Seed Germination of *Pieris floribunda*: Influence of Light and Temperature[1]

Mark C. Starrett[2], Frank A. Blazich[3], and Stuart L. Warren[4]
Department of Horticultural Science
North Carolina State University
Raleigh, NC 27695-7609

Abstract

Seeds of *Pieris floribunda* (Pursh ex Sims) Benth. and Hook. (mountain andromeda) were germinated at 25°C (77°F) or an 8/16 hr thermoperiod of 25°/15°C (77°/59°F) with daily photoperiods of 0, ½, ½ twice daily, 1, 2, 4, 8, 12, or 24 hr. In seeds exposed to light, germination at 25°C (77°F) began between 3 and 6 days compared to 6 to 9 days at 25°/15°C (77°/59°F), but the delay did not influence cumulative germination. For seeds exposed to light, 30-day germination for equivalent photoperiods at both temperatures was similar. Without light, 30-day germination at 25°C (77°F) and 25°/15°C (77°/59°F) was 38% and 52%, respectively. Daily photoperiods as short as ½ hr increased cumulative germination to 90% at 25°C (77°F) and 25°/15°C (77°/59°F). The remaining light treatments yielded 88 to 95% germination. High germination percentages were due in part to rigorous seed grading prior to initiation of the study.

Index words: seeds, sexual propagation, mountain andromeda, Ericaceae, native plants

Significance to the Nursery Industry

Quantitative data are presented regarding the influence of light and temperatures of 25°C (77°F) and 25°/15°C (77°/59°F) on seed germination of *P. floribunda*. Regardless of temperature, seeds do not require light for germination. However, for seeds placed under constant or alternating temperature, daily photoperiods as short as ½ hr will result in germination of approximately 90%. Although germination is not difficult to accomplish, seed viability of *P. floribunda* is inherently low. Thus, to achieve high germination percentages as reported herein, rigorous seed grading is necessary prior to sowing. Nurserymen are cautioned not to cover the seeds during sowing since they require light to maximize germination and are relatively small [approximately 210,000 seeds per 28g (1 oz)].

Introduction

Pieris floribunda (mountain andromeda) is a native ericaceous, evergreen shrub of the southeastern United States. It occurs mainly in the high mountain areas of Virginia, North Carolina and Tennessee (9). Within this range, distribution is limited and scattered throughout the Blue Ridge Mountains (13).

Pieris floribunda can grow to a height of 2 m (6 ft) with a dense, mounded habit. Flowering occurs in late spring with upright clusters of white, bell-shaped flowers. The erect habit of the flower spike (panicle) is a unique characteristic of this species that distinguishes it from others within the genus. The flower buds, developed in fall, are an added feature of the plant in the winter landscape.

In addition to having several desirable growth characteristics, *P. floribunda* is seldom afflicted by lacebug (*Stephanitis takeyai* Drake and Maa.), which is common on *P. japonica* Thunb. (Japanese andromeda), tolerates a higher pH and is more cold-hardy (to Zone 4) (4). As a result, landscape-size plants are in demand. Unfortunately, supplies are often limited because propagation is slow and generally difficult.

Traditionally, the principal means of meeting demand has been the harvesting of mature, native plants that are sold balled and burlapped or the digging of "cutbacks". The latter is a process whereby the tops of mature, wild plants are removed (cut back) to within 8 to 10 cm (3 to 4 in) of the soil surface (1). Following removal of the tops, the plants are dug and then planted in the field for further growth prior to sale. Both methods of production have resulted in severe depletion of native stands. In North Carolina, exploitation has been so extreme that the species has become rare in areas where it was once abundant. Thus, the scarcity of native plants and other problems associated with digging (e.g., high labor costs) no longer provide a means to produce adequate numbers of landscape size plants. As a result, research is needed to develop propagation techniques for the species.

Propagation of *P. floribunda* can be accomplished by both sexual and asexual means. Although vegetative propagation by stem cuttings would be the most desirable method permitting cloning of superior selections, rooting of cuttings is reportedly difficult (5, 7, 8). Unlike *P. japonica*, which roots readily from hardwood cuttings, limited success has been reported for rooting stem cuttings of *P. floribunda* (5). As a result, sexual propagation is used as the primary method of propagation. However, propagation by seed also has problems. Nurserymen have often commented to the authors that germination is slow and generally poor. Difficulties associated with sexual propagation may be related to lack of knowledge regarding the influence of various environmental factors (e.g. light and temperature) on germination.

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[2]Graduate Teaching Assistant.

[3]Professor.

[4]Associate Professor.

Surprisingly, this is an area that apparently has received no attention. Therefore, the objective of this research was to study the influence of varying photoperiods and a constant versus an alternating temperature on seed germination of *P. floribunda*.

Material and Methods

On October 25, 1986 mature seed capsules were collected from a native population of open-pollinated plants of *P. floribunda* growing in Haywood County, North Carolina at an elevation of 1860 m (6100 ft). Capsules were stored in a paper bag at 20°C (68°F) for 21 days. Seeds were then removed from the capsules and stored at a moisture content of 6% in a sealed glass bottle at 4°C (39°F). Moisture content of the seeds was determined by calculating the mean moisture content of six, 100-seed samples following drying at 105°C (221°F) for 24 hr.

In March 1990, seeds were removed from storage and initially graded with the use of an air column (General Seed Blower-Model ER, Seedburo Intl. Equip. Co., Chicago, Ill.). To remove chaff and empty seeds, the device was operated for a duration of 3 min using pan screen #2 (60 mesh) and a setting of 25 with all ports closed. Seeds retained on the pan screen were then subjected to further grading under a dissecting scope. Abnormal, damaged, undersized or discolored seeds and other large debris, not eliminated by the air column, were removed manually. Graded seeds [approximately 210,000 pure seeds per 28 g (1 oz)], selected for the germination study, were firm and had a golden color.

Graded seeds were then sown in covered, 9-cm (3.5 in) glass petri dishes, each containing two pre-washed (rinsed) germination blotters (Filtration Sciences Corp., Mt. Holly Springs, Pa.) moistened with tap water. Following placement of seeds in the dishes, half were designated for germination at 25°C (77°F) and the other half for germination at an 8/16 hr thermoperiod of 25°/15°C (77°/59°F). All dishes were placed in double-layer, black, sateen cloth bags and the seeds allowed to imbibe overnight at 21°C (70°F). The next day, bags were randomized within two growth chambers [C-chambers (6)], set at the appropriate temperatures. Chamber temperatures varied within ± 0.5°C (0.9°F) of the set point.

Within each temperature regime, seeds were subjected daily to the following photoperiods: total darkness, ½, two ½ hr photoperiods separated by 7½ hr of darkness, 1, 2, 4, 8, 12 or 24 hr. Regardless of temperature, photoperiod treatments were administered at the same time each day. All photoperiod treatments for the alternating temperature of 25°/15°C (77°/59°F), with the exception of total darkness and 24 hr, began with the transition to the high temperature portion of the cycle.

Growth chambers were equipped with cool-white fluorescent lamps that provided a photosynthetic photon flux (400–700 nm) of 69 μmol m^{-2} s^{-1} (5.3 klx) as measured at dish level with a cosine corrected LI-COR LI-185 quantum/radiometer/photometer (LI-COR, Lincoln, Neb.). All photoperiod treatments, except total darkness and the 24 hr irradiation, were regulated by removal and placement of the petri dishes in black sateen cloth bags. For the 24-hr photoperiod treatment, the petri dishes remained continuously unbagged in open chamber conditions. Regardless of the photoperiod, temperatures within the petri dishes, as measured by a thermocouple, never exceeded ambient temperature by more than 1°C (2°F). The constant darkness treatment was maintained by keeping the petri dishes in the black cloth bags throughout the experiment and all watering and germination counts were performed in a darkroom utilizing a fluorescent lamp equipped with a green acetate filter (Rosco Laboratories, Port Chester, N.Y.). Germination blotters were kept moist with tap water throughout the duration of the experiment. Seeds showing signs of decay were immediately removed from the dishes.

Each photoperiod treatment was replicated four times with a replication consisting of a petri dish containing 100 seeds. Germination counts were recorded every 3 days for 30 days. A seed was considered germinated when the emerging radicle was ≥1 mm (0.04 in).

Percent germination was calculated as a mean of four replications per treatment. Within each temperature, data were subjected to analysis of variance and regression analysis (12).

Results and Discussion

At both temperatures, seeds of *P. floribunda* did not require light to germinate. However, germination was greatly enhanced by daily photoperiods as short as a ½ hr (Fig. 1), resulting in 90% germination by day 30 for both constant and alternating temperatures.

In seeds exposed to light, germination at 25°C (77°F), began between 3 and 6 days compared to 6 to 9 days at 25°/15°C (77°/59°F) (Fig. 1). The delay in germination did not influence cumulative germination by day 30 (Fig. 2).

Analysis of variance showed that for each temperature, photoperiods, time (days) and their interactions were highly significant. Therefore, regression analysis was conducted on cumulative germination within each temperature for every 3-day sampling interval (Table 1). The analysis did not include data for total darkness or the split photoperiod.

At 25°C (77°F) a significant linear germination response to photoperiod was noted, beginning at day 9 and continuing to day 15 (Table 1, Fig. 2A). Thereafter, the response was nonsignificant. This response demonstrated that increasing photoperiod inhibited germination up to day 15. For seeds germinated at 25°/15°C (77°/50°F), a significant linear germination response was observed by day 9 after which the response was nonsignificant (Table 1, Fig. 2B). Regardless of temperature, there was no quadratic germination response to photoperiod.

Germination of 38% and 52% in darkness at 25°C (77°F) and 25°/15°C (77°/59°F) (Fig. 1), respectively, was surprising since germination studies with other native ericaceous species such as leucothoe [*Leucothoe fontanesiana* (Steud.) Sleum. (3)], mountain laurel [*Kalmia latifolia* L. (11)], flame azalea [*Rhododendron calendulaceum* Michx. Torr. (10)] and rosebay rhododendron [*Rhododendron maximum* L. (2)], have shown that when seeds of these species are placed for germination in darkness at the aforementioned temperatures, germination is negligible. The response of *P. floribunda* in darkness raised the question whether there was a loss of light sensitivity with storage (aging) since the seeds had been in storage since November 1986. Another question was whether dark germination was characteristic of this particular seed lot. To answer these questions, an experiment was conducted, using procedures described in the materials and methods, in which the germination response of

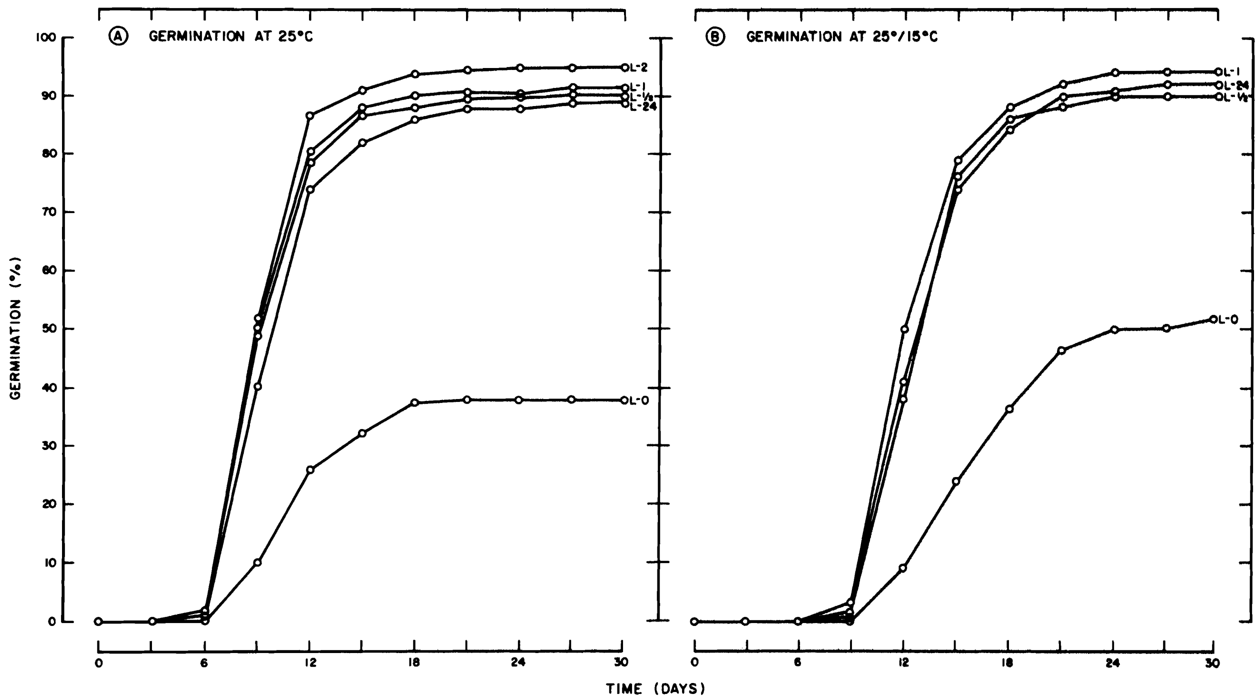

Fig. 1. Influence of light and temperature on seed germination of *P. floribunda*. (A) germinated at 25°C (77°F) with daily photoperiods (L) ranging from total darkness (L-0) to 24 hr (L-24). (B) germinated at 25°/15°C (77°/59°F) utilizing the same photoperiods as in A. Data for ½ + ½, 4, 8 and 12 hr photoperiods were omitted from both graphs and in Fig. 1B data for the 2 hr photoperiod were also omitted since they were similar to the ½ hr light treatment.

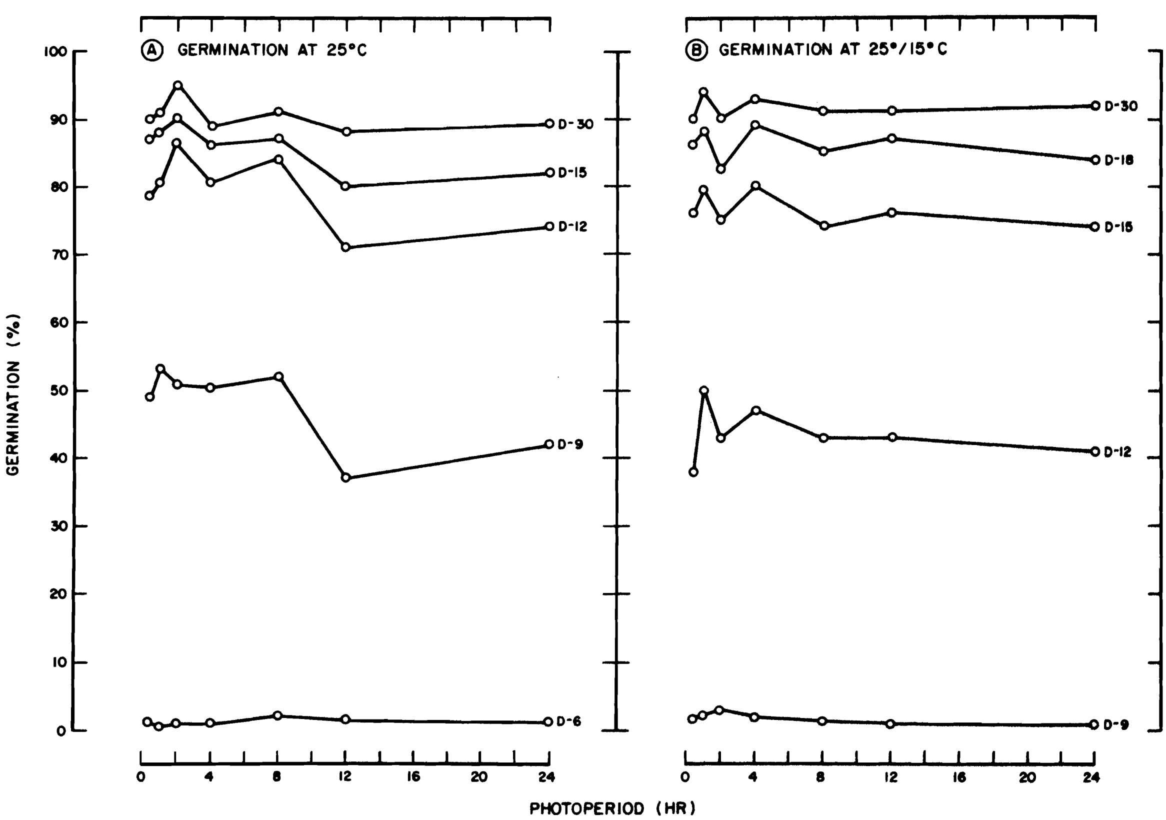

Fig. 2. Cumulative seed germination of *P. floribunda* as influenced by photoperiod at days (D) 6 to 30. Data for seeds germinated in total darkness and the ½ + ½ hr photoperiod were omitted. (A) germinated at 25°C (77°F). Data for days 18, 21, 24 and 27 were omitted since they were similar to day 30. (B) germinated at 25°/15°C (77°/59°F). Data for days 21, 24 and 27 were omitted since they were similar to day 30.

Table 1. **Influence of photoperiod on cumulative seed germination of *Pieris floribunda* for days 6 to 30.**

		Time (days)								
Temp. (°C)	Photoperiod[z]	6	9	12	15	18	21	24	27	30
25°	L	NS	*	*	*	NS	NS	NS	NS	NS
25°/15°	L	—[y]	*	NS	NS	NS	NS	NS	NS	NS

[z]NS, * indicates nonsignificant or significant (p = .05) linear (L) response, respectively.

[y]No germination occurred by day 6.

the 1986 seeds in darkness at 25°C (77°F) and 25°/15°C (77°/59°F) was compared to that of seeds collected from the same plants in 1987, '88, '89 and '90. Results (data not presented) showed that germination at both temperatures in darkness for all seed lots was similar. This suggests that for the particular provenance of *P. floribunda*, whose germination response is presented in Fig. 1, the seeds do not have a light requirement for germination. However, as the data in Fig. 1 illustrate, exposure to light stimulates germination. It would be intriguing to determine if other provenances of *P. floribunda* respond similarly when germinated in the absence of light.

Although light was needed for maximum germination at 25°C (77°F) and 25°/15°C (77°/59°F), the highest germination was with photoperiods of 2 hr and 1 hr, respectively (Fig. 1). Photoperiods of greater duration were slightly inhibitory. Starting at day 12 and continuing to day 30, germination at 25°C (77°F) under a 2 hr photoperiod was always greater than photoperiods of 4, 8, 12 and 24 hr. Germination at 25°/15°C (77°/59°F) under a 1 hr photoperiod was consistently greater than 2, 4, 8, 12 and 24 hr photoperiods, beginning at day 12 and continuing to day 30.

Prior to initiating this experiment, a preliminary study was conducted using procedures described in the materials and methods to determine viability of the seed lot utilized. Seeds were graded under a dissecting scope as described in the materials and methods and divided into two groups, both of which were placed at 25°C (77°F). One group was maintained in constant darkness and the other received 16 hr of cool-white fluorescent light daily. Germination was recorded daily for 30 days. Results indicated greater germination in light as opposed to darkness. However, germination in both treatments was poor (<30%). Examination of nongerminated seeds at the conclusion of the study showed that many were empty, suggesting that more rigorous seed grading was required. This led to use of the air column (General Seed Blower) as also described in the materials and methods. Such a device is commonly used to separate seeds of different grass species based on a variable air flow. Seed grading, as used in this study, involved initial use of the air column followed by additional grading under the dissecting scope. This procedure permitted us to achieve the high germination reported herein.

The relatively poor germination observed when seeds are not rigorously graded may explain why nurserymen have often stated that germination is difficult to accomplish. Although germination of viable seeds is not difficult, as our results demonstrate, viability appears to be inherently low and rigorous grading is necessary to achieve high germination. The reason(s) for low viability are deserving of further study.

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