lbs/yd³) Osmocote 19-6-12 (N-P-K), 3.6 kg/m³ (6 lbs/yd³) dolomitic limestone, 1.2 kg/m³ (2 lbs/yd³) gypsum, and 0.9 kg/m³ (1.5 lbs/yd³) Micromax in 1-gal containers on April 30, 2007. Roundup Pro[®] was applied at four rates (0.25, 0.50, 1.0, and 2.0 lbs ai/a) in 30 GPA with a CO₂ backpack sprayer. Treatments were applied on June 10, 2007, August 30, 2007, or Feb. 20, 2008 to separate groups of plants not

previously treated. One group of plants was treated on all dates. There was one non-treated control group; seventeen treatments in all. Plant injury ratings were taken throughout the study and final growth indices were taken on June 13, 2008. Plants were grouped by species in a completely randomized block design with 10 single-pot replications. Data was analyzed in a statistical software package (SAS Institute, Cary, NC) using a Waller-Duncan k ratio t tests ($P \leq 0.05$). Data was analyzed separately for each sampling date.

RESULTS

Dwarf mondo grass and Blue Pacific juniper growth indices (Table 1) were similar compared to the non-treated control plants regardless of rate or application time. Mondo grass growth indices were similar among all treatments except with 2 lb ai/a three times. Growth suppression on liriopae was minimal. Growth of variegated liriopae was suppressed by 2.0 lb ai/a applied either in February or on all three dates. Liriopae 'Cleopatra' growth was suppressed only with 0.5 lb ai/a in August.

Blue Rug juniper growth indices were smallest with 2 lb ai/a in June, August, or on all three dates. The February application did not affect Blue Rug juniper growth. On the other hand, Asiatic jasmine was affected most by February application, where rates ≥ 0.5 lb ai/a suppressed plant growth. A similar response occurred when applied on all three dates.

'Pink Gumpo' azalea growth was suppressed with ≥ 1.0 lb ai/a when applied in either June or February. August application resulted in growth indices similar to non-treated controls at all rates. Application on all dates resulted in severe growth suppression at 1.0 lb ai/a and plant death at 2.0 lb ai/a.

'Stokes dwarf' holly growth was reduced by 74% when treated with Roundup at 2.0 lb ai/a on all dates; by 21% with 1.0 lb ai/a applied in Feb or June; and by 19% with 0.5 lb in June.

DISCUSSION

Research indicates that windows of opportunity exist for the use of Roundup over the top of container ornamentals with no injury or loss of growth. Dwarf mondo grass, variegated liriope and liriope ‘Cleopatra’ were tolerant of Roundup Pro[®] up to 2 lbs ai/a. Mondo grass and Blue Pacific juniper were tolerant up to 2 lbs ai/a applied in June and August. Asiatic jasmine was tolerant up to 2 lbs ai/a in August, and dwarf yaupon was tolerant up to 1 lb. Blue rug juniper was tolerant up to 2 lbs ai/a in February. Pink Gumpo azalea was injured by all rates of 0.5 lbs ai/a and above and did not have a safe window. Growth indices taken the second season appear to be a much better indicator of overall effects than are injury ratings taken weeks or even months after treatment. June and August, 2007 data was collected 12 and 10 months after treatment, well into the growing cycle, thus providing the opportunity to study long-term effects.

Our research indicates varied responses of individual species to applications of Roundup Pro. For example, there was a significant range of tolerance in junipers. Blue Pacific juniper showed injury 15 DAT in February, but recovered quickly; and growth indices were not significantly different for all rates and dates of application. Blue Rug showed no injury or reduced growth from February treatment up to 2 lb ai/a, but was injured and growth was reduced by 1 and 2 lb ai/a at all other application dates. Therefore, individual species should be tested for tolerance before large groups of plants are treated. Our research is intended to provide data for emergency measures for weed control when labor is unavailable or when it would cost more to weed the crop than it is worth. It should not replace a solid program of weed management consisting of monitoring, some hand weeding, and preemergent herbicides.

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Table 1. Growth indices taken on 6/13/08 for ornamentals treated with Roundup Pro®

Rate lbs ai/a	Treatment date	Dwarf Mondo	Mondo	Liriope 'Cleo'	Liriope variegated	Blue Pacific	Blue Rug	Asiatic jasmine	Dwarf yaupon	Pink Gumpo
	nontreated	18.0ab	35.4ab	29.4abc	36.9abc	34.4cde	44.2abc	49.0abc	27.4a	27.2abc
0.25	2/20/2008	17.7ab	35.9ab	33.7ab	37.6ab	44.1abc	39.8bcd	44.3cd	25.5ab	28.6a
0.5		17.2ab	38.0a	33.5ab	38.4a	47.1a	46.3ab	36.2e	24.5a-d	26.0b-e
1		15.0c	36.7ab	29.8abc	38.0ab	45.2ab	47.2ab	25.9f	22.0cde	23.8efg
2		18.5ab	32.7b	26.8bcd	33.2d	46.6a	45.4ab	26.0f	17.1g	22.0g
0.25	6/10/2007	17.6ab	35.3ab	35.2a	34.0cd	38.3a-d	44.4abc	50.7abc	27.0a	27.9ab
0.5		17.8ab	36.5ab	27.5abc	37.5ab	46.2a	45.7ab	54.0a	21.8de	26.3a-d
1		18.6ab	34.9ab	29.0abc	35.5a-d	42.2abc	39.6bcd	46.1bcd	20.6ef	24.5def
2		17.8ab	34.7ab	33.0ab	37.6ab	38.4abc	35.4de	44.2cd	18.9fg	23.4fg
0.25	8/30/2007	19ab	35.0ab	30.6abc	36.4a-d	42.5abc	48.8a	40.6de	27.2a	28.0ab
0.5		19.5a	36.0ab	20.7d	35.3a-d	38.2a-d	44.5abc	45.0cd	24.9abc	27.8ab
1		19.5a	35.6ab	32.7ab	34.0cd	42.7abc	36.2cde	52.4ab	26.3a	26.9abc
2		19.1ab	37.1a	34.0ab	36.1a-d	42.2abc	12.6g	46.5bcd	22.7b-e	24.9c-f
0.25	All dates shown above	18.3ab	34.0ab	31.0abc	35.4a-d	30.5de	46.0ab	45.1cd	27.4a	27.6ab
0.5		18.7ab	36.6ab	26.4bcd	35.3a-d	36.0b-d	44abc	35.6e	22.2cde	25.1c-f
1		18.0ab	34.9ab	29.3abc	34.5bcd	32.3de	31.0e	28.7f	16.1g	17.2h
2		17.0b	16.6c	23.0cd	21.6e	28.4e	22.4f	25.2f	7.2h	0.0i

Growth indices [(height + width 1 + width 2)/3] presented in centimeters.