

very compact habit. All are very easy to root, grow and flower, and command a good retail price at 2 to 3 years.

*Vaccinium glaucalbum*. This superb foliage ground cover thrives on the poorest sandy soils and can be propagated either by stem cuttings or plunged in pots allowing suckers to root which are then removed and potted on. This plant is harmed by nitrogen fertilizers and scorches easily.

Other ericaceous subjects worth considering are:

*Arctostaphylos uva-ursi*, *Gaultheria miqueliana*, *G. cuneata*, *Cassiope* 'Muirhead', *Leucothoe fontanesiana* 'Rainbow', *L. rollisonii*, *Zenobia pulverulenta* (Syn.: *Z. speciosa*), *Vaccinium vitis-idaea* 'Nana' (*V. vitis-idaea* var *minus*? Bot. Ed.), *Phyllodoce aleutica*, and *R. camtschaticum* (which can easily be grown from seed).

Although not an ericaceous subject, *Cornus canadensis* provides a superb ground cover foil for all rhododendrons and associated plants and if planted amongst the stock beds and/or show areas, will prove itself to be another moneyspinner. It can be propagated by forced softwood cuttings or, as in the case of *Gaultheria procumbens*, be planted out to stock frames and allowed to go rampant prior to division and potting.

## GROWTH REGULATORS AND DWARF PLANTS

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In the 1950s there were great hopes of an agricultural revolution through the use of hormones in plant production. Gibberellic acid ( $GA_3$ ) was of particular interest because of many physiological and morphological changes it could cause in the plant. For example, it could increase shoot growth, initiate flower production, break winter dormancy, increase the rate of seed germination and promote cell division. But now, 30 years later, gibberellic acid is being used only in a few cases such as in the production of parthenocarpic fruits in pears and increasing fruit size in grapes. Not all possibilities of its use has been investigated, however. It is known that GA treatment of herbaceous plants such as dwarf peas, tomatoes and maize causes plants to take on the growth pattern of the "normal" plant. With this in mind, it is hoped to cut the production time of woody dwarf plants by applying GA. This should lead to a temporary suppression of the factors that cause dwarfness and

should result in quicker growth. The cultivation time in the nursery can take up to 10 years, which means that they have to be sold at a price which may turn away potential buyers. This article summarizes the progress of the work which is being carried on in this field in the Institut für Obstbau und Baumschule at Hannover University.

## MATERIALS AND METHODS

In 1978 uniform plants of the following species: *Viburnum opulus* 'Nanum', *Salix purpurea* 'Nana', *Lonicera* × *xylosteoides* 'Clavey's Dwarf', *Berberis thunbergii* 'Atropurpurea Nana', *Tsuga canadensis* 'Nana' and *Picea abies* 'Nidiformis' were treated with different concentrations of GA<sub>3</sub>. Experimental design was a randomized block trial with four blocks and five plants per plot. Treatment commenced with bud burst and the concentration ranged between 100 and 1000 ppm. GA<sub>3</sub> was applied either weekly or biweekly until the end of July. Treatment of *Salix* and *Berberis* had to be discontinued at an earlier stage because the plants were too sensitive even at the lowest concentration.

## RESULTS AND DISCUSSION

Every one of the plant species studied reacted to GA. In comparison to the control, *Picea* showed a more upright growth form, longer shoots and a clearly reduced second growth flush in July. Apical dominance was strongly promoted. The plants have been so radically changed in shape that they look like seedlings. They have continued to grow like seedlings in 1979 so that they are no longer recognizable as *P. abies* 'Nidiformis'. Possibly it will take 2 or 3 years before the plants regain their dwarf appearance.

*Tsuga* reacted strongly to GA. Shoots were up to 100% longer without any damaging side effects. The number of side shoots was reduced, which resulted in plants with an open appearance (Table 1).

**Table 1.** Influence of GA<sub>3</sub> on shoot growth and number of side shoots in *Tsuga canadensis* 'Nana'.

GA <sub>3</sub>	Average shoot growth	Average number of side shoots
0 ppm	12.6 cm	6.2
500	20.3	5.3
1000	21.7	3.5

In 1979 *Tsuga* treated in the previous year maintained their growth lead and have, for the most part, regained their dwarf habit.

*Berberis* showed a strong reaction to GA even at the lowest

concentration with respect both to shoot length as well as to number of side shoots. GA could possibly be used to produce larger plants quicker but the optimal concentration should be looked for at a rate of less than 100 ppm.

*Salix* grew almost 100% taller under the influence of GA but the number of side shoots was reduced (Table 2). The higher rates damaged the plants. It should be possible to use it at rates below 100 ppm without any negative side effects, such as susceptibility to winter frosts.

**Table 2.** Influence of GA<sub>3</sub> on plant height, number of main and side shoots in *Salix purpurea* 'Nana'.

GA <sub>3</sub>	Plant height	Average number of main shoots	Average number of side shoots
<i>Applied weekly</i>			
0 ppm	65.6 cm	5.96	5.0
100	103.0	4.96	0.84
250	97.7	3.13	0.61
500	87.0	3.34	0.22
<i>Applied biweekly</i>			
100	109.7	5.33	1.97
200	92.4	4.06	1.42
500	104.0	2.82	1.18
1000	108.7	3.23	0.54

In the case of *Viburnum*, leaf size was increased and internodes were longer, which resulted in larger plants. The number of side shoots was reduced (Table 3).

**Table 3.** Influence of GA<sub>3</sub> on plant height, shoot number and leaf size in *Viburnum opulus* 'Nanum'.

GA <sub>3</sub>	Plant height	Shoot number	Leaf size
0 ppm	18.6 cm	33.5	103.3 cm <sup>2</sup>
100	22.6	26.6	117.5
250	25.1	25.6	121.3
500	27.1	25.6	126.7

A few shoots grew stronger than others but this did not seriously affect the shape of the plants.

In *Lonicera*, however, the leaves were reduced in size and, although the plants were larger, the shape was spindly and will probably not retain an acceptable shape (Table 4).

In spite of the severe winter of 1978/79 all treated plants survived undamaged in unheated frames with the exception of *Salix* where the treated plants died back, in some cases, to ground level. The growth of the plants in this season (1979) will be recorded. It is hoped that the treated plants maintain their size advantage and return to their dwarf character.

**Table 4.** Influence of GA<sub>3</sub> on plant height, shoot number and leaf size in *Lonicera × xylosteoides* 'Clavey's Dwarf'.

GA <sub>3</sub>	Plant height	Shoot number	Leaf size
<i>Applied weekly</i>			
0 ppm	45.0 cm	20.0	6.75 cm <sup>2</sup>
100	66.1	24.4	5.03
250	62.1	24.7	3.08
500	56.9	21.6	3.60
<i>Applied biweekly</i>			
100	62.4	24.8	6.18
200	67.4	25.3	5.30
500	63.4	23.5	4.67
1000	59.9	20.9	3.90

### SUMMARY

Six species of dwarf woody plants were treated with gibberellic acid at concentrations between 100 and 1000 ppm. All plants reacted strongly to GA<sub>3</sub>. It is hoped that by stimulating growth production, time to produce saleable nursery plants can be reduced.

### DESIRABLE AMENITY TREES

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Other things being equal an evergreen tree gives twice the value of a deciduous tree visually and more because it provides shelter when most needed. Evergreens are not fully exploited in the U.K. There are few broadleaved evergreen species of rapid growth or large structure. Conifers have been restricted badly by sooty air near towns until recently, but are much used urban trees in other countries.

*Flowers* or *autumn color* are spectacular but brief and have a low score on their own. *Foliage* is of long duration or is permanent (evergreen) and so has a high score. *Bark* is permanent and is best seen on deciduous trees in winter and therefore scores highly. Any combinations of the above add greatly to value. *Ease of propagation*, and hence (but not necessarily) *ease of acquisition*, is considered secondary, even if decisive.

*Some trees with high general scores.*

*Arbutus menziesii*. Pacific madrone. Evergreen, rich bark colors; prominent flowers, colored fruit; good growth and stature. Tender when grass-high but hard to say whether fully