

**SOAKING AND RETUMBLING
CONTROLLED-POLLINATED SCOTS PINE
CONES INCREASES SEED YIELDS**

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Tree seed produced by controlled pollination is expensive, particularly when the breeding stock is high-cost introduced or exotic material. Phenological and physiological differences among genetically diverse seed sources and individuals within these sources may also decrease seed yields compared with more closely related trees. Thus, techniques to maximize seed yields of cones from controlled pollinations are worthwhile. This article describes how soaking and retumbling greatly increased seed yields from controlled pollinations on superior Scots pine (*Pinus sylvestris* L.) trees selected in a provenance plantation of diverse sources.

Just as there are differences among provenances and between trees within provenances in conelet receptivity at pollination time, there also appear to be differences in stage of cone maturity at harvest time—as suggested by variations in cone color and degree of dryness. It is not always economical to collect small lots of controlled-pollinated cones from several thousand matings just at the peak of cone ripening for each tree. For instance, if collection sites are distant, it is often necessary to collect all the cones at one time

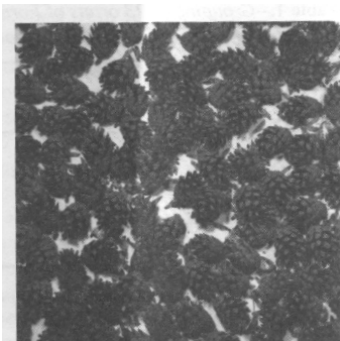


Figure 1.—Air-dried Scots pine cones before first tumbling to

extract seed.

when the majority are judged mature. Invariably, some of the cones are not quite ready to open fully, even though seeds are mature.

Also, scales of Scots pine cones commonly do not open completely. Cones can become "case-hardened" from being dried under conditions that are too cool, too dark, or too confined to permit unrestricted scale opening (6). In addition, resin between the cone scales can preclude complete opening until it is melted or loosened (2). Dipping unopened or partially opened cones in boiling water for 10 seconds (3), in 130° F. water for 5 to 20 minutes (5), or in water at room temperature for 12 to 24 hours (6) will produce maximum cone scale reflexing (4). Scots pine cones can also be opened by air-drying in open paper sacks in

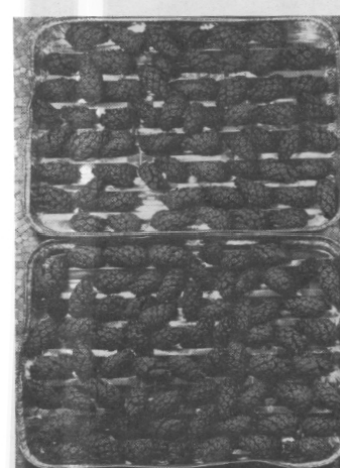


Figure 2.—Cones have reclosed after soaking in water-filled trays.

a greenhouse, and given one to several sprinklings with water and re-dryings preparatory to a single tumbling.'

In our Scots pine breeding program, approximately 2,000 matings are made annually, involving 7 select pollen donors and about 40 select receiving trees. Thus, we expect to harvest over 250 separate cone lots each fall—with many slightly different dates of maturity.

Cones are collected, kept separate by matings, and spread on paper sheets in the laboratory to air-dry (figure 1). After the cone scales cease to open further,

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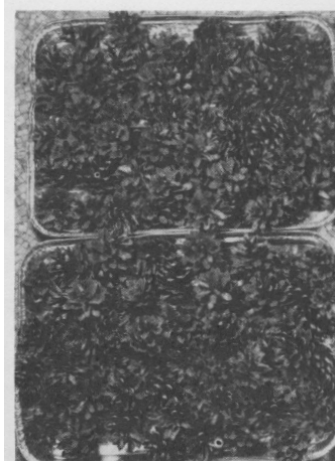


Figure 3. - Fully opened cones after soaking and air-drying, ready for second tumbling.

indicated by cessation of snapping and cracking, cones are tumbled to extract seeds (1).

Since some of our cones do not open sufficiently to release all seeds, the following technique is used to force release. The tumbled cones are thoroughly wetted in trays filled with 85° F. water for about 30 minutes until the cones soften and begin to close (figure 2). Water is then drained from the trays and the cones are allowed to air-dry. After thoroughly drying the second time, nearly all cone scales open wide (figure 3). The cones then are tumbled again, yielding additional seed. Second tumbblings after soaking and drying have resulted in an overall increase of about one-third in the total numbers of sound seed. Thirty-four select trees yielded 5,217 sound seeds from controlled pollinations on first tumbling and an additional 1,861 sound seeds on second tumbling (36 percent increase).

Percentages of seed increase ranged from 18 to 84 among provenance origins used as select ovulate parents (table 1). There was also considerable variation among trees within origins.

Table 1.—Numbers and percent increase of sound seed from controlled-pollinated Scots pine, after soaking, redrying, and retumbling

Origin of ovulate parents	Number of trees	Total seed		Percent increase
		1st tumbling	2nd tumbling	
Scotland	1	566	99	18
Belgium	1	32	12	38
Spain	4	183	154	84
France	6	786	283	36
Germany	4	612	210	34
Italy	4	1251	391	31
Yugoslavia	4	189	59	31
Greece	2	544	419	77
Turkey	2	152	30	20
Russia	6	912	204	22
Totals	34	5217	1861	36

Variation in seed yield increase, attributable to pollen donors, ranged from only 31 to 40 percent

In Scots pine, at least, inherent differences in time of cone maturation and/or ease of cone opening between provenances and among trees within provenances make special treatment of cones worthwhile to obtain the maximum amount of seed.

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