SEVEN-YEAR RESULTS IN DOUGLAS-FIR (PSEUDOTSUGA MENZIESII (MIRB) FRANCO) VAR. MENZIESII CLONAL SEED ORCHARD

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Introduction

A little over a decade ago the Industrial Forestry Association under the leadership of Dr. Duffield embarked on a cooperative Tree Improvement Program in the Pacific Northwest. The aim was to help companies launch their own program and to support them with laboratory aid and technical advice as part of the Tree Farm Program.

The Georgia-Pacific Corporation, then Booth-Kelly Lumber Company, was among the first to join in this endeavor.

The work began under the supervision of George Bradshaw. The seed orchard was planned to provide seed with improved qualities to reforest the cutover land on the Company's Springfield Division.

Plus Tree Selection and Grafting

For the above-mentioned reason the original 15 plus trees were selected mainly on Company land around Springfield from an elevation range of 1500-3000 feet in 1957.

The scionwood was gathered and the first grafting was completed in early spring of 1958. The grafting was carried out at the I. F. A. Nisqually nursery on 2-0 rootstock as bench-grafts, and then planted in nursery beds for one year.

The veneer side-grafting method was used on the entire project. In order to obtain a close match between scion and rootstock, the scion was generally placed on the lower portion of the rootstock with no feeder limbs below the union. This had the effect of holding back the graft development considerably and also influenced the graft survival rate.

The first 1866 previously bench-grafted trees were transplanted in the Row River orchard in the spring of 1959. Due to grafting failures, some clones were short of grafted stock. In this case 2-0 rootstock was planted on the assigned spots for later field grafting.

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The ramets of the 15 clones have been distributed at random with a spacing of 12 feet between rows and ramets. This distribution is recorded on a map by the clone numbers. This map serves the purpose of orientation and information gathering in the orchard.

The first year's activity was mainly concentrated on replacing root-stocks, ramets, and grafting on those rootstocks which were not grafted before. This phase of work is well known by all those who are engaged in establishing a clonal seed orchard.

The first 332 field grafts were made in 1961. This time the higher sitting veneer side-grafting method was used.

Two hundred and fifty-three (253) new field grafts were added in 1962 (higher sitting veneer side grafts); and two hundred and eighty-two (282) bench grafts were planted out from the Nisqually clone bank.

In 1963, two hundred and twenty-six (226) field grafts were made (veneer side and crown cleft grafts) and ninety-four (94) bench grafts were planted out from the Nisqually nursery again.

An all-out attempt was made to graft all the rootstocks in the orchard in 1964. For this reason 1004 new field grafts were made.

Our main aim was to achieve a stage in which all the rootstocks were grafted. By this time 4052 grafts were made on the total number of 2300 rootstocks. This shows that no matter how hard we work at it, it still does not seem that we will ever succeed in reaching 100%.

An annual inventory was conducted each year and a progress report was kept on the development of the orchard, but this did not give enough information to pinpoint the grafting failures. Six years passed by before the decision was made to analyze each clone separately. The reason this was not done sooner was that there was not enough emphasis put on it, and the lack of an easy and quick method also prevented us from doing the job. Several attempts were made with very little success. Finally last year the job was carried out successfully, but the grafting result was rather disappointing.Hahn (1965).

It was shown among other things, what tree improvement workers repeat-edly found by grafting Douglas-fir, that some ortets produce scions which make good unions and have high survival, while others exhibit low graft-ability. Duffield and Wheat (1964).

For graphic illustration, there are two examples--a poor grafter, clone 96 and a good grafter, clone 62. See Figure 1.

The grafts survival rate is shown on the vertical axis in percentage. The numbers 1-5 on the upper horizontal line show when the five different grafting attempts were made. The figures in brackets show the number of grafts in the survey. The capital letters on the lower horizontal line mark the end of the year, starting with 1959. Each segment represents one year commencing with 1959.

The graphs show the survival rate of the five different grafting attempts.

While examining clone 96, it is especially noticeable that the graph for the first grafting attempt is very closely repeated by the second, third, and fourth. There is a sharp decrease in the survival rate, and in all four cases it never failed to decrease sharply. This indicates the clone is a poor grafter, despite the high survival rate in the fifth grafting attempt in 1964.

There were favorable weather conditions during the summer of 1964. This factor is proved without doubt because the segments of all five graphs in section E and F during the year of 1964 show the same trend. Most of the scions were grafted on strong rootstock taller than three feet in 1964. This proved to have some influence on grafting success, also.Schmidt and Soegaard (1960). The indication of this is still quite pronounced in 1965.

In clone 62 the pattern is similar in all five cases. Each line follows the same general trend again, but the survival rate remains high for the first four grafting attempts; therefore, clone 62 could be rated as having a good graftability. The sharp decrease in the fifth grafting attempt may be a result of grafting on newly planted 2-0 rootstock.

While analyzing all 15 clones, there was no significant difference found in the survival result originating from the different methods used in grafting.

About 2000 out of the 2300 total number of rootstocks (87%) have a living graft at the present time. There are seven clones which show a definite sign of incompatibility. These clones will not be rogued, but any grafts lost since last year will be replaced with new clones to raise the number of clones in the orchard.

Our latest survey shows that 5% of the ramets show a strong indication of graft overgrowth. When examining the older grafts which have the indications of graft overgrowth, it is frequently noticed that the union is very short (just around 1 inch). A longer union (3 or 4 inches) might help to reduce this problem. This was incorporated in the 1964-1965 grafting projects. We have to wait for at least five or six years to prove this point. In one respect we are convinced already. We feel with a long union

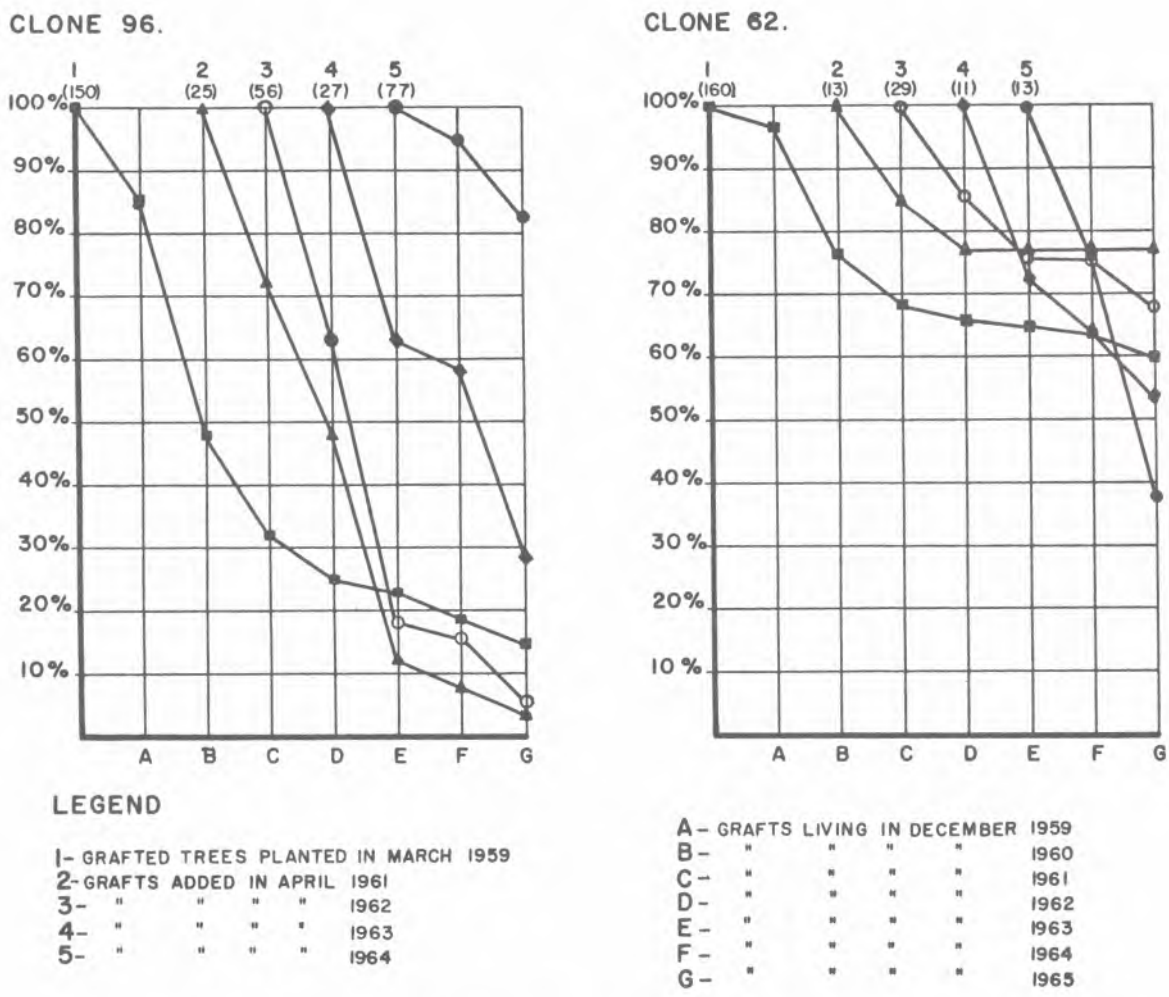

Figure 1. Graft survival rate for clone 96, a "poor" grafter, and clone 62 a "good"grafter.

there is more cambium exposed and this certainly raises the chances for achieving a stronger union. This shows some encouraging signs in the last year's and this year's survey.

The graft overgrowth problem is serious indeed, and we have to learn a lot more about it to be able to solve it.

Eliminating the poor grafting clones is somewhat easier, as they generally show incompatible signs in the first or second year after grafting. The six years' grafting result, by clones, in the seed orchard was carefully

compared with the first year bench graft survival rate in the Nisqually nursery. The correlation was very close. For further proof, three hundred fifty (350) new bench grafts were made last year using mainly the poor grafting clones. These trees were planted at the Canby I. F. A. nursery under fairly uniform conditions. The results were similar to our earlier findings. After this, we decided to test each new clone for graftability before it was used in the seed orchard. The scionwood gathered from the plus trees is grafted onto 2-0 or 2-1 rootstock as bench grafts and planted in nursery bed for two years. The reason for using the bench grafting method is that the grafting is done in more uniform conditions and about twice as fast as in the field. The out-planted grafted trees are also growing under more uniform conditions than generally a seed orchard can secure. This no doubt raises the chances in separating the poor grafters from the good grafters. Perhaps in a few more years we will know more about the causes of grafting failures, but until then we will have to use the best measures available. This method certainly requires some extra cost, but from our past experiences, we feel that this is justified.

This program is operational already. One thousand one hundred (1100) bench grafted trees were planted out at Canby this spring. Fifty new plus trees were located this year, and their testing will get under way in the future. While grafting still goes on, some older grafts slowly begin to produce cones. This makes it possible to control pollinate and start the progeny testing program.

Controlled Pollination and Seed Production

The first controlled pollination was attempted in 1963. Just a small number of trees produced flowers; therefore, the pollen gathered in the orchard was combined into one lot instead of making specific crosses. The dry pollen was injected through the bag directly onto the flowers by using a syringe with a hypodermic needle. The seedlings raised from this first crop of seed show a promising result. After the first growing season in the nursery, their average height was 98% higher than the average height of the controls. The seed used for controls was taken from the seed harvested in the Springfield Division timberlands for routine annual reforestation of cut-over areas. After the second growing season, still in the nursery, the height difference dropped to 28%. This is quite normal. Such a growth rate is significant, but height growth is just one of the characteristics in which we are interested be-sides adaptability, bole form, wood qualities, and disease resistance in our tree improvement program.

The first twenty-three (23) combinations of crosses were made this year. This time the "wet" pollination method was used which was develop-ed by Allen and Sziklai (1962).

The seed collected this year is the first portion of a more meaningful progeny test. It will be kept in cold storage until there is enough seed for all the crosses and then the progeny testing will get under way at the same time.

Inducing Flowering With Commercial Fertilizer

Certain measures are needed to stimulate flower production in a seed orchard. Experience to date shows that a balanced commercial fertilizer has some effects in increasing cone yields on treated trees, but the type of fertilizer to be used, the timing and rate of application for the best result, still figures a great deal in experimentation. To come closer to solving this problem, a year ago in September a fall fertilization trial was carried out to aid the differentiated flower buds in their development.

The fertilizer used was a mixture of the following:

43%	16-16-16
14%	20-10-0
43%	Ammonia Nitrate
100%	

The amount of fertilizer used per tree was 0.5 pound on the average as a ground application. Only those trees received an application which were possible flower producers (two years or older grafts).

The result is combined in the following table.:

TABLE 1. Flower production after the 1964 fall fertilization trial.

Trees In Production Stage In The Orchard		Trees Fertilized			Not Fertilized (Controls)		
			Produced Flowers			Produced Flowers	
No.	%	No.	No.	%	No.	No.	%
1116	47%	990	205	20.8%	126	12	9.5%

The result was surprisingly good. Percentage-wise more than twice as many trees had flowers out of the fertilized trees as did those out of the controls. 4

This year another attempt was made to induce flowering. This time three applications were given in the spring.

First application: March 29, 1965, five weeks before general bud bursting.

Second application: followed two weeks later.

Third application: this was applied May 21, two weeks after general bud bursting.

The fertilizer used was ammonia nitrate and 16-16-16 mixed in equal amounts. In each application a tree received 0.5 pound of fertilizer on the average--the smaller less, the larger more. This was also a ground application.

There was a very wide range (6 weeks) of bud bursting time recorded among clones this year. This should give some aid in finding the right application date in the future. The results remain to be seen next year and the following years.

Record Keeping and Data Analysis

One of our major accomplishments lately was the introduction of constant record keeping and detailed analysis. This helps us more than we realized in working out handling techniques and managing the orchard. Without this, it is almost like walking in darkness. It is desirable to record any indications for certain symptoms which might lead to some correlation or to certain patterns which could be very helpful in pinpointing a problem and then correcting it.

Looking back on the past seven years, we must say that we are still far from having a clonal Douglas-fir seed orchard established; although besides the many failures, we have had some success. It seems as if we traveled a rough road on a long journey. In spite of this, it still was a great experience. We all must learn as we go on; and that is, in fact, the principle reason for our meeting today.

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