LIGHTING AND OVERWINTERING

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Abstract Night-break lighting during the late summer, early autumn was shown to delay the onset of dormancy with *Cornus alba* 'Argenteo-marginata', *Weigela florida* and *Viburnum opulus*, provided the temperature was not too low; however, this was accompanied by a corresponding delay in the breaking of dormancy the following season. This delay could be reduced by growing plants under cold conditions after lighting was finished. The potential of short periods of photoperiodic lighting as a commercial technique are discussed.

INTRODUCTION

Deciduous cuttings taken during the summer and potted the same season become dormant shortly after potting under natural daylengths, possibly before an adequate root system has developed or plants have become properly established. This can lead to severe overwintering losses. With certain species the onset of dormancy and leaf-fall in the autumn can be delayed by artificial extension of daylength using low intensity illumination (1, 4, 5, 7). This technique can be used to improve the rooting of some species (6, 8) but the aspect considered in the trials at Efford concerned the effect of extending daylength on the subsequent growth of the plant. The photoperiodic response of a range of trees and shrubs were listed in a review by Naylor (3) and those where dormancy had been delayed by the use of long photoperiods included *Cornus florida*, *Viburnum opulus* and *Weigela florida*.

The scope of the work reported here was limited to the examination of the effectiveness of night-break lighting in extending the growing season of summer struck cuttings and its effect on plant establishment and overwintering. In an early trial (2) one species in particular was found to be highly sensitive to photoperiod, namely *Cornus alba* 'Argenteo-marginata', and consequently the major part of the work has looked at effects of extending daylength on this species, although other species have also been included for observation and comparison.

MATERIALS AND METHOD

Summer rooted cuttings were potted in the late summer into 3½ in. plastic pots in a 75% peat, 25% sand mix, based on the recommendations from the Glasshouse Crops Research Institute (2b). Plants were grown in a glasshouse on an irrigated sand bench and lighting treatments were applied one week after potting. Night-break lighting was given from 0200 to 0700 hours using 60 watt tungsten filament bulbs with reflectors suspended 2'6" above bench height and spaced at 4' intervals along the bench.

Trial 1: Cuttings of *Cornus alba* 'Argenteo-marginata' and *Weigela florida* taken during the first week in July, 1971, were potted during the third week in August. Half the plants received night-break lighting from the end of August until early March 1972, the other half being grown under natural daylengths. A minimum temperature of 40°F was maintained.

Trial 2: Cuttings of *Cornus alba* 'Argenteo-marginata' and *Viburnum opulus*, taken during the second week of July, 1973, were potted during the third (*Cornus*) or final (*Viburnum*) week of August. Plants were grown at a minimum of either 55°F or 40°F and received natural daylengths or night-break lighting for 8, 16 or 18 weeks before being moved to unlit areas at a similar temperature, or transferred outside to receive a "cold" treatment. (The original design incorporated a 24 week period of lighting to examine effects of lighting throughout the winter, but as a result of the 1973/74 fuel crisis lights had to be switched off after only 18 weeks).

RESULTS

Trial 1. The unlit plants of both *Cornus* and *Weigela* became dormant shortly after potting but those receiving night-break lighting continued in growth until January, at which time they also became dormant. However, while the unlit plants recommenced growth in late February to early March, the lit *Weigela* plants remained dormant until April and the majority of the lit *Cornus* failed to break dormancy at all and eventually died the following autumn. Even where the lit plants did eventually grow again, because of the delay in breaking dormancy they were rapidly overtaken by the unlit plants which had started to grow earlier in the year.

Table 1. Influence of night-break lighting on the growth of rooted *Cornus* cuttings.

	Percent Breaking Dormancy	Average Height (cm) of plants during:				
		Aug. '71	Dec. '71	June '72	Sept. '72	Oct. '72
Lit	25	4	13	14	35	35
Unlit	100	5	5	18	51	51

The fact the lighted plants stopped growing during January suggested that temperature had become the dominant factor in determining dormancy. This led to the second trial being designed to investigate the interaction of temperature and lighting on dormancy.

Trial 2. Final results are not yet available but certain aspects are already clear.

a) *Onset of Dormancy:* (Table 2) Dormancy was assessed as the date by which buds had obviously ceased to be active, and leaf senescence occurred on average 1-4 weeks after buds had become dormant. As previously, plants grown under natural daylengths became dormant shortly after potting.

Cornus: Extending the daylength delayed the onset of dormancy, and the longer lighting continued, the greater was the delay. In this particular trial the onset of dormancy did not appear to be influenced by temperature.

Viburnum: The influence of lighting in delaying dormancy was less marked than with *Cornus* but temperature did have an effect, a higher temperature maintaining growth for almost a month after plants at the lower temperature had ceased growth.

Table 2. Average date by which plants were dormant

	Temperature	Number of weeks lighting			
		Unlit	8	16	18
Cornus					
	55^{0}F	5 Oct	10 Dec	31 Dec	31 Dec
	40^{0}F	5 Oct	10 Dec	31 Dec	27 Dec
Viburnum					
	55^{0}F	31 Dec	9 Dec	15 Jan	—
	40^{0}F	30 Nov	10 Dec	24 Dec	—

b) *Breaking of Dormancy:*

Table 3. Average date by which plants broke dormancy

	Temperature	Number of weeks lighting			
		Unlit	8	16	18
Cornus					
	55^{0}F	15 April	20 April	31 May	4 June
	40^{0}F	4 March	20 March	23 March	2 April
Viburnum					
	55^{0}F	12 March	12 March	8 April	—
	40^{0}F	25 Feb	12 March	4 March	—

Cornus: Both temperature and lighting had a marked effect on the breaking of dormancy. The influence of daylength was such that the longer the duration of lighting the greater the delay in breaking dormancy while plants grown at a minimum temperature of 40^{0}F started into growth well in advance of those grown at a minimum of 55^{0}F (Table 3). Regardless of lighting treatment all plants grown at 40^{0}F eventually recommenced growth the following spring, but several plants grown at a minimum of 55^{0}F and receiving 16 or 18 weeks of lighting have so far failed to break dormancy. The actual percentage of buds growing out was also reduced by lighting as compared with plants grown under natural daylengths, especially where lit for 16 or 18 weeks (Table 4). The reduction in number of internodes at the 18 week lighting treatment (55°F) was due to some die back of shoots in this particular treatment.

Table 4. Effects of treatments on plant growth of rooted *Cornus* cuttings.

		Number of weeks lighting		
	Unlit	8	16	18
1) Number of Internodes/Plant (April 1974)				
55°F	11	21	32	20
40°F	8	20	18	18
2) Buds Growing Out (June 1974)				
55°F	67%	56%	5%	2%
40°F	54	59	63	66

Transferring plants outside after giving the lighting treatments had the effect of initially hastening dormancy but also of breaking dormancy on average 2-3 weeks earlier than plants grown on at 55°F, or 1 week earlier than those grown on at 40°F. In addition the "cold" treatment had the effect of improving the percentage of buds growing out and this particularly marked where plants were moved out from the higher temperature after receiving 16-18 weeks lighting. Left at 55°F, only 2-5 percent of the buds grew; this improved to 60 percent where plants were transferred outside. Some shoot damage was observed where plants were moved outside from the higher temperature. Final measurements have not been completed but in view of the earlier breaking of dormancy of the unlit plants, it appears inevitable that the growth of these will catch up those lit for 16-18 weeks, but whether they will catch up with those lit for 8 weeks, where the delay was reduced, remains to be seen.

Viburnum: Effects of temperature and lighting were not as marked as with *Cornus* but there was a delay in the breaking of dormancy as a result of lighting, especially at the higher temperature (Table 3). Unlike *Cornus* all plants eventually broke dormancy the following spring. Effects of transferring plants outside after treatments followed a similar pattern to that observed with *Cornus*.

DISCUSSION

These trials were of a preliminary nature only and were not designed for statistical analysis. However, the marked effects of treatments means that certain conclusions are possible.

While it was shown that plants could be induced to continue growing into the autumn by the use of night-break lighting, long term effects must also be considered since, associated with the delay in dormancy, was a corresponding delay in the breaking of dormancy. The magnitude of the delay varied with species but with *Cornus* the point was reached where plants failed to break dormancy after a prolonged period of lighting. This was thought to be associated with temperature, with *Cornus* having perhaps a greater cold requirement for breaking dormancy than either *Weigela* or *Viburnum*. Thus the initial advantage of increased growth in the autumn became offset by plants grown under natural daylengths starting growth earlier in the spring.

It was clearly demonstrated that the plant's ability to continue growth out of season was linked with temperature, too low a temperature causing dormancy even with lighting. At higher temperatures, growth continued for as long as lighting continued. At the Glasshouse Crops Research Institute (9) it was shown that growth of *Cornus alba* 'Spaethii' could be maintained by lighting throughout the winter. The somewhat weaker growth obtained under lighting was due no doubt to forcing growth under low light intensities. The adverse effects of lighting were reduced at lower temperatures and where plants were subjected to a period of cold after lighting. However, it seems likely that a more severe winter than that experienced during 1973/74 would cause severe damage to plants transferred outside in active growth; a more logical approach would be to gradually reduce temperatures under glass to harden plants off.

In terms of improving initial growth as an aid to establishment, the most promising treatment appears to be the use of night-break lighting for an 8-week period as plants grown here received an initial boost but the delay in breaking dormancy was reduced. In addition, it would be possible to give this treatment under cold glass conditions as temperatures during the lighting period should not be limiting to growth, plants would harden off naturally, and a weakening of growth would be avoided. In deciding to extend the growing season by the use of photoperiod, it is important to start lighting well before leaf fall as the axillary buds cease to be active some time before signs of leaf senescence are apparent.

While there was no obvious improvement in establishment as a result of lighting with species used in these trials, an improvement in initial growth could be of greater importance with plants which are relatively difficult to overwinter such as *Acer* and *Magnolia*, species of which have been shown to respond to long photoperiods (4, 5, 7). In view of the varying response of the limited number of species used in these trials further work is required before this technique can be generally recommended for a wider range of species. Classification of species as to their photoperiodic response group would be a starting point. That the technique can be of benefit to the hardy nursery stock industry has been proved as low intensity photoperiodic illumination is already successfully in use on some commercial nurseries to improve rooting and initial growth of *Rhododendron* and *Celmatis* species.

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