Early Lifting and Transplanting of Flowering Dogwood Seedlings Increases Survival in the Southern United States[1]

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Abstract

Effects of lift date and photoperiod on budbreak and survival of 1-0 flowering dogwood (*Cornus florida* L.) seedlings were studied under greenhouse conditions while survival was evaluated on plants transplanted in field plots. Seedlings were lifted from field beds on October 3, 1990; October 31, 1990; November 28, 1990; December 18, 1990; and February 5, 1991 (0, 63, 192, 357, and 851 chill hours, respectively (<7°C, 45°F)) and were placed in photoperiod chambers (10, 12, and 14 hr) constructed in a greenhouse or planted in the field under natural conditions. Increasing photoperiod under greenhouse conditions decreased the number of days to budbreak across lift dates. Photoperiod had no effect of survival. Survival of greenhouse plants was greater than 85% for all but the February lift date (72%). Survival of plants in the field decreased to 50% for the December lift date compared to >90% for both October lift dates. Mean survival across lift dates for the greenhouse and field plants were 88% and 77%, respectively. No differences in shoot growth or root regeneration were seen between treatments for greenhouse-grown plants. Results of these studies suggest that bareroot seedlings of flowering dogwood should be lifted and planted in the fall for optimal survival in the warmer areas of the southern United States.

Index words: chilling, dormancy.

Species used in this study: Flowering dogwood (*Cornus florida* L.).

Significance to the Nursery Industry

The results in this study demonstrate that flowering dogwood seedlings grown and planted in the coastal plain region of the southeastern United States can be planted in the fall with good field survival. Seedlings should set terminal buds but do not appear to require chilling temperatures in the nursery prior to lifting. High survival of fall transplanted trees expands the lifting season in the nursery and provides an opportunity to reduce peak labor requirements. Fall lifting could help reduce the need for cold storage facilities; however, the effects of cold storage should be explored as another way to enhance seedling performance and improve nursery efficiency.

Introduction

Flowering dogwood (*Cornus florida* L.) is a shade-tolerant understory tree native to the eastern United States. The tree is extremely popular as a landscape plant with many named cultivars (3, 4). Seed propagated flowering dogwoods are produced by transplanting liners from seedbeds to nursery blocks (3). While many of the silvicultural characteristics of flowering dogwood are known (7), little is known regarding the optimum time for transplanting. A recent report indicated that bare-root flowering dogwood seedlings should be transplanted from November through April (1).

Decreasing photoperiod was shown to enhance the onset of dormancy of flowering dogwood (5, 15). Most temperate-zone deciduous trees require a period of chilling to break dormancy (10, 11). Dormant seedlings generally have a low root regeneration potential which makes timing of transplanting important since root regeneration potential influences transplant survival (2, 12). This study investigated the effects of lift date and photoperiod on the budbreak and survival of flowering dogwood seedlings under greenhouse and field conditions. A better understanding of the effects of lift date, chilling hours, and photoperiod on flowering dogwood could help establish optimal lift dates to enhance seedling survival.

Materials and Methods

Seed used in these studies were collected from seed-grown trees at the Georgia Forestry Commission nursery in Pulaski Co., GA. Flowering dogwood seedlings were produced under standard cultural conditions at the Georgia Forestry Commission nursery in Peach Co., GA. The 1–0 seedlings were mechanically harvested and graded for uniformity in the field before being transported to the Coastal Plain Experiment Station in Tifton, GA. The five lift dates used in these studies were October 3, 1990; October 31, 1990; November 28, 1990; December 18, 1990; and February 5, 1991. Chilling hours accumulated (<7°C, 45°F) at the nursery in Peach Co., GA for the lift dates used were 0 (Oct 3), 63 (Oct 31), 192 (Nov 28), 357 (Dec 18) and 851 (Feb 5), respectively.

For the greenhouse study, plants were potted in Zarn 900 containers (10 cm wide (3.9 in) × 36 cm (14.2 in) deep, Zarn, Inc.) using Metro-Mix 300 (Grace-Sierra) within 24 hr of lifting and were randomly placed in three separate photoperiod chambers (1.8 m (6 ft) × 2.4 m (8 ft)) constructed in a greenhouse. Photoperiods of 10, 12, and 14 hr were maintained by covering the photoperiod chambers with black

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plastic between 1700 and 1800 EST nightly and providing supplemental light (1 to 2 µmol $m^{-2}s^{-1}$ at plant level) using a 75 w incandescent light bulb in each photoperiod chamber. Plants were watered as needed. Greenhouse temperatures during the study were maintained above 13°C (55°F) at all times using a natural gas greenhouse heater to prevent further accumulation of chilling hours. Daytime temperatures in the greenhouse were allowed to follow outdoor temperature patterns but were not allowed to exceed 35°C (95°F). For analysis purposes, daily fluctuations of temperature in the greenhouse were considered as part of the lift date effects.

Plants were evaluated in the greenhouse for 60 days following lifting. Data collected were: 1) days to budbreak, 2) survival, 3) number of new shoots developed per plant, 4) shoot length, and 5) number of new roots (> 1 cm in length) at the end of the 60 day period. Budbreak was defined as the stage when expanding green leaves from a bud were visible. For each lift date, twelve replicate plants per photoperiod treatment were used.

For the field study, plants were outplanted in a randomized complete block design with three replications and eight sample plants per replication for each lift date. Plants were grown in a Tifton loamy sand (fine-loamy, siliceous, thermic plinthic paleudult) and were irrigated using solid set sprinklers when needed. Maximum and minimum temperatures outdoors during the experimental period were 35.6°C (96°F) and –2.8°C (27°F), respectively. Percent survival was recorded on November 4, 1991. Data for both studies were evaluated by analysis of variance (SAS Institute Inc., Cary, NC).

Results and Discussion

As the season progressed and chill hours accumulated, days to budbreak decreased and budbreak was more rapid at 14 hr than at the 12 hr or 10 hr photoperiods except at the February 5 lift date (Table 1). Plants under a 12 hr photoperiod broke bud sooner than those placed under a 10 hr photoperiod for all but the October 3 lift date.

Percent budbreak was described by a curvilinear relationship between photoperiod and lift date (Table 1). Photoperiod induced budbreak in dogwood seedlings that had not been exposed to chilling temperatures at the October 3 lift date. One-third of the plants placed under a 14 hr photoperiod broke bud compared to less than 8% budbreak under the shorter photoperiod treatments. These results suggest that flowering dogwood seedlings were in endo-dormancy on October 3 as described by Lang et al. (9) since the plants were dormant but did not break bud under favorable environmental conditions unless photoperiod was at least 14 hr. Before the February 5 lift date few plants under the 10 hr photoperiod regime broke bud. The natural photoperiod in Georgia between October and March is 10 to 12 hrs, so plants in the nursery would therefore receive similar photoperiods as used in this study. Beginning with the October 31 lift date through December 18, photoperiods of 12 and 14 hrs were able to partially substitute for lack of chill hours by allowing budbreak to occur.

Lift date and photoperiod had no effect on the number of shoots, shoot length, or number of new roots on flowering dogwood seedlings in the greenhouse study (data not shown).

Photoperiod had no effect on the survival of flowering dogwood seedlings in the greenhouse (data not shown). Survival was greater than 85% through the December 18, 1990 lift date but decreased to 72% for the February 5 lift date (Table 2). Mean survival across lift dates in the greenhouse was 88%.

In the field, mean survival across lift dates was 77%. Survival decreased from 100% at the October 3 lift date to 50% at the December 18 lift date before increasing to 63% survival for the February lift date (Table 2).

Photoperiod is important for the onset of dormancy in flowering dogwood (5) and plays a minor role in the release from dormancy (13). The results of this study were similar to those of Garber (8) who found the effects of photoperiod on release from dormancy decreased with increased chill hours in seedlings of *Pinus taeda* L. Photoperiod had a greater effect on budbreak on the October 31, November 28, and December 18 lift dates in this study.

Mean survival of plants in the greenhouse was greater than for plants in the field. Although days to budbreak was

Table 1. Influence of lift date (LD) and photoperiod (PP) on the number of days to budbreak and percent budbreak of flowering dogwood seedlings in the greenhouse 60 days after lifting. Means of 12 replicate plants per treatment are shown.

		Days to budbreak			Percent budbreak		
	Chill	Photoperiod (hr)			Photoperiod (hr)		
Lift date	hours	10	12	14	10	12	14
10/3/90	0	> 60	> 60	56	8	0	33
10/31/90	63	> 60	51	33	17	58	100
11/28/90	192	> 60	50	40	0	75	67
12/18/90	357	57	49	39	33	80	92
2/5/91	855	33	22	26	75	100	100
ANOVA[z]							
LD		**			**		
LD*LD		*			**		
PP		**			**		
PP*PP		NS			*		
LD*PP		NS			NS		
LD*LD*PP		**			**		
LD*PP*PP		NS			*		
LD*LD*PP*PP		NS			*		

[z]NS, *, ** Nonsignificant or significant at P = 0.05 or 0.01, respectively.

Table 2. Influence of lift date on the survival of flowering dogwood seedlings in the greenhouse and under field conditions. Means ± standard error are shown.

Lift date	Chill hours	Percent survival in greenhouse (n = 36)	Percent survival in field (n = 24)
10/3/90	0	92 ±4.7	100 ± 0.0
10/31/90	63	100 ±0.0	92 ± 5.7
11/28/90	192	89 ±5.3	79 ± 8.4
12/18/90	357	86 ±5.8	50 ±10.4
2/5/91	855	72 ±7.5	63 ±10.0
ANOVA[z]			
Lift date			
Linear		**	**
Quadratic		NS	NS
Cubic		NS	*

[z]NS, *, ** Nonsignificant or significant at P = 0.05 or 0.01, respectively.

least and percent budbreak highest in seedlings lifted on February 5, survival appeared to decrease after December 18. Survival of plants in the field decreased after the November 28 lift date but began to recover at the February lift date. Transplant survival has been linked to root regeneration (2, 12, 14). Although treatments had no effect on root regeneration under greenhouse conditions, soil moisture content has been shown to be the most important factor for the survival of flowering dogwood seedlings under field conditions (6). While moisture was not considered limiting under greenhouse or field conditions, wilting of dying plants was observed. Low root:shoot area ratios which limited water uptake after transplanting may have resulted in seedling mortality from desiccation.

The results of this study suggest that bareroot seedlings of flowering dogwood be planted in the fall for best survival in warm areas such as the coastal plain region of the southeastern United States. In areas with colder winters, for example the mountains of north Georgia, fall transplanting is not recommended because plants may be killed by low temperatures or desiccation due to frost heaving of transplanted seedlings. The lift dates used in this study were dictated by chilling hours and field accessibility. Further research on lifting dates and the effects of chilling accumulation under controlled storage conditions may give additional insight to the results obtained in this study.

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