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Seed orchard management research

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SEED ORCHARD MANAGEMENT RESEARCH

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Keywords: cone induction, container seed orchards, crown management, gibberellin application methods.

Research is presently underway in three areas aimed at improving the efficiency of tree breeding and seed production programs for commercially important B. C. conifers. One is the development of containerized orchards as a cost-effective alternative to traditional soil-based orchards, both for accelerating breeding programs and the volume production of improved seeds for reforestation. Portions of this work are being done in collaboration with Dr. R.P. Pharis (University of Calgary) and Dr. R.C. Bower (MacMillan Bloedel Ltd.). A second area of research concerns the development of more efficient methods for seed orchard application of gibberellins (GAs) for cone induction, also in collaboration with Drs. Bower and Pharis. The third involves crown management as a means both to height control for improved efficiency of orchard operations, and to increase flowering by favoring the development of those types of shoots having a high potential for differentiating seed- and(or) pollen-cone buds.

CONTAINER SEED ORCHARD RESEARCH

A full discussion of the potential for container seed orchards, and of progress to date in achieving this potential for western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) and the interior spruces, Engelmann (*Picea engelmannii* Perry) and white (*Picea glauca* (Moench) Voss), is provided elsewhere by Ross *et al.* (1985b). The recent papers by Pharis and Ross (1985), Pharis *et al.* (1985), Ross (1985a) and Ross and Pharis (this volume) also are relevant to this subject and the control of flowering in conifers in general.

Western Hemlock

Studies over the past five years have demonstrated the potential that indoor-potted orchards of western hemlock offer for

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accelerating seed production and realizing higher genetic gains. Production costs also promise to be lower due to improved efficiency of management compared with soil-based orchards presently being established. The basic treatment and cultural regimens for sustained abundant seed production have now been largely worked out, with current research aimed at further improving the efficiency of operations.

The potted orchard approach has already been utilized to accelerate the western hemlock breeding program, and pilot testing for volume production of genetically improved seeds for reforestation could begin shortly.

Interior Spruce

The key to successful promotion of flowering in interior spruce is properly timed high temperatures, coupled with water stress and GA_{4/7} applications. The critical times for each of these treatments have now been defined (Ross 1985a). A series of 1984 experiments (see Ross *et al.* 1985b) have confirmed that whereas such treatments will promote flowering in field-grown trees, they are far more effectively and efficiently used with potted trees subject to strict environmental control within a plastic-covered house.

Current research aims to further refine and improve the floral-induction regime, including determination of optimal conditions of shoot and root temperatures; to delineate the optimal environmental conditions for subsequent cone and seed development; to evaluate alternative pollen management strategies; and to better understand the physiology of flowering, its mechanism and control.

A working plan is presently being prepared to establish by 1986 a pilot-scale test of the container seed orchard concept for interior spruce. As proposed, this will be a five-year project undertaken jointly between Research and Silviculture Branches. Its specific objectives are to: (a) demonstrate operational feasibility and cost effectiveness; (b) refine treatment strategy and container handling systems; (c) train operations personnel; and (d) gain a head start in the production of genetically 'elite' seed for reforestation.

HORMONE APPLICATION RESEARCH

Use of GAs to enhance cone production in conifer seed orchards (see Pharis and Ross 1985) is hampered by the practical difficulties of applying this relatively expensive hormone (\$13 to \$20 per gram, Can.) to large, field-grown trees. Bower and Ross describe elsewhere in these proceedings the pros and cons of ultra low volume spraying based on two recent trials with Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and western hemlock.

CROWN MANAGEMENT RESEARCH

Western Hemlock

Long-term crown pruning trials with western hemlock were initiated in 1982, in Western Forest Products' 1979-established clonal orchard #26 at Lost Lake and in the Canadian Forestry Service's 13-year-old clone bank at Cobble Hill (Ross 1984). Removal of the upper 50-60% of initial stem length has not adversely affected cone production in the older clone bank in the two years following top pruning, and it has resulted in a fuller crown that should in future years be capable of producing more abundant cones.

The younger trees have responded even more favorably in terms of vegetative development. However, flowering to date in this well-watered seed orchard has been sparse, even following a significant response to GA_{4/7} sprays in 1983. Both trials are continuing, with GA_{4/7} induction treatments being applied on a biennial basis (most recently in 1985).

Douglas-fir

Seedling trees in two blocks of the 1975-established Saanich seed orchard #20 received three levels of top pruning factored with three levels of branch thinning, each with and without stem injections of GA_{4/7} (Ross 1985b). A moderate top pruning from 6 back to 5 whorls of branches significantly depressed the production both of seed and pollen cones. So too did all levels of branch thinning designed to increase light penetration within the tree crown. More severe top pruning, back to 3 whorls of branches, caused a further significant reduction in flowering in one of the orchard blocks. However, this same treatment increased flowering relative to untopped controls in the other block wherein trees were slightly smaller and less vigorously growing. While the long-term response remains to be assessed, crown training beginning at a young age appears to have potential for increasing Douglas-fir seed yields, and for controlling tree size for improved efficiency of orchard management.

Trees in all treatments responded positively to stem injections of GA_{4/7} following procedures described by Ross *et al.* (1985a). Increases in seed- and pollen-cone bud production averaged 161 and 91%, respectively, although cone abortion also was 35% higher for the GA_{4/7}-treated trees.

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