

RESEARCH NOTES

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YELLOW CEDAR CONE PRODUCTION

by

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Collection of cones in order to obtain seed for reforestation of high elevation species such as yellow cedar (*Chamaecyparis nootkatensis* (D. Don) Spach) is very expensive as the trees are often inaccessible and very difficult to climb. Yet, the increased demand for this species requires an economical source of seed. This may be accomplished by more efficient field collections or the establishment of seed orchards. In either event, an understanding of the reproductive cycle of the species is essential. This is particularly true since cones of yellow cedar mature in two years (1) and both immature 1-year-old cones which were initiated the previous spring, and mature 2-year-old cones appear similar and may be found on the same tree and branch. Seed from immature cones will not germinate and the proper time for collection of mature cones is unknown. There is also a very high percentage of inviable seed in yellow cedar. A study just completed answers many of these and related questions.

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Hormonal Induction of Cones

Seed orchards should provide a very practical means of cone production in yellow cedar since, as in other members of the Cupressaceae (4,5), cones can be induced on very young trees by treating them with a plant hormone (gibberellin A₃). In 1973, tests involving the application of this hormone were conducted at the University of Victoria and at the North Road Laboratory of the Research Division, B.C. Forest Service. As many as 600 seed cones and 3,000 pollen cones were induced on 3-year-old trees and an average of 57 seed cones and 40 pollen cones were induced on 1-year-old seedlings (Fig. 1). Both pollen and seed cones appear to be normal and pollination of these trees was carried out in the spring of 1974. Developing cones from these plants will be studied until the seed is mature in order to determine whether viable seed was produced.

Cone Initiation Under Natural Conditions

Collections of branches with reproductive buds and cones were obtained at intervals between November 1971 and December 1973 at 2,000 and 2,800 ft. elevations on Vancouver Island to study the reproductive cycle of yellow cedar.** The study of cone initiation under natural conditions has shown that pollen cones are initiated during late June and early in July and mature pollen is formed before dormancy begins at the end of September. Seed-cone initiation begins about two weeks after that of pollen cones. Similar observations have been made under natural conditions in western red cedar (*Thuja plicata*) (3) and western Hemlock (*Tsuga heterophylla*) (2). This information may allow for more precise cone induction by hormone treatment where the total number and proportion of pollen and seed cones can be controlled.

Pollination and Seed Development

Pollination occurs in mid-April in cones that were initiated in June or July of the year before. Individual cones are receptive for only about one week but the stage of cone development on a tree is quite variable; therefore, pollination may occur over a two-week period on a tree. As in pines, seed is not mature until about 18 months after pollination. However development is not the same. In yellow cedar fertilization occurs about three months after pollination and embryo development begins but seed cones become dormant in October when the embryo is only partially developed. Embryo development resumes in April, after dormancy, and embryos are mature by July or August, 15 or 16 months after pollination. Most seed is shed late in September or October but some cones do not open until January.

Pollination and rate of seed development vary with elevation. Dates given in Table 1 are for a site at 2,000 ft. elevation. Development in trees at 2,800 ft. elevation was generally about two weeks behind, whereas, trees at sea level were two to four weeks more advanced than the trees at 2,000 ft. elevation.

** These collections were made by members of the Climate and Data Services Division, E.L.U.C. Secretariat and by members of the Research Division, B.C. Forest Service.

Table 1. Approximate phenology of the stages of cone initiation, embryo and seed development as compared to the time of pollination.

Stage of cone and embryo development	Approximate Date	Stage as related to the time of pollination
Pollen-cone initiation	Late June, early July	10.5 months before pollination
Seed-cone initiation	Early July	10 months before pollination
Pollen formation	Late August	8 months before pollination
Pollination	Last half of April	
Fertilization	End of July	3 months after pollination
Embryo development begins	Mid-August	3.5 months after pollination
Dormant, partially developed embryo	October	6 months after pollination
Embryo resumes development	Mid-April	12 months after pollination
Embryo mature	July-August	15-16 months after pollination
Seed shed	Late September to January.	17-21 months after pollination

Recognizing Mature Cones and Seeds

The 2-year developmental cycle of the seed results in both immature and mature seed cones of equal size being borne on the same branch in September when cones should be collected. Immature cones are normally found close to the tip of the branch and mature cones further from the tip (Fig. 2). Immature, 1-year-old, cones are green often with some purple and are soft and easily opened using fingernails (Fig. 3). Seeds from immature cones are white, soft and moist (Fig. 4). Mature, 2-year-old, cones are yellow-green, often with some dark brown markings, hard, not easily opened using fingernails and the lines between and on the scales are more distinct and raised (Fig. 5). Seeds from mature cones are dark brown with medium brown wings, hard and dry (Fig. 6).

Abundant Empty Seed

The proportion of filled seed obtained from mature yellow cedar cones is generally low and extremely variable from one cone to another and from one tree to another. In the seven trees studied, the number of seeds per cone averaged 7.2 and ranged from 5.3 to 10.6 but the proportion of filled seed averaged only 29 per cent ranging from 13 to 46 per cent. The causes of empty seeds are uncertain and may be varied. Some cones did not appear to have been pollinated, whereas in others, normal first-year embryo development occurred but embryo development did not resume in the second year. Still other first-year cones appeared to be diseased or insect damaged, causing scales to proliferate producing callus-like growth between the scales. Seeds from these cones were irregular in shape and usually did not develop mature embryos.

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This Research Note represents a summary of several papers which are being published in the *Canadian Journal of Botany*.



Seed
Cones

Pollen
Cones

Figure 1. One-year-old yellow cedar seedlings. Seedling on the right was sprayed twice weekly with 100 ppm gibberellin A_3 in a Tween-20 solution and has produced many pollen cones and seed cones. Seedling on the left was sprayed twice weekly with a Tween-20 solution without gibberellin A_3 .

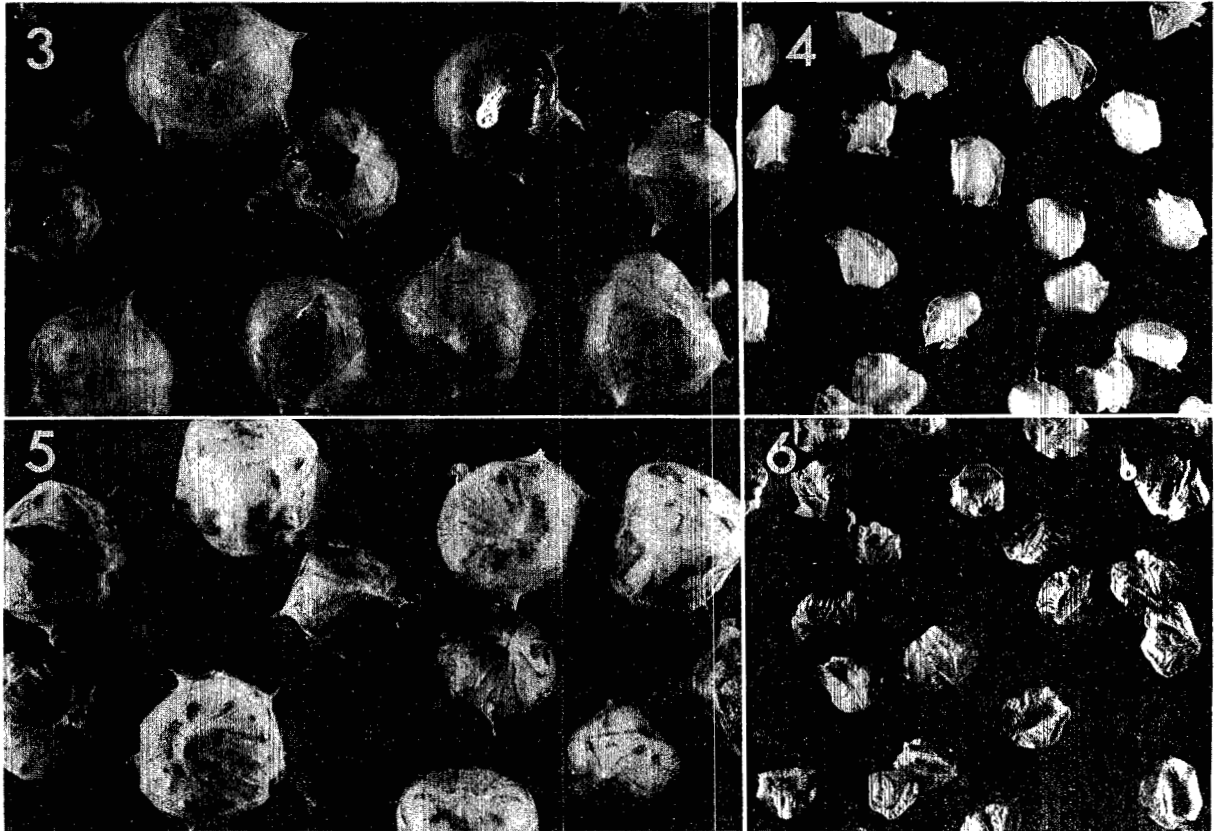
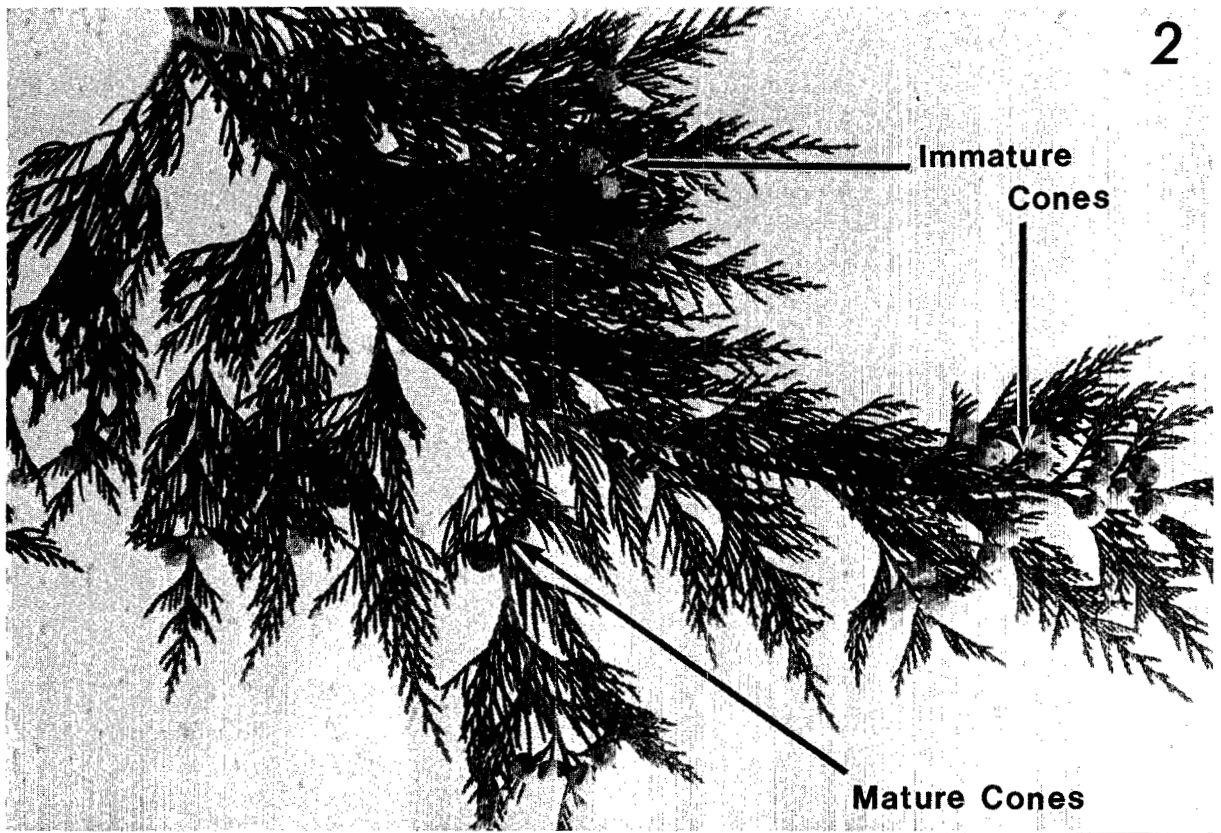


Figure 2. Branch collected in October showing immature 1-year-old cones and mature 2-year-old cones. x 1.3.

Figure 3 & 4. Immature 1-year-old cones and seeds collected in August. x1.4.

Figure 5 & 6. Mature 2-year-old cones and seeds collected in August. x 1.4.