SOME PROBLEMS IN MAINTAINING AN ADEQUATE SEED SUPPLY FOR A PROVINCIAL REFORESTAION PROBLEM

By A. H. Bamford

Every nurseryman and tree planter is constantly haunted by a horrible picutre - the vision of an empty seed store. In British Columbia we have been faced with this prospect perhaps oftener than most organizations represented here today. Although operating near the northern extremity of the range of coastal Douglas-fir, we found good cone crops at low elevations occurred frequently enough. However, as the planters followed the stump line up the hills to the top elevation range of this species we found that cone crops here were a rare occurrence. Time and time again a good cone crop would fade out at eleven to thirteen hundred feet and we would be left with the stopgap alternative of using seed collected farther north. (We try as much as possible to follow Leo Isaac's suggested rules (2) for Douglas-fir seed but will stretch the elevation limit of planting stock to 1,000 feet above seed source if necessary).

The Reforestation Division not only grows and plants trees on Crown or Public Land but also supplies seedlings to the Forest Industry. Companies holding Tree Farm Licences are encouraged to collect their own seed from Licence areas but we receive many requests for stock from other companies for varied provenances and try to keep a sufficiently varied supply of seed to supply all these requests with suitable planting stock.

Some of the steps taken to solve this most pressing problem of seed supply have been:--

(1) Initiation of a province-wide cone crop survey for all commercially important species.

(2) Initiation of a seed improvement program for all species which involves:

(a) Establishing high and low elevation coastal Douglas-fir seed orchards (to be followed by hemlock).

(b) Developing high elevation Douglas-fir seed production areas. to be followed by other species in the interior.

(c) Setting up a province-wide system of seed registration.

(d) Following a policy of collecting only from the best formed trees and stands.

(3) A detailed reconnaissance by Reforestation Division personnel in local areas to locate best stands for collecting and recording and mapping same.

(4) Collecting all seed requirements with own crews under supervision.

(5) Extracting all our own seed.

(6) Storing own seed under what are believed to be ideal conditions.

(7) Sowing or storing for the Forest Industry only registered seed;

(8) Conducting complete germination tests and analysis of all seed presented for storage.

The province-wide cone crop reconnaissance instituted in 1953 is conducted primarily by the rangers who report the average crop of important species for their Dictrict on a numerical rating system. Good crops judged suitable for collecting are noted on the survey form which is forwarded to the Forest District Headquarters and eventually to Victoria. These reports not only guide Reforestation and District Silviculture staff in locating cone collecting areas but also provide a fund of information on cone crop periodicity, etc.

While this survey assisted us in finding collecting areas when there were crops, it did not increase the frequency of crops. Accordingly, we decided to try to help nature along. In January 1956, Dr. Alan Orr Ewing (3) Forest Service Geneticist, presented a plan to improve the supply and quality of high elevation coastal Douglas-fir seed. The first step in this program was to be the establishment of a high elevation (1500 feet plus) seed orchard. Dr.. Orr. Ewing immediately began with a small crew to carry on a one-hundred percent cruise of 50 to 100 year old stands at the desired elevations in order to locate plus trees which would supply the scions to be grafted on rootstocks at low elevations to make the seed orchards. A clone bank was started at the Duncan Nursery where scions are grafted as soon as possible after trees are located. The magnitude of the job undertaken by three men was awe-inspiring and progress was heartbreakingly slow,

but in 1959 a new impetus was supplied. The recently formed Tree Farm Forestry Committee appointed a plus Tree Board under the Chairmanship of W. G. Burch to organize cruising and to record candidate plus trees. During the summer, Forest Service and Industry foresters got together under the aegis of the Plus Tree Board on a cooperative cruise of one large stand which yielded three candidate plus trees. Member companies undertook to cruise suitable stands of their own ownership. The search continues highlighted by another cooperative effort during Plus Tree Week, June 20-24.

To date, 15 plus trees have been located. Clones are being increased in the clone bank and when a minimum of 20 trees nave been located the orchards will be grafted. As progeny testing points out poor clones these will be rogued and replaced by new and tested clones. At present orchards are planned by the Forest Service and four or five companies holding Tree. Farm Licences. Some already have rootstocks established and ready for grafting.

The second step of the program to secure a better supply of high elevation seed which would at the same time be genetically superior to ordinary wild seed was the development of Seed Production Areas at the desired elevations. Young Douglas-fir stands 20 to 40 years old which had come in after logging or fire were examined in detail in 1957 and four were selected for treatment. These were generally understocked and had a preponderance of straight-stemmed, narrow-crowned, fine-limbed trees. During 1957-58 two of these were marked and thinned to about 200 trees per acre. All rough or poorly formed trees were cut out. Brush species were killed by a dormant season hormone spray in oil. In the spring of 1953 two of these areas were fertilized using four different treatments. On area No. 1 the best treatment 4N-2P in May gave a seed yield 37 times that of the control plots during the bumper 1959 seed year. On area No. 2 the best treatment was 4N May (200 lbs. Nitrogen) with a sixfold increase, but there was no significant advantage over the next best treatment in either case. The best treatment gave a yield of 104 lbs. of seed per acre (1). Had the. entire No. 2 area of 7 acres received this treatment, increased yield would have more than paid for cost of development. One of the most significant results was the increase in number of cone-bearing trees. Such were the results obtained during the 1959 bumper seed year. It remains to be seen whether results of similar magnitude can be secured in years when the normal seed crop is negligible.

Several other areas are planned so that eventually our entire requirement of coastal Douglas-fir seed will come from seed orchards and production areas.

The whole seed improvement program is based on a system of seed registration also initiated in 1956. This involves gathering complete stand information about each cone lot at time of collecting and forwarding on a prescribed form when cones are sent to the extraction plant. At the extraction plant each lot is registered and given a tripartite number consisting of an identifying number, a suffix which

shows the **year** of collection and a prefix indicating the **classification** of the seed based on the physical appearance of the stand or trees collected from (e.g. B /501/59). This system of classification **is based** mainly on that used by the Royal Board of Private Forestry in Sweden (4).

All tree seed is classified into one of two main groups:--

A. Special Seed. This group contains only seed from selected individual trees and from seed orchards. It is divided into the following five classes.

A 1: Seed from controlled crosses.

A 2: Seed from a genetically tested plus tree i.e. an elite tree

A 3: Seed from a plus (elite) tree plantation, i.e. a seed orchard.

A 4: Seed from a registered plus tree.

A 5: Seed from a "type" tree selected for a particular characteristic, good or bad, and seed from a candidate plus tree which has not been inspected by the Forest Service Geneticist and registered as a plus tree.

. All other single tree collections should be classified in one of the "B" classes.

B. Stand Seed: This group includes all seed collected from stands. For seed collecting purposes, all stands are classified as follows: into three classes, based primarily on the outward or phenotypic appearance of the trees of the stand.

(1) Plus Stand: A well developed stand judged by local conditions and age with a preponderance of straight-stemmed, slender-branched and self-pruning types of trees. Coarse-branched, wide-crowned or straggling trees must be few in number and not occur in extreme forms. (No stand will be classified as a plus stand until it has been examined and registered by the Research Division staff).

(2) Normal Stand: A stand comprising trees of medium quality, or a stand with comparatively few coarse-branched, wide-crowned or straggling types of trees but with a considerable portion of good or medium types (most seed collections will be from stands **in** this class).

(3) Minus Stands A stand containing a preponderance of decidedly coarse-branched, wide-crowned or straggling types. A stand with a large number of crooked or sabre-curved stems. (Seed will only be collected from such stands in extreme cases and when no other stand is bearing cones in the desired location. -

Using these three stand descriptions, all stand seed should be placed in one of the following five classes --

B 1: Seed from cleaned and registered plus stands.

B 2: Seed from other plus stands and seed from the better trees in a normal stand collected under direct supervision.

B 3: Seed from normal stands collected without any special selection of the mother (cone-bearing) trees.

B 4: Seed from minus stands or seed collected without information as to stand type.

B 5: Seed from plantations.

Seed from cleaned seed production areas where only the better trees remain is classed B 2. The ultimate objective, of course, is to have cones collected only in classes B 1 and B 2. Preliminary tests carried out by Dr. Orr Ewing indicate that the narrow-crowned types we are selecting in this class of stands have an advantage in initial height growth over the wide-crowned types.

During the summer of 1959 Reforestation Division and Industrial foresters reconnoitered numberous young stands of coastal Douglas-fir and selected the best for collecting. Information was correlated by the Tree Farm Forestry Committee and mutually beneficial exchanges of collection areas were arranged. When the seed was judged mature on the basis of embryo length, cones were collected by crews of from 6 to 12 teen age boys who climbed the trees and picked the cones. Trained Reforestation Division supervisors indicated the trees to be collected from and kept tallies of sacks, etc.. Inmates of Attorney-General's Department Forestry camps also did an excellent job of picking cones. Altogether 4400 pounds of high quality coastal Douglas-fir seed were secured.

In the interior of the province the emphasis was on spruce seed. Here the collecting has to be done from mature trees. District Reforestation officers, District Silviculturists and Regional Research officers all cooperated on selecting suitable stands. Much of the spruce none crop did not mature properly in 1959 due to the very cool wet summer. Spruce seed has failed to mature in the past. It is hoped that development of spruce seed production areas in favorable locations will assist in earlier maturation of the seed. Collections were further hampered by an epidemic of the cone rust Chrysomyxa pyrolata Winter, which destroys the seed.

In the past it has been the practice to dry out all Douglas-fir cones immediately after picking. Last year cones were stored green in the sacks. Carefully tagged sacks were stored in special cone sheds which permitted ample air circulation between sacks. Mould was mainly superficial. Due to the very wet fall, many cones still had 100 percent moisture content going into the kiln but extraction was good

after 48 hours in the kiln at not over 110° F. and R.H. 48 percent (E.M.C. 7.8). Trial batches of tray-stored Douglas-fir cones were difficult to extract and mold penetrated the cones. The seed tended to dry out quicker than the partially opened cones with consequent danger of damage.

Doing our own extraction has enabled us to complete germination tests etc. in time for sowing. We have absolute control of processing conditions and seed lots. Cleaning and testing all are done under close and sensitive control.

Seed is dried to 8 percent moisture content (6-9 percent) before being placed in plastic bags (3 mil.) and then in four-gallon cans. All seed is stored at 0° F. in our own cold storage. At present, 13,000 pounds are *in* storage. Seed is tested and stored for the Forest Industry if it is registered before being presented for storage. Over 200 separate seed lots were tested and stored in the 1959-60 season.

We are very thankful for the bumper seed year of 1959 and the opportunity to replenish our seed store. No farmer would think of securing his seed from weeds left by the roadside; tree farmers should follow his example and use only the best seed available. We firmly believe that the seed we have and will secure from production areas is not only of much better genetic quality than wild seed but that it will be much cheaper and easier to collect. In the near future all our coastal Douglas-fir seed will come from production areas and eventually mostly from seed orchards. I expect to see the day when no. "wild" seed will be used in our provincial reforestation program.

References

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(3) ORR EWING, A.L. A Proposed Outline for the Improvement of Douglas-fir Seed. Research Division, B. C. Forest Service, Victoria B.C. Unpublished Report 1956.

(4) Royal Board of Private Forestry of Sweden. Directions for Seed Collecting. 1950.

Discussion following A.H. Bamford's Paper

In the discussion that followed Mr. Bamford's paper, the question was raised as to the British Columbia method of selecting plus trees. Mr. Bamford stated that this search and selection *is* carried on jointly by the British Columbia Forest Service and the British Columbia timber industry. Selected areas which are thought to be of

suitable site and origin are covered by 100 percent. The cruisers are looking for nothing but plus trees. They take no other information except to be sure that the location of selected trees is sufficiently located so that they can be relocated. Trees that are evidently superior to their nearest dominant neighbor are recorded and then checked out for the desired characteristics. They day. checked cked all candidate form, , vigor, phenotype, and thoroughly visible signs checked, of
they may come up with perhaps one tree. As an example, last year during one "plus tree week" they cruised one stand of about 1,000 acres and came up with three trees. They have difficulty in organizing the searches at times, because some people come for one day and then leave to go back to their jobs. During this past June, the same plan was repeated in three different stands on the west side of Vancouver Island. Mr. Bamford fears that they will not even get one plus rated tree out of this search.

John Barber then discussed the selection of plus trees and the development of seed orchards in the South. He showed some very interesting slides which represented some of these developments. One slide showed white pine trees six years from seed, with one year in the nursery and five years in the field. These seedlings were from open pollinated selected parent trees which, after three or four years of screening in the field, indicated that they gave offspring of a generally good form and resistance to blister rust. They have established quite an acreage of this type of material from these parents and have so arranged them that there will be close cross-pollination from the different lines. They expect very heavy seed production in just a few years. The orchards are being rogued for rust-infected trees and trees with poor form or slow growth. Mr. Barber pointed out that seed production areas in the South, when established, have relatively few stems per acre, generally coming down to about 14 to 20 per acre. Another slide showed a seed production area established in Texas which was probably one of the first established in the. South. It was pointed out that these trees probably wouldn't stand the test of seed production areas today because of some slight crooks. However, most of the trees were about 60 feet to the first limb. Aluminum bands had been placed on them for squirrel protection. This orchard is one which has been used as the basis for figures on cone collection and cone yield in Journal articles. Another shot showed a breeding orchard established at Athens, Georgia. These were all grafted trees, two to three years old, of shortleaf pine, resistant to the littleleaf disease which is a soil-fungus relationship. This orchard is one from which a number of clones have been brought in strictly for the development of the resistant material. Another slide showed an orchard established by the Texas Forest Service. This was all grafted material from pine of high specific gravity and good form and growth rate for the production of seed. In this instance, one of the objects was a study

of methods of conservation because this orchard is located in the Texas country where drouth is a serious problem. Good management requires clean cultivation such as is used in fruit orchards in that part of the country. Another slide showed a seed production area of slash pine established by Continental Can Company about 22 acres in extent. These trees were about 35 years old and the stand averages 14 trees per acre after it has been thinned and all the undesirables removed. These were about 70 feet tall and ran from 10 to 14 inches in diameter. This was the first area inspected and approved under the certification program of the State of. Georgia.

Certified seed will be collected from that area this fall. Further slides depicted the processes of grafting, with an interesting discussion of the effect of gravity on flowering and the position of grafts with relation to pollination. In one case buds were actually present on the scion when it was grafted. They were control pollinated and have matured seed. There were further interesting slides with respect to both greenhouse and field grafting and a view of a Georgia slash pine seed orchard of 47 acres, all grafted material, **in** which controlled pollination had produced something over 5,000 cones. Mr. Barber's report indicated good progress in the development of seed orchards in the South, and is probably indicative of the interest and progress which is being made throughout the United States. There are, of course, still many problems to solve and the testing in the development of techniques will be an important factor in this phase of the reforestation program.

Mr. Hedlin was asked if the insects he described are common on the U. S. side of the line as well as *in* Canada. He replied that the Douglas-fir cone midge is the number one tree destroyer in their area. Several other species of the cone moths are also serious seed destroyers. The species found on Vancouver Island and generally. through British Columbia occur pretty generally throughout the range of Douglas-fir. There was some discussion regarding aerial spraying programs for the control of seed destroying insects. Tom Greathouse was asked why they didn't go into an aerial spraying program in Region 6. He stated that they had wanted to but didn't have the background on such spraying and that the research people felt there was insufficient background knowledge to justify a program. In fact, the research people could not give then anything to go on or any hope that they could control the insects satisfactorily. Unfortunately, the tape recorder missed some interesting discussion on this point, but the consensus was that information so far is too sketchy to provide an adequate basis for widespread control programs. Further research is needed. An example was cited of an attempt to use aerial spray control for tip moth infestations. The problem there is insufficient concentration of chemicals on the plant to control the insects. Further discussion revealed the fact that there are many Insects involved, sometimes as many as three or four in the same cone. These have

different life cycles and therefore may require different treatment with respect to time. This pointed up the need for: further research and the fact that this is one of the key problems in forestation at the present time. It is a particularly important factor during periods of low cone crops when the yield of viable seed may be reduced to a point where collections are not economically feasible.

Following the discussion on seed destroying insects there was some lively discussion regarding the development of seed orchards and the testing of progeny. This all boiled down to the fact that there is so much to be learned regarding the transmission of mature tree characteristics to the progeny and that further development of techniques for testing progeny will be required before the final answers can be determined. It was emphasized that the chance for developing super trees that will be a cure-all for growth, resis- tance to disease and to insects and frost, with superior wood quality, is very remote. This does not mean that we should not go ahead with the program, because there are going to be tests for each one of these characteristics independently. It will be found that one is good for this and another is good for that characteristic, following which the geneticists can begin to combine all these things. One of the points which was stressed by more than one speaker was the fact that this is a big and complicated job which is going to require a whole lot of attention. This fact should be impressed upon everyone who is entering into the field of tree breeding. There followed some discussion regarding the responsibilities of research and administration in the development of this seed orchard program.

Following this discussion, the chairman thanked the panel and introduced the next one.

2.