Effects of Fall Fertilization on Freeze Hardiness of Deciduous Versus Evergreen Azaleas

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Introduction: For many woody ornamental plants, a large portion of annual growth and stem extension occurs in spring and early summer. Fall fertilization is an efficient way to build nutrient reserves in woody plants and increase spring growth. Nursery and landscape managers often use the same regime to fertilize evergreen and deciduous plants. However, plants that maintain their leaves throughout winter may respond differently to fall fertilization than deciduous plants. Along with leaf retention, evergreen plants maintain higher transpiration rates and may maintain photosynthate production throughout much of fall and winter. Previous studies have investigated the effects of fall fertilization on freeze hardiness of evergreen and deciduous plants separately. Because these studies did not include deciduous and evergreen plants in the same experiment, they could not be used to determine if fall fertilization affects deciduous and evergreen plants differently.

Materials and Methods: On 1, May 300 liners each of *Rhododendron canescens* (a deciduous azalea) and *Rhododendron xsatsuki* 'Wakaebisu' (an evergreen azalea) were transplanted into trade 1 gallon containers and moved to an uncovered ornamental nursery production area at the University of Georgia's Riverbend Horticulture Research Facility in Athens Georgia. The growing media used in this study was aged pine bark amended with 4 lb dolomitic limestone, and 1 lb Micromax micronutrient mix per cubic yard. Prior to the initiation of fertility treatments on August 1, all plants were fertilized daily with a 0.5 liter solution of 75 ppm N Harrell's 16-8-8 liquid fertilizer. Fertility treatment consisted of daily liquid feed application of diluted 0.5 liter solutions of the same liquid fertilizer. Beginning August 1, 2003 plants of each *Rhododendron* species were grown under 3 different fall fertility regimes: 1) 1 Aug. – 29 Sept., 75 ppm N, 2) 1 Aug. – 28 Nov., 75 ppm N and 3) 1 Aug. – 28 Nov., 125 ppm N. Providing 75 ppm N from 1 Aug. – 29 Sept. was considered the industry standard, ending fertilization 6 weeks before the predicted frost date.

Data collection: Stem sections 4-5 cm long were harvested from the currents season's growth once 18 November and 17 December, 2003 and 27 January, 17 February and 17 March, 2004. Under laboratory conditions, accessions were exposed to 10 progressively lower temperature intervals between -3°C and -30°C and a T_{50} value (temperature at which 50% of stems were killed) for plants in each treatment was calculated.

Results and Discussion:

Time and interactions: In this study, two *Rhododendron* species were included in the same experiment in order to determine if extending the application of fertilizer in fall affects the cold hardiness of evergreen and deciduous plants differently. The absence of an interaction between fertilizer treatment and plant species in this study indicates that nursery growers and landscape managers may not need different fall fertilization schedules for managing the cold hardiness of evergreen versus deciduous species.

Species: Deciduous (*R. canescens)* and evergreen (*R. xsatsuki)* azaleas both became more cold hardy during the winter months and then dehardened in spring. However, freeze hardiness of the two species was significantly different. Among treatments receiving extended fertilization applied at the low rate (75 ppm N, Aug.–Sept.), *R. canescens* developed greater freeze hardiness than *R. xsatsuki* in November, December and January (Table 1).

Treatment: Similar to the species effect, fall fertilization treatments had a significant effect on azalea cold hardiness. Compared to the industry standard (75 ppm N, Aug.–Sept.), *R. canescens* that received extended fertilization at the high rate (125 ppm N, Aug. – Nov.) was less freeze hardy in November, December and January, and *R. xsatsuki* was less freeze hardy in December (Table 2.). However, when compared to the industry standard, the low rate extended fertilization (75 mg $N \cdot L^{-1}$, Aug.– Nov.), did not affect azalea freeze hardiness (Table 2.).

Table 1. Difference in species freeze hardiness (T_{50}) between deciduous *R. cane*scens and evergreen *R. xsatsuki* grown under 3 fall fertilization regimes, with stem tissue harvested 15 November and 17 December, 2003 and 16 January, 18 February and 19 March, 2004.

	N fertilization ($mg \cdot L^{-1}$)		------------------------ T_{50} (°C) ------------------------				
Species	Aug.1 - Sept.29	Sept.30 - Nov. 28	Nov.12	Dec. 11	Jan. 14	Feb. 18	Mar.19
R. canescens	75	0	-8 b[z]	-23 b	-26 b	-26.5 a	-21.5 a
R. xsatsuki			-4.5 a	-17.75 a	-21.5 a	-23 a	-17.75 a
R. canescens	125	0	-7 a	-18.75 a	-22 a	-23.75 a	-18.5 a
R. xsatsuki			-4.25 a	-14.75 a	-22.5 a	-21.5 a	-18.75 a
R. canescens	125	125	-4 a	-15.25 a	-20 a	-21.5 a	-14.75 a
R. xsatsuki			-2.75 a	-12 a	-19.75 a	-18 a	-16 a

z Species treatment means within each fertilizer treatment row for each date column that are not followed by the same letter are significantly different at $(F_{1,4})$ $P \leq 0.05$.
≤ 0.05.

Table 2. Effects of 3 fall fertilization treatments on freeze hardiness (T_{50}) of *R. cane*scens and *R. xsatsuki* stem tissue harvested November 15 and December 17, 2003 and January 16, February 18 and March 19, 2004.

	N fertilization ($mg \cdot L^{-1}$)		------------------------- T_{50} (°F) -------------------------				
Species	Aug.1 - Sept.29	Sept.30 - Nov. 28	Nov.12	Dec. 11	Jan. 14	Feb. 18	Mar.19
R. canescens	75	0	-8 b[z]	-23 b	-26 b	-21.5 a	-14.75 a
	75	75	-7 b	-18.75 ab	-22 ab	-23.75a	-18.5 a
	125	125	-4 a	-15.25 a	-20 a	-26.5a	-21.5 a
R. xsatsuki	75	0	-4.5 a	-17.75 b	-21.5 a	-23 a	-17.75 a
	75	75	-4.25 a	-14.75 ab	-22.5 a	-21.5 a	-18.75 a
	125	125	-2.75 a	-12 a	-19.75 a	-18 a	-16 a

z Fertilizer treatments means in each date columns for the 2 different species that are not followed by the same letter are significantly different at ($F_{2,6}$) $P \leq 0.05$, using Tukey's HSD.

Conclusion: Because extending fall fertilization through November at a low rate did not significantly affect azalea freeze hardiness (Table 2), nurserygrowers and landscape managers may be able to apply fertilizer in fall at a low rate in order to build nutrient reserves in woody ornamental plants and increase spring growth without increasing freeze damage. Over the course of this study we observed that the leaves of deciduous azaleas (*R. canescens*) which received extended fertilization tended to persist and remain green longer in the winter season. Leaf maintenance may have provided the photosynthates or transpiration pump that *R. canescens* needed to absorb nutrients in fall. This observation may help explain why extending fall fertilizer application produced a similar freeze hardiness responses in evergreen and deciduous azaleas. The lack of any interaction between fertilizer treatment and plant species is an indication that nursery growers and landscape managers may not need different fertilization schedules for managing the freeze hardiness of evergreen versus deciduous species.