DORMANCY REQUIREMENT AND GREENHOUSE FORCING OF THREE EUONYMUS CULTIVARS

CALVIN CHONG

Ministry of Agriculture and Food
Horticultural Research Institute of Ontario
Vineland Station, Ontario, Canada L0R 2E0

Abstract. Summer-rooted cuttings of *Euonymus fortunei* 'Sarcoxie', 'Emerald Gaiety', and 'Gold Tip' transferred from outdoors to a greenhouse between Dec. 15, 1987 and Feb. 15, 1988, grew vigorously under greenhouse conditions (23°/14°C day/night) indicating that 1128 chilling hours below 7.2°C was adequate. In contrast, rooted cuttings brought in between Sept. 15 and Nov. 15 remained dormant. There was no visible growth except for the occasional basal shoot sprouting intermittently throughout the forcing period, and uneven or suppressed bud burst and shoot growth towards spring. Vigorous growth was restored when these plants were later chilled at 4°C for 3 weeks (500 chilling hours) in a cooler.

INTRODUCTION

Winter forcing of *E. fortunei* in a heated greenhouse can significantly shorten the production cycle. However, some nurseries in Ontario have experienced uneven or poor growth and significant plant losses during the winter. These problems appear to be related to improper scheduling and (or) cultural practices during fall and winter.

When seasonal growth ceases in the fall due largely to short days and low temperatures, buds of woody temperate species first enter predormancy, a reversible transitional phase (4). Plants in predormancy still have the capacity for growth but conditions under which growth occurs become narrower until plants are truly dormant. During dormancy or "rest", no growth occurs even under the most favorable conditions (4). After the chilling requirement has been satisfied, a transition to postdormancy occurs, and buds resume growth, at first under narrow but later under widening environmental limits (3, 4, 5).

The present study was undertaken to determine the chilling requirements of three *E. fortunei* cultivars and to elucidate their cycle of dormancy and growth to facilitate better scheduling for winter forcing.

MATERIALS AND METHODS

In early Sept. of 1987, 8 to 12 cm long summer-rooted cuttings of *E. fortunei* 'Sarcoxie', 'Emerald Gaiety', and 'Gold Tip' were potted in 10-cm square pots and placed outside under lath.

A total of 240 rooted cuttings of each cultivar were divided into 6 groups of 40 cuttings. Each group was subdivided into 4 replications, each with 10 cuttings. The first group was placed in a greenhouse with 23°/14°C day/night temperature regime on Sept. 15,

1987. The others were kept outdoors and transferred by group to the greenhouse on Oct. 15, Nov. 15, Dec. 15, Jan. 15, and Feb. 15, respectively. On each date, the number of hours of temperature exposure below the base temperature of 7.2°C was calculated (2, 5). The experimental design was a split plot with the 6 dates as the main plot and the 3 cultivars as subplot treatments.

In the greenhouse, rooted cuttings were watered and fertilized weekly with 20-20-20 only after shoots showed signs of new growth activity. Once per month, the following observations were recorded: number of shoots; length of new shoots; and position of new shoots (terminal, lateral, basal). Final observations were recorded on Apr. 28, 1988.

RESULTS AND DISCUSSION

Rooted cuttings, transferred to the greenhouse on Dec. 15 or later, initiated rapid bud break and grew vigorously throughout the forcing period (Table 1), indicating that adequate chilling (1128 hours) was received outdoors (2, 4, 6). In comparison to the Jan. and Feb. groups, the Dec. group produced the greatest shoot extension, probably due to the extra time in the greenhouse (Table 1). All cultivars reacted similarly when transferred to the greenhouse, but 'Emerald Gaiety' and 'Gold Tip' produced significantly more and longer shoots than 'Sarcoxie' (Table 2).

Table 1. Chilling hours and total winter growth of *E. fortunei* rooted cuttings brought in from outdoors to greenhouse at monthly intervals between Sept. 15, 1987 and Feb. 15, 1988.

	Date of transfer to greenhouse						
	Sept.15	Oct.15	Nov.15	Dec.15	Jan.15	Feb.15	LSD 5%
Accumulated chillings hours[z]	0	104	480	1128	1816	2544	
Total no. of new shoots per plant[y]	0.9	1.0	1.1	5.0	5.5	4.7	1.0
Total shoot extension (cm) per plant[y]	4.3	4.3	4.3	19.7	10.5	5.9	3.5

[z]Number of hours that the mean air temperature was below 7.2°C

[y]Mean over 3 cultivars measured in April 1988. Data between Sept. 15 and Nov. 15 are for basal shoots mainly. Data between Dec. 15 and Feb. 15 include terminal, lateral and basal shoots.

Rooted cuttings brought in between Sept. 15 and Nov. 15 were dormant (Table 1) due to lack of or to incomplete chilling (4, 6, 7). There was no visible top growth except for the occasional basal shoot sprouting intermittently throughout the forcing period (Fig. 1). Towards spring, terminal buds began to swell but bud burst and

shoot growth were sporadic and(or) suppressed. When these plants were chilled at 4°C for 3 weeks (500 chilling hours) in cold storage during May, then returned to the greenhouse, all plants showed active growth. In relation to the amounts of chilling received, the Oct. and Nov. groups, receiving accumulated outdoor and cold room chilling hours of 604 and 980, respectively, exhibited more rapid and prolific growth activity than their Sept. counterparts receiving 500 cold room chilling hours only.

Table 2. Total winter growth of three *E. fortunei* cultivars.

	Sarcoxie	Emerald Gaiety	Gold Tip	LSD 5%
Total no. of new shoots per plant[z]	2.2	3.6	3.4	0.7
Total shoot extension (cm) per plant[z]	3.4	9.8	10.0	2.5

[z]Mean over 6 dates measured in April 1988.

Kramer and Kozlowski (4) indicated that metabolic activity continues throughout dormancy but dormant buds do not elongate. However, as in the present study, Crabbe (1) observed spontaneous outgrowth of basal buds in certain shrubs in late summer and into autumn when dormancy peaked. This phenomenon, which he referred to as "autumnal basitonic dormancy gradient", is related to the shrubby habit of these species. In the present study, each new sucker grew for 6 to 8 weeks, sometimes becoming taller than the parent shoot, and then remained inactive for the rest of the forcing period. 'Emerald Gaiety' and 'Gold Tip' produced more basal shoots than 'Sarcoxie'. The proximity of roots or even the potential for rooting of these basal shoots seem to play a significant role in morphological development (1).

Figure 1. Basal shoot sprouting from dormant rooted cutting.

At nurseries where problems occurred, rooted cuttings were placed in heated environments after receiving little or no chilling. The presence of basal shoots suggested to growers that these plants were in the active phase. Continued application of fertilizer and water probably induced excessive salts build-up and/or water-logging in the medium, resulting in plant loss. Sluggish growth that persisted after rooted cuttings were planted in container or field nurseries might possible be attributed to incomplete chilling of these plants (4, 5, 7).

Dormancy can be induced in most plants by altering temperatures, day length, light quality, mineral availability or water supply (4,6). In view of the key role of short days and low temperatures in triggering dormancy (8), a study of the interaction of these two factors should yield useful information on the winter forcing of this species.

CONCLUSIONS

This study demonstrated that summer-rooted cuttings of *E. fortunei,* receiving less than 480 hours of chilling below 7.2°C outdoors between Sept. 15 and Nov. 15, remained dormant throughout the winter in a heated greenhouse. Subsequent chilling in a cold room at 4°C for 500 hours allowed normal growth resumption. Chilling of 1128 hours received by Dec. 15 broke dormancy. Between this time and spring a significant amount of winter growth, equivalent to about one year's growth in a field or container nursery, was achieved in the greenhouse.

Acknowledgements. Plant material for this research was generously supplied by Niagara-Holland Nurseries, Niagara-on-the-Lake, Ontario. The technical assistance of Bob Hamersma is appreciated.

LITERATURE CITED

1. Crabbé, J. J. 1981. The interference of bud dormancy in the morphogenesis of trees and shrubs. *Acta Hort.* 120:167–172.
2. Eggert, F. P. 1951. A study of rest in several varieties of apple and in other fruit species grown in New York State. *Proc. Amer. Soc. Hort. Sci.* 57:169–178.
3. Kobayashi, K. D. and L. H. Fuchigami. 1983. Modelling bud development during the quiescent phase in red-osier dogwood (*Cornus sericea* L.) . *Agri. Meteor.* 28:75–84.
4. Kramer, P. J. and T. T. Lozlowski. 1979. *Physiology of woody plants.* Academic Press, N.Y.
5. Richardson, E. A., S. D. Seeley, and D. R. Walker. 1974. A model for estimating the completion of rest for 'Redhaven' and 'Elberta' peach trees. *HortScience* 9:331–332.
6. Samish, K. M. 1954. Dormancy in woody plants. *Ann. Rev. Plant Phys.* 5:183–204.
7. Shaltout, A. D. and C. R. Unrath. 1983. Effect of some growth regulators and nutritional compounds as substitutes for chilling of 'Delicious' apple leaf and flower buds. *Jour. Amer. Soc. Hort. Sci.* 108:898–901.
8. Whalley, D. N. 1977. The effects of photoperiod on rooting and growth of hardy ornamentals. *ADAS Quart. Rev.* 25:41–62.