# Time of Pruning Effects on Cold Hardiness of Butterfly Bush©

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**A study was conducted at Auburn University to determine how time of pruning affects cold hardiness in *Buddleja davidii* 'Royal Red' (Franchet). Buddleia, or butterfly bush, were pruned in November, January, and March, and frozen at six target temperatures 2 weeks later. Both January and March sampling periods included plants pruned at the previous sampling dates. After each freeze event, plants were rated weekly for injury, and at 6 weeks after treatment (WAT) percent mortality was determined. Injury ratings at 2 WAT and percent mortality data are presented. Only fall pruning affect injury rating and percent mortality. There was a greater injury rating in pruned plants than in nonpruned plants at the highest temperature tested, -6°C (21.2°F). At lower temperatures, injury ratings were high, regardless of pruning treatment. Also in fall, percent mortality was greater in pruned (87%) than in nonpruned (67%) plants. There were no significant differences among pruning treatments in injury rating or percent mortality when plants were frozen in January or March. Injury rating and percent mortality increased as freeze temperature decreased, regardless of when pruned.**

## INTRODUCTION

*Buddleja davidii* 'Royal Red'(butterfly bush) is a woody shrub with rich purple, fragrant flowers in long panicles known to attract butterflies and bees. Butterfly bush grows as an arching shrub and blooms on new wood (Dirr, 1998), and is used in perennial borders, butterfly gardens or in mass shrub plantings.

Butterfly bush grows profusely throughout the summer and can become leggy and unkempt late in the season in the landscape. Growers also often find it necessary to prune butterfly bush throughout the growing season to maintain compactness for shipping, as a source of cuttings or to save valuable space for overwintering.

Low temperature is one of the most limiting factors affecting the distribution of plants, and cultural practices may affect cold acclimation and susceptibility to cold injury. Plants cold acclimate in response to low, nonfreezing temperatures and this acclimation is enhanced by decreasing temperatures and shortening photoperiod. This process naturally occurs in the fall before winter temperatures arrive (Levitt, 1980).Growth cessation is a major prerequisite to cold acclimation (Weiser, 1970), thus cultural practices which delay growth cessation can increase the amount of cold injury. In a study with Chinese elm, Lindstrom and Dirr (1991) stated that all six cultivars studied had a higher lowest survival temperature before winter acclimation in the fall and after deacclimation in the spring in Georgia.

Pruning late in the season before plants are dormant stimulates new, tender growth if environmental conditions are conducive (Mika, 1986). Haynes et al. (1991) reported that to minimize cold injury, *Lagerstroemia* 'Natchez' (*L. indica* × *L. fauriei*) should be pruned in late winter or early spring and ×*Cupressocyparis leylandii* 'Haggerston Gray' pruned in late winter. Because butterfly bush are pruned

**Table 1**. Injury[z] to royal red butterfly bush in fall, winter, and spring taken 2 weeks after freeze treatment.

| | Time of freeze treatment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | November | | January | | | March | | | |
| Temp (°C) | NP[y] | P | NP | P1 | P2 | NP | P1 | P2 | P3 |
| -6 | 2.8a[x] | 4.8b | -[w] | - | - | - | - | - | - |
| -8 | 3.8 | 4.4 | - | - | - | - | - | - | - |
| -10 | 4.6 | 4.8 | 1.8 | 2.0 | 1.6 | 2.0 | 2.4 | 2.6 | 2.6 |
| -12 | 4.8 | 4.8 | 2.2 | 2.8 | 2.2 | 3.0 | 4.0 | 4.2 | 4.8 |
| -14 | 4.8 | 5.0 | 2.0 | 2.4 | 2.2 | 5.0 | 4.4 | 5.0 | 5.0 |
| -16 | 5.0 | 5.0 | 2.8 | 3.6 | 2.4 | 5.0 | 5.0 | 4.8 | 4.8 |
| -18 | - | - | 4.0 | 4.0 | 3.8 | 5.0 | 5.0 | 5.0 | 5.0 |
| -20 | - | - | 4.0 | 3.4 | 4.2 | 5.0 | 5.0 | 5.0 | 5.0 |
| Significance | | | | | | | | | |
| Prune[v] | | ** | | NS | | | NS | | |
| Temp | L***Q* | NS | ----------L***---------- | | | ----------Q***---------- | | | |
| P × T[u] | **NSNS | | | | | | | | |

[z]Injury rating scale: 1=no injury; 2=marginal leaf chlorosis; 3=marginal leaf chlorosis; leaf tip necrosis; very little shoot necrosis; 4=marginal leaf chlorosis; leaf tip necrosis; shoot necrosis; 5=death.

[y]NP=nonpruned plants; P, P1, P2, P3= plants pruned 1 Nov. 2001, and 1 Jan. and 1 March 2002, respectively.

[x]Mean separation between pruning treatments within season significantly different at -6C.

[w]Denotes non-target temperatures.

[V]Regression not significant (NS), linear (L), or quadratic (Q) at P=0.05 (*), P=0.01 (**), or 0.001 (***).

[U]P × T=Prune temperature interaction.

**Table 2.** Percent mortality of royal red butterfly bush in fall, winter, and spring taken 2 weeks after freeze treatment.

| | Time of freeze treatment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | November | | January | | | March | | | |
| Temp (°C) | NP[z] | P | NP | P1 | P2 | NP | P1 | P2 | P3 |
| - 6 | 40 | 80 | - | - | - | - | - | - | - |
| - 8 | 40 | 60 | - | - | - | - | - | - | - |
| -10 | 80 | 100 | 0 | 0 | 0 | 20 | 20 | 20 | 20 |
| -12 | 60 | 80 | 0 | 0 | 0 | 0 | 40 | 60 | 60 |
| -14 | 80 | 100 | 0 | 0 | 20 | 100 | 60 | 80 | 100 |
| -16 | 100 | 100 | 20 | 0 | 0 | 100 | 100 | 80 | 80 |
| -18 | - | - | 40 | 40 | 40 | 100 | 100 | 100 | 100 |
| -20 | - | - | 60 | 40 | 20 | 100 | 100 | 100 | 100 |
| Significance | | | | | | | | | |
| Prune[x] | * | | NS | | | NS | | | |
| Temp[w] | L*** | | ----------L***---------- | | | ----------Q***---------- | | | |
| P × T[v] | NS | | NS | | | NS | | | |

[z]NP=nonpruned plants; P, P1, P2, P3= plants pruned 1 Nov. 2001, and 1 Jan., and 1 March 2002, respectively.

[y]Denotes nontarget temperatures.

[x]Mean separation between pruning treatments within season nonsignificant (NS) or significant at P=0.05.

[w]Regression not significant (NS), Linear (L), or quadratic (Q) at P=0.05 (*), or 0.001 (***).

[v]P × T= Prune by temperature interaction.

at various times of the year and there is no information on how this affects cold hardiness, a study was conducted at Auburn University to determine how time of pruning affects cold hardiness in *Buddleja davidii* 'Royal Red'.

## MATERIALS AND METHODS

Royal Red butterfly bush were potted 1 Sept. 2001 and grown outdoors in full sun under nursery conditions in 3.8-liter (1 gal) pots. Substrate was a bark and sand mix (7 : 1, v/v) amended per $m^3$ ($yd^3$) with 2.7 kg (6 lb) Osmocote 17-7-12, 2.2 kg (5 lb) dolomitic limestone, and 0.7 kg (1.5 lb) Micromax. Plants were blocked according to size with mean height ranging from 45.4 cm (17.9 in) to 68.8 cm (27.4 in). On 1 Nov. 2001, 90 plants were pruned to 10 cm (4 in) above the soil line. On 15 Nov., cold hardiness evaluations were begun using 30 pruned and 30 nonpruned controls subjected to six sample temperatures 2°C (3.6°F) apart**.** Plants were placed in a programmable temperature chamber and cooled to 4°C (39°F) and held for 8 h to allow plants to reach a uniform temperature. The chamber was cooled at 2°C (3.6°F) per hour until it reached the first target temperature, -6°C (21.2°F). Chamber temperature was held for 30 min at target temperatures to allow samples to reach a uniform temperature. Upon removal from the freezer, samples were placed in a walk-in cooler maintained at 4°C (39°F) to thaw slowly. Samples were removed the next morning, placed in a heated greenhouse and allowed to re-grow.

November sampling temperatures ranged from -6°C (21.2°F) to -16°C (3.2°F). January and March sampling temperatures were -10°C (14°F) to -20°C (-4°F). Starting 1 week after treatment (WAT), plants were rated weekly for injury (Table 1). Four weekly ratings were taken, and at 6 WAT percent mortality was determined. On 1 Jan. and 1 March 2002, additional plants were pruned to 10 cm (4 inches) above the soil line. The same protocol was followed for plants pruned in January and March as with November-pruned plants. Injury ratings at 2 WAT and percent mortality data only are presented. Treatments in this factorial experiment were arranged in a randomized complete block design. SAS statistical package version 8.2 was used to analyze data.

## RESULTS

**Fall Freeze.** Mean ambient air temperature between November pruning and freeze treatment was 17.2°C (63°F) and ranged from 6.7°C to 27.2°C (44°F to 81°F). Plants were still actively growing and plant tissue was succulent and green. After pruning, re-growth was stimulated and new growth occurred. In November, there was a significant interaction ($P \leq 0.05$) between pruning and freeze temperature for the injury rating. The interaction of pruning butterfly bush in the fall significantly increased the injury rating of plants at -6°C (21.2°F), but not at lower temperatures where all injury ratings were high. Pruning × freeze treatment was not significant for percent mortality in the fall. Percent mortality increased linearly as temperature decreased, regardless of pruning treatment. In addition, percent mortality was greater in pruned plants (87%) than in nonpruned plants (67%) in the fall. One hundred percent mortality was reached at -16C (37°F) for nonpruned plants and -14°C (42°F) for pruned plants (Table 2).

**Winter Freeze.** Mean ambient air temperature between January pruning and freeze treatment was 2.8°C (37°F) and ranged from -2.8°C to 13.3°C (27°F to 56°F). In winter, no new growth was stimulated by pruning. The plants were fully dormant with woody stems and grayish leaf color. There were no interactions between pruning and freeze temperature for injury rating or percent mortality of butterfly bush frozen in January. Across pruning treatments, butterfly bush rating increased linearly in injury rating and mortality as temperature decreased, but pruning treatment did not affect either injury ratings or percent mortality. In January, the lowest sample temperature tested, -20°C (-4°F), did not result in 100% mortality.

**Spring Freeze.** Mean ambient air temperature between the March pruning and freeze treatment was 10°C (50°F) and ranged from –5.6°C to 25°C (22°F to 77°F). When spring pruned plants were deacclimating and new growth was stimulated. There were no significant interactions for injury rating or mortality between pruning and freeze temperature for November, January, or March pruned plants or control plants frozen in March. Both injury rating and percent mortality increased linearly as freeze temperature decreased, regardless of pruning treatment. In March, 100% mortality was reached at -14°C (42°F) for both nonpruned and March-pruned plants. November-pruned plants had 100% mortality at -16°C (37°F) and January-pruned plants reached 100% mortality at -18°C (30°F).

## DISCUSSION

Our study demonstrates that fall pruning butterfly bush before the plants have become dormant and conditions are still favorable for re-growth, increases the chance for low temperature injury and possibly death. Since plants were fully acclimated in the winter, there was not significantly more injury when pruned. During spring pruning, plants were more deacclimating and the killing temperature was higher than at the winter sampling. However, pruning at this time did not significantly alter the hardiness of butterfly bush. Therefore, growers and homeowners alike should prune late in winter or early spring to minimize the chance of cold injury to butterfly bush.

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