ONTARIO'S APPROACH TO THE GENETIC IMPROVEMENT OF BLACK AND WHITE SPRUCE - A BRIEF SUMMARY

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Presently Ontario's artificial regeneration program involves the planting of some 80 million seedlings per year of which 17 million are black spruce and 25 million white spruce, Since these two species do play such a large role, it only follows that we should have an extensive genetic improvement program established in the Province.

In the past few years much of the emphasis in spruce breeding and improvement at Maple has changed, so I would like to present a brief summary of one aspect of the current work in these two native species. Although both species are treated separately, the program outline for each is basically the same. There are some minor differences in approach and treatment to date, and as results are obtained, it is likely that the program for each will diverge further.

There are several different approaches that we have used in our efforts to obtain the best possible material. Each approach requires a different amount of time and effort which in turn results in different amounts of gain. Since we require seed immediately, we do have short term programs such as the testing of seed production areas which will provide us with some improvement within the next few years. Other more involved programs such as the evaluation of the seed orchards will take longer, but will provide us with better results.

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Much of our work is a cooperative effort with the Tree Improvement Group and the field staff of the Forest Management Branch of our Ministry. They are responsible for the selection and management of the seed production areas, the selection of plus trees, and for the establishment of the seed orchards. It is our responsibility in research to test and evaluate the stands and the trees selected.

The Province of Ontario is divided into several site regions (Fig. 1) which act as working groups for each of the species and define the outer limits of seed transfer. Presently, all of the seed collected is identified at least by site region, but in addition some collections are further identified by stand and township. All of our seed production areas and seed orchards are also classified according to site region.

Our first step in providing genetically improved seed is in the selection, management, and testing of seed production areas. We have 225 acres in 9 areas selected in white spruce, and 129 acres in 7 areas selected in black spruce. Figure 2 illustrates one of these black spruce areas. One of our first priorities is the selection of many more areas such that we can evaluate several within each seed zone for each of the two species. We will do individual tree testing as well as stand testing. On this basis we will select the best areas and intensively manage them for seed production. These seed production areas will be used as an interim measure until the seed orchards come into production.

We expect to obtain our greatest gains from the selection of plus trees and their establishment into clonal seed orchards. Originally, when the program was started all trees which were selected were grafted and established into a seed orchard without prior testing. But due to the expected size of our program and the number of plus trees to be selected, we have modified the program so that preliminary testing of the plus trees is made before it reaches the orchard. As of 1973, cones are collected when available, and cone measurements and seed data are taken for each of the plus trees. One-parent progeny tests are then established in the nursery for each of the selected trees. On the basis of early data, we can rogue a percentage of the trees so that they will not get into the seed orchard nor enter into the controlled pollination program.

At the same time that the seed is collected, 25-30 scions are also taken. The scions are grafted and held until preliminary data for the parent tree is available. If the parent is eliminated through this evaluation, then the grafts are also eliminated. Those trees which are kept, can then have the grafts placed into the seed orchard design. More scions can be taken from the established grafts so that this clone can then be represented in several blocks within the orchard.

The existing clones within the orchard and all future clones which are added will be evaluated with what I term a modified bi-parental mating design (Fig. 4). I feel that there are many advantages to this type of a design with a minimum amount of work. Since both parents are known, not only can we get a good estimate of specific combining ability, but we can also select the best individuals from the best families and use this material as a basis for second generation selections. As each clone is represented six times with this crossing pattern, we can also get an estimate of general combining ability.

We realize the time and effort required to select plus trees in the field and that in many instances the selection intensity is quite low. Thus, we have adopted another approach as we also select in the nursery beds. Here, the intensity of selection is 1 per 100,000. The trees are removed from the beds with a minimum of disturbance to the root system and planted in a holding area, When the trees are of sufficient size to take cuttings (usually 2 years from lifting), cuttings are taken from the selections and placed in a mist house for rooting (Fig. 3). The rooted cuttings are field tested in replicated experiments. The material which shows good rooting ability and good field performance will then be placed in clonal stools where they will be used as base material for nursery production and incorporated into the artificial regeneration program.

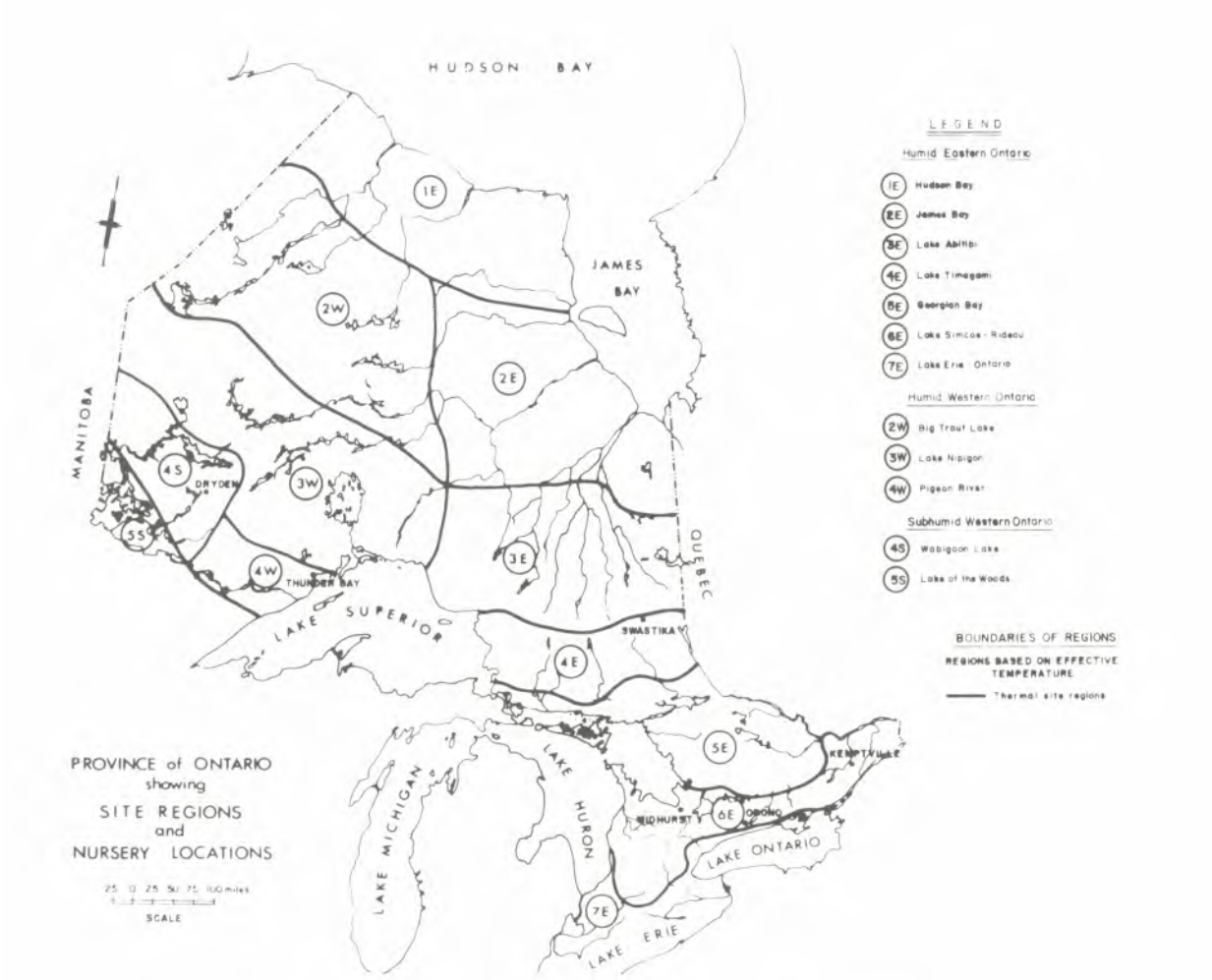

Figure 1.--Site regions for the Province of Ontario.

Figure 2.--Black spruce seed production area in site region 3E.

Figure 3 --Mist house for rooting of cuttings.

FEMALE CLONES

MALE CLONES	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A							*						o			x
B	x							*						o		
C		x							*						o	
D			x							*						o
E	o			x							*					
F		o			x							*				
G			o			x							*			
H				o			x							*		
I					o			x							*	
J						o			x							*
K	*						o			x						
L		*						o			x					
M			*						o			x				
N				*						o			x			
O					*						o			x		
P						*						o			x	

Figure 4.--Modified bi-parental mating design where each clone is represented 3 times as a male and 3 times as a female.