PROLIFERATION OF SHORT SHOOTS IN CONTAINER-GROWN SCOTS PINE SEEDLINGS: A MEANS TOWARD RAPID VEGETATIVE MULTIPLICATION

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Rapid proliferation of short shoots followed removal of terminal bud clusters on 9-month-old container-grown Scots pine (*Pinus sylvestris*) seedlings. Growth was stimulated by continuous light providing 2,000 fc intensity at average plant height.

Short shoots (also referred to as needle bundles, dwarf shoots, brachyblasts, fascicles, and spur shoots) provide a partial solution to a twofold problem:

1. Rootability in pine cuttings is highest when the stock plant is in the seedling stage, and decreases rapidly with age.
2. Young seedlings, by virtue of their size, yield only a limited number of cuttings.

Short shoots from young pines are not difficult to root but seldom develop terminal buds, and eventually die (*4*); however, it has long been known that terminal (interfoliar) bud development on short shoots follows damage to the branch terminal bud (*5*), (*1*), (*10*), (*3*). Isikawa and Kusaka (*8*) decapitated leaders of 12-year-old Japanese black pines and obtained short shoots with predeveloped interfoliar buds. These were subsequently rooted and developed into normal, upright trees. The need for development of an interfoliar bud while the short shoot is still on the tree has also been recognized by Rudolph and Nienstaedt (*9*) and by Hoff and MacDonald (*7*).

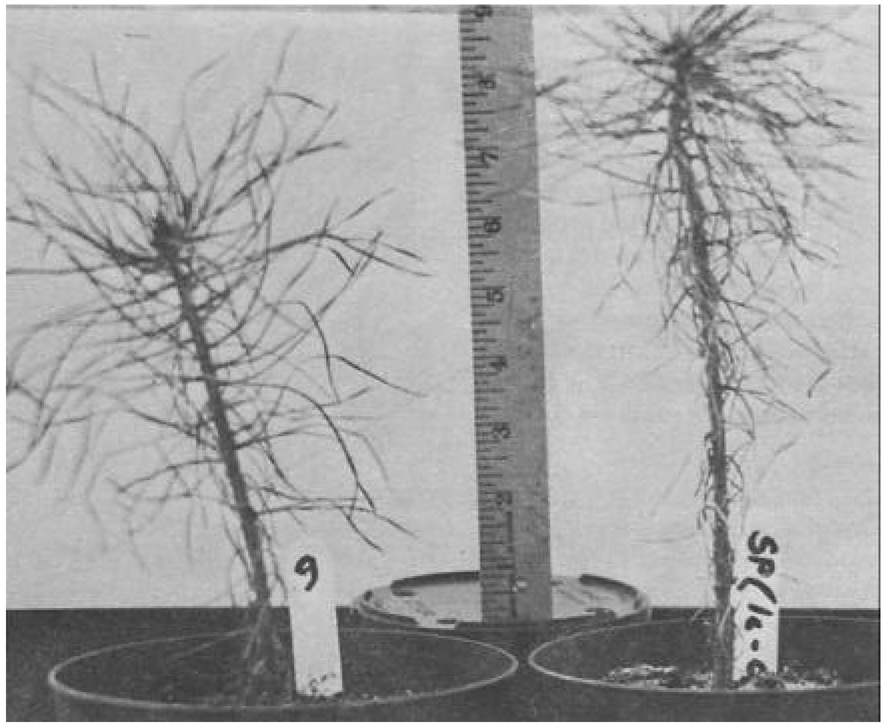

Figure 1.–*Before terminal buds were removed on October 11, seedlings averaged approximately 8 in. in height.*

More recently Hillson (*6*) reported that interfoliar shoots exhibiting high rootability were produced on 5-year-old Scots pines (*Pinus sylvestris*) subjected to a 24-hour photoperiod following removal of all leader and branch apices. Attention was drawn to the suggestions of Dickson and Thomson that the proliferating short shoot may represent a reversion to the juvenile phase, and the report suggested that scion wood from mature trees be grafted onto seedling stock. Successful grafts exposed to extended photoperiods, following decapitation of leaders and branches, might then produce juvenile (rootable) interfoliar shoots and thus overcome the age problem.

Whitehill and Schwabe (*11*) showed that outgrowth of interfoliar shoots could be influenced by precutting treatment of the stock plant with cytokinins and other growth substances. The number of shoots was increased (at the expense of size) by the cytokinin treatment and was depressed by the gibberellin treatment. These authors also reported success in inducing rootable interfoliar shoots on mature scion wood grafted onto juvenile rootstocks.

Three facts are thus apparent:

1. Interfoliar shoots can be used to increase the number of rootable cuttings available from young (and therefore

small) rootstocks.

2. Interfoliar shoots must be induced while the short shoot is still on the parent tree.
3. Interfoliarshoots induced on scions from mature trees can help overcome the problems of age-influenced decrease in in rootability.

This note is concerned with the early production of interfoliar shoots on pine seedlings as a first step in obtaining rootable cuttings.

Method

As part of a continuing study, terminal bud clusters were removed on October 11 from five 31-week-old container-grown Scots pine seedlings. The seedlings were then placed in a growth-chamber providing a light intensity of 2000 fc at average-plant height. Temperature was held within the 15°-21° C range throughout the trial. These seedlings, obtained from the Alberta Provincial Tree Nursery, were produced in an intensive-culture programme involving an initial (winter) greenhouse phase and a secondary (summer) outdoor phase. On October 11 they averaged approximately 8 in. in height (fig. 1), and each seedling bore a number of short shoots (in the axils of primary leaves) on the upper half of the single, unbranched stem (fig. 2).

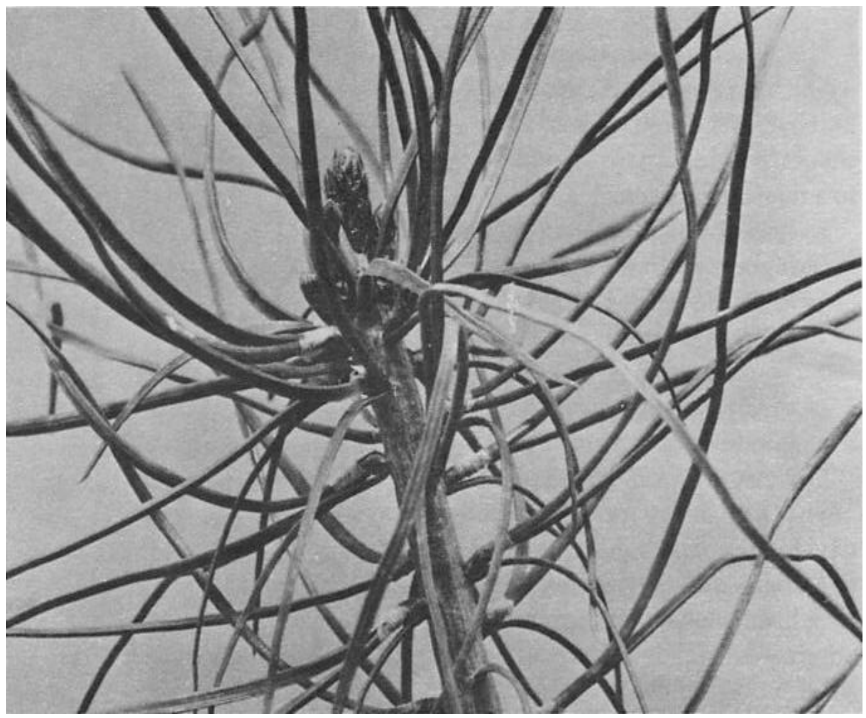

Figure 2.–*Each seedling bore a number of short shoots (in the axils of primary leaves) on the upper half of the single, unbranched stem.*

Results

By October 19, only 8 days after the seedlings were placed in the growth chamber, one to several interfoliar buds were macroscopically visible on all five seedlings. These developed rapidly into actively growing interfoliar shoots – without any intervening period of apparent quiescence – and, by November 4, some shoots were over an inch in length. Bud development was mainly basipetal, but on one seedling the lower short shoots proliferated earlier and more vigorously than the upper.

By November 7, short-shoot primordia were visible. in the axils of scale leaves borne on some of the interfoliar shoots. The scale leaves themselves were much modified, being long, stiff, and much flattened. Because of this, young interfoliar shoots resembled small pineapple crowns.

Interfoliar shoots were measured on November 15, 35 days after the beginning of the trial (table 1).

Discussion

The method outlined above would be most appropriate for use in conjunction with intensive-culture, container-growing programmes, such as those now operated by Provincial, State, and Federal departments, especially where these are associated with studies involving such areas as disease resistance and site evaluation. The multiple ramets produced would allow for replicated testing of many infection levels or on many sites.

Use of the method for multiplication of selected genetic material for outplanting depends on the effectiveness of other studies aimed at determining criteria for correlating juvenile characteristics with adult performance. As yet these are not considered to be fully reliable.

It is also interesting to conjecture that, if the proliferated short shoot really does represent a reversion to the juvenile phase, then the possibility exists for the multiplication of mature trees selected in the field or in test plantations. This could be accomplished by grafting selected scion wood onto seedling stock and by inducing proliferation of short shoots on successful grafts (*6*), (*11*). This might overcome the age-related decrease in growth rate which has been observed in conventional grafts, and in rooted cuttings from mature trees (*2*).

Finally, it is worth pointing out that, once the parent material is available, the procedure outlined in this note has the following advantages:

1. It requires only the simplest manipulation of the stock plants.
2. It requires little in the way of equipment other than some means of providing a suitable

Table 1.–*Number and length of interfoliar shoots 35 days after the beginning of the trial*

Tree No.	Interfoliar shoots *(Number)*	Average length of interfoliar shoots (*mm*)	Range (*mm*)
1	10	38	16-64
2	8	27	5-69
3	10	28	14-42
4	8	28	6-50
5	5	22	5-31

Figure 3.—*Interfoliar buds developed rapidly into interfoliar shoots, some over an inch in length by November 4.*

light source and an acceptable ambient temperature. The standard tree-nursery greenhouse would be adequate.

3. It does not require the application of growth-regulating chemicals.

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