Using Preemergence Herbicides in Containerized Rootstock During Grafting©

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Historically, growers have been reluctant to use preemergence herbicides in containerized rootstocks prior to grafting, because herbicides are thought to affect grafting success. Four common preemergence herbicides were applied to various rootstocks during an 8- to 9-month production cycle prior to winter bench grafting. Subsequent grafting success was not affected. This information will allow propagators to control weeds during production without reducing grafting success.

INTRODUCTION

Successful bench grafting of deciduous species is aided by growing rootstock for 8–12 months to establish a root system prior to grafting (Macdonald, 1986). During this time, hand weeding is the main mode of weed suppression because application of preemergence herbicides is not a common practice for grafters. When rootstocks are brought into a covered structure mid-winter for proper pre-grafting care, weed seeds can germinate and affect grafting efficiency (Macdonald, 1986). If plants are kept for a second growing season prior to or after grafting, weed populations in containers can become unmanageable. Emerged weeds in containerized grafted liners can be introduced into field production of other nurseries or into landscapes after installation. Ungerminated weed seeds, in addition to the emerged weeds, may not be controlled by the management system of the unsuspecting nursery (Neal, 2000).

An application of preemergence herbicides to rootstock during pre-graft establishment would eliminate weed problems as well as decrease weed problems in the period after grafting. Applying preemergence herbicides during grafting is not reported in Garner (1988), Macdonald (1986), or in other literature. Moreover, there are no preemergence herbicides listed for application in a covered structure. Thus, applications of preemergence herbicides would need to be applied during the establishment period of the understock prior to bringing plants into a covered structure for grafting. Its effect on grafting success, however, is unknown.

Use of preemergence herbicides on containerized or field-grown stock plants used for stem cutting production has been studied extensively (note: this is not producing scions for grafting, it is producing stem cuttings for root initiation). Earlier studies have shown that rooting percentage and root system quality were not affected when stem cuttings were collected from stock plants receiving either repeated applications within a year or repeated annual applications of a wide variety of preemergence herbicides (Ahrens 1972; 1979; Briggs, 1977; Ticknor, 1972). More recent results have supported these findings (Catanzaro et al., 1993).

Applying preemergence herbicides to the rooting substrate prior to setting stem cuttings has had mixed effects on rooting percentage and root system quality depending on the active ingredients and species. During vegetative propagation of softwood stem cuttings of *Rhododendron* 'Trouper' and *Gardenia jasminoides* 'August Beauty', an application of preemergence herbicides to the rooting substrate surface prior to insertion of cuttings did not affect rooting percentage (Gilliam et al., 1993). In contrast, applications of Ronstar 2G, OH2 3G, Rout 3G, and Prowl 60 DF and 2.45G affected rooting and root system quality differentially for stem cuttings of *Berberis* 'Rose Glow', *Ilex ×attenuata* Foster Hybrid Group, *Euonymus japonica*, *Rhododendron* 'Trouper, and *Gardenia jasminoides* 'Radicans'. Applications of Rout 3G reduced both variables of all taxa but *Euonymus*. Ronstar decreased both variables on *R.* 'Trouper' only (Thetford et al., 1988). Surflan (oryzalin) reduced rooting percentage and root system quality of *Rhododendron* Obtusum Group (syn. *R. ×obtusum*) and *Cotoneaster horizontalis* (Johnson and Meade, 1986). Therefore, Thetford et al. (1988) concluded that no one herbicide is safe on all plants, however, several herbicides were non-injurious to several of the ornamentals tested.

Rooting stem cuttings and grafting are both forms of vegetative propagation. Because preemergence herbicides inhibit root growth as a mode of action, previous studies were conducted to test their effect on rooting and root growth of stem cuttings. A straight line could be drawn between this concern for rooting stem cuttings and the reluctance of using preemergence herbicides in grafting despite the apparent lack for adventitious root formation during the grafting process. Moreover, grafting is an art passed from propagator to propagator, with careful consideration to every environmental and physiological variable that affects success. Use of preemergence herbicides may not have been part of that time honored process. Therefore, this report investigated the effect of preemergence herbicides applied to containerized rootstock on subsequent grafting success.

MATERIAL AND METHODS

Two experiments were conducted over 2 years to study the effect of four common preemergence herbicides on grafting success of six common woody ornamental species. Seedlings of *Cercis canadensis* L., redbud; *Acer palmatum* Thunb., Japanese maple; *Ginkgo biloba* L., ginkgo; *Hamamelis virginiana* L., witch-hazel; *Styphnolobium japonicum* (L.) Schott. (syn. *Sophora japonica* L.), Japanese pagoda tree; and *Ulmus alata* Michx., winged elm; with root collar diameters approximately 3⁄16 inches (0.48 cm) were obtained in February-March 2006 (Expt. 1) and 2007 (Expt. 2). Plants were potted in either 2⅞ inch (7.1 cm) × 2⅞ in. (7.1 cm) × 5½ in. (14.0 cm) (*A. palmatum*, *G. biloba*, *H. virginiana*, *S. japonicum*, and *U. alata*), or 3⅝ in. (9.2 cm) × 3⅝ in. (9.2 cm) × 6 in. (15.2 cm) (*C. Canadensis*, Expt. 1) plastic containers (Anderson Die and Manufacturing Co., Portland, Oregon) or #1 containers (3.79 L) (*C. canadensis* Expt. 2) containing a substrate of composted pine bark amended with 2 lbs/yd^3 (0.69 kg·m^{-3}) dolomitic limestone and 10 lbs/yd^3

(3.45 kg·m^{-3}) alfalfa meal. After potting, plants were side-dressed with 0.28 oz (8 g) (or 15 g for a #1 containers) of a commercial controlled-release fertilizer (18N : 6P : 8K; Nutricote, 5–6 month, Sun-Gro Horticulture, Canada) and placed in a cold frame covered with white polyethylene.

Snapshot 2.5TG (isoxaben + trifluralin) (Dow Agro Sciences LLC, Indianapolis, Indiana) at 5.6 kg a.i./ha (5.0 lbs a.i./A), Scott's OH2 3G (pendimethalin + oxyfluorfen) (Scotts-Sierra Crop Protection Co. Marysville, Ohio) at 3.4 kg a.i./ha (3.0 lbs a.i./A), Ronstar (oxadiazon) (Bayer Crop Science Inc Calgary, Alberta) at 4.5 kg a.i./ha (4.0 lbs a.i./A), or Sureguard (flumioxazin) (Valent U.S.A. Corporation, Walnut Creek,California) at 0.43 kg a.i./ha (0.38 lbs a.i./A) in Expt. 1 [Broadstar (flumioxazin) (Valent U.S.A. Corporation, Walnut Creek, Calif.) in Expt. 2] were surface applied using either a shaker jar or solo backpack sprayer (Sureguard only). Herbicides were applied 8 weeks apart for four applications in Expt. 1 and three applications in Expt. 2. Herbicides were watered in after treatment. All herbicide treatments were compared to nontreated plants. During the growing season plants were under 40% shade cloth and grown according to general nursery practices (Catanzaro et al., 1993). In November of each year, plants were placed in an over-wintering structure covered with white polyethylene (3 mil). The experimental design was a randomized complete block with a factorial arrangement of treatments in each of seven blocks. Treatments in each block contained three plants per species (7 replications × 5 treatments × 3 plants per species in each treatment = 105 plants per species). Species were considered separate experiments and grown and analyzed separately.

In December of each year, plants were brought into an unshaded greenhouse structure and prepared for grafting (Catanzaro et al., 1993). Scion wood of *H. ×intermedia* 'Primavera' witch-hazel; *G. biloba* 'Autumn Gold', ginkgo (Expt. 1 only), *A. palmatum* var. *dissectum* 'Tamukeyama', Japanese maple; *U. alata* 'Lace Parasol', winged elm; *S. japonicum* 'Pendulum' weeping Japanese pagoda tree (syn. *Sophora japonica* 'Pendula'); and *C. canadensis* 'Hearts of Gold' PPAF redbud approximately 4–6 inches (10.2–15.2 cm) long and possessing 3–5 nodes was grafted to its respective genera of seedling rootstock in winter using a modified side-veneer graft (Catanzaro, et al., 1993). Grafts were considered successful if leaves on new growth had fully expanded on or after 10 April each year. Data were subjected to analysis of variance (ANOVA) using SAS v 9.1 (SAS INSTITUTE, Inc. 2003).

RESULTS AND DISCUSSION

Grafting success in either experiment was not affected significantly by the application of four preemergence herbicides to containerized rootstock (ANOVA not presented) (Table 1). Grafting success was affected significantly by experiment for 'Hearts of Gold' redbud and 'Lace Parasol' winged elm. Mean success was 90% in Expt. 1 and 62.4% in Expt. 2 for 'Hearts of Gold' redbud. For 'Lace Parasol' elm, grafting success was 96% in Expt. 1 and 82.4% in Expt. 2. For either cultivar, there was not a significant treatment by experiment interaction, indicating that overall grafting success was lower in Expt. 2 for these species. Therefore, mean grafting success over both experiments was 76.9% for 'Hearts of Gold' redbud and 88.5% for 'Lace Parasol' elm, regardless of which preemergence herbicide was applied to containerized rootstocks in production prior to grafting (Table 1).

These findings indicate that preemergence herbicides can be used in containerized rootstock to control weed populations prior to grafting. The six cultivars tested represent a major portion of ornamental species bench-grafted in the nursery industry. Similarly, the active ingredients tested represent a large portion of the preemergence herbicides applied to containerized nursery stock. By following the methods herein, as well as the label recommendations for the herbicides tested, growers can use preemergence herbicides on an operational scale in rootstocks of the species tested. When implementing preemergence herbicides into any production system, however, growers are cautioned to test the herbicides on a small scale first prior to widespread use in grafting production.

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Table 1. Percent grafting success of six cultivars for two experiments. Rootstocks of cultivars were treated during establishment prior to grafting with nothing (untreated control) or four preemergence herbicides.

Preemergence Herbicide Treatments	Cultivars: *Acer palmatum* 'Tamukeyama'	*Cercis canadensis* 'Heart's of Gold'	*Ginkgo biloba* 'Autumn Gold' Expt. 1[z]	*Hamamelis* ×*intermedia* 'Primavera'	*Styphnolobium japonicum* 'Pendula'	*Ulmus alata* 'Lace Parasol'
	Grafting success (%)[y] (SE)					
Untreated Control	92.3 (4.0)	81.6 (6.4)	100 (0)	94.6 (3.8)	94.4 (3.9)	87.5 (5.3)
Snapshot 2.5TG (isoxaben + trifluralin)	92.9 (4.0)	82.3 (5.9)	94.7 (5.3)	95.1 (3.4)	91.7 (4.7)	85.4 (5.6)
OH2 3G (pendimethalin + oxyfluorfen)	92.5 (4.2)	79.5 (6.6)	100 (0)	97.6 (2.4)	92.1 (4.4)	94.9 (3.6)
Ronstar (oxadiazon)	90.2 (4.7)	70.3 (7.6)	100 (0)	94.9 (3.6)	95.0 (3.5)	92.9 (4.0)
Sureguard (flumioxazin) Expt. 1[w]	NG[x]	85.7 (7.8)	95.2 (4.8)	94.4 (5.6)	NG	NG
Broadstar[y] (flumioxazin) Expt. 2[v]	76.5 (10.6)	52.6 (11.8)	N/A	100 (0)	80.0 (9.2)	76.2 (9.5)
Mean	90.7 (2.1)	76.9 (3.0)	97.8 (1.5)	95.9 (1.4)	91.7 (2.1)	88.5 (2.4)

[z]*Ginkgo biloba* 'Autumn Gold' was included only in Expt. 1.

[y]There were no significant differences between the untreated control and any preemergence herbicide treatments.

[x]Not grafted (NG) after an initial application of Sureguard to rootstocks prior to grafting. Death, stem burn and lesions on rootstocks were noted; as a result cultivars marked NG were not grafted onto their rootstocks in that treatment.

[w]Sureguard, the liquid formulation of flumioxazin, was used only in Experiment 1 (See note [x]).

[v]Broadstar, the granular form of flumioxazin, was used only in Expt. 2.