

REPORT OF THE NEFTIC COMMITTEE ON HARDWOOD TREE IMPROVEMENT

William J. Gabriel, Chairman¹

The Committee report for the current year, 1964, will be on the results of the program for the survey and selection of sugar maples for high sugar content.

This year I am pleased to announce that we had an increase in organization and personnel participating in the program. In addition to the State Committees operating in Vermont, Maine, New York and New Hampshire, we had a committee working in Massachusetts. I might add that they did a wonderful job this season.

The new progressive sampling technique was used this year along with the preliminary screening method which minimizes environmental effects. I don't wish to go into detail on these techniques at this time, but a full explanation of how they work can be found in the 11th NEFTIC Proceedings, pp. 8-11. These improvements over our old methods were a great help to field personnel during the current year's operations.

This spring, training sessions were held for fieldmen in Vermont, New Hampshire, Maine, and Massachusetts. At these sessions instructions were given in the operation of instruments, the procedures used in surveying and screening, and in filling out the necessary survey and selection forms.

The number of bushes in which surveys were conducted, broken down according to states, are as follows: Vermont 25, Massachusetts 17, New Hampshire 12, New York 11, and Maine 1, for a total of 65 bushes and 4,043 trees. Lew Bissell, the Chairman of the selection committee in Maine has written me that 1964 was a miserable year for sap flow in his state and he hopes that conditions next year will be better than this year for conducting the study.

The number of trees which met the initial selection criteria of being at least 30 percent sweeter than the average of 11 surrounding standard trees and more than 1 percent higher in sap sugar than the sweetest of the standards are as follows: Vermont 52, Massachusetts 35, New Hampshire 11, New York 7, and Maine 0; a total of 106 trees.

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The largest variation between a selection candidate and its standards reported this year was 100 percent, which is most encouraging. Trees which were chosen as selection candidates last year using our new methods were still superior to their standards this year, but were somewhat lower in sugar content. Trees that were selected using the old method of taking 10-tree-100-tree samples were nearly all eliminated in this year's screening.

I have not yet been able to plot on a map the location of the surveyed bushes and the variation within each, to determine whether a state or region may be stratified according to the magnitude of differences. First I want to circulate a questionnaire among all the fieldmen to inquire whether they feel that their local areas have been adequately sampled. Replies to the questionnaires will determine, in large part, the amount of survey work we will be doing next year.

At this time I would like to announce that we have openings on the Northern Hardwood Tree Improvement Committee for a couple of live-wire men. The purpose of adding to the committee is to expand our improvement activities into other areas. We will definitely continue with the work on the improvement of sap sugar in sugar maple in the meantime.

DISCUSSION

CALLAHAM - I'd like to ask Mr. Hunt to clarify the table. Am I correct in understanding that the acres to be converted are long-range goals and that the seed production areas needed are to meet a short-term goal?

HUNT - The figures in the column on the left are the projected acres (in thousands) requiring conversion from hardwoods to softwoods of those species mentioned. The figures in the center column are the acres of seed production areas to be completed during Fiscal Year 1965; they will eventually reach, according to our projection, about 4,400 acres. In the meantime, the area in the left column may be re-assessed to include some hardwood stands with too few stems of merchantable quality. We anticipate some of these areas may remain in hardwoods but hardwood species of greater value. This may increase the total number of acres required. Potentially, there exists a need for at least 4,400 acres of seed producing areas. I hope some emphasis will also be given to plus tree selections for seed orchard establishment in addition to the seed production areas to increase quality and quantity of seed produced.

ALLISON - I'd like to direct this question to Mr. Hocker. What rate of fertilization and what standards did you base your rates on for white pine?

HOCKER - This was published in the Ninth Proceedings, but to answer your question right now; we used a ten-ten-ten commercial mix; applying it at a rate of a tenth of a pound per projected square foot of crown basal area. In other words, we estimated the average diameter of the crown and projected this as a basal area. It was roughly a tenth of a pound of fertilizer per square foot of projected area. Rate per tree ranged from sixteen to thirty pounds for trees fourteen to eighteen inches; eighteen inches was the largest tree. The maximum amount then was about three pounds of elemental NDK fertilizer to an eighteen-inch tree.

ELIASON - Is that one application?

HOCKER - Yes. The results we obtained are similar to other studies where one application was made. What would happen if there were an annual application, as they're doing with the seed orchards in the South, I don't know. Probably this would level out this cycling effect that we noticed; i.e., 3-4 year seed crops.

CLEMENTS - I'd like to ask Dr. Hocker, did I understand correctly that the seed yields per acre indicated in your data were without any control of seed insects? What do you think it might be if you had reasonable control?

HOCKER - This report is a projection of estimations, several estimations, cone numbers and seed yield per cone. So, if we obtain control of the insect, we don't know whether it will be fifty percent control, seventy-five percent control or thirty percent control. Some people estimate thirty percent control with current techniques. But what it will eventually be, I don't know.

GENYS - I have a question for Mr. Gabriel. If I understood correctly, you are conducting a phenotypic selection for maple sweetness. What are your plans for determining the genetic variation or heritability of this trait?

GABRIEL - We are planning to run a two-parent progeny test to test our selections, There is some question at this stage as to whether we will establish a parallel clonal test.

GENYS - These tests would be most valuable, because the phenotypic selection alone may mislead.

GABRIEL - No are fortunate that we are dealing with a character in our selection work which can be measured rather precisely with an instrument. In addition, our technique of comparison of selections with surrounding standards probably will keep us from being misled too far in making our phenotypic selections. This is our initial screening-.. In addition, we are also planning a final screening of our selections. This will be carried out by a crew of perhaps four specialists, one in the field of forest soils, a second in silviculture, another in genetics and a fourth that may be a sugar producer. We don't intend to start our breeding program until after we have reasonable assurance that the genetic differential appears to be high enough for our purposes.

GENYS - Naturally, you will receive the strongest data from the progeny tests.

GABRIEL - This point is academic, I think we are all in agreement that the final criterion for determining whether the selections are genetically superior would be a replicated progeny or clonal tests. In our case it probably will be a two-parent progeny test, as I have stated earlier.

ANONYMOUS - How about use of grafted stock?

GABRIEL - Here we have a problem. It is quite possible that the rootstock might influence the sugar content in the sap of the scion. For example, storage of starch in the rootstock and the scion may be inherently different. Unless rootstocks derived from the same clone are used in clonal tests we may be introducing a confounding variable that could result in the drawing of erroneous conclusions.

GABRIEL - Actually, Cedric, we are still in the survey phase of our program, and haven't made any definite plus tree selections thus far. We have a physiologist who is working on techniques to extract sap from young seedlings. We hope that in the near future we will be able to extract sap from seedlings--possibly as young as two years of age.

WELCH - This is returning to the forenoon session where there's quite a bit of attention paid to Scotch pine, and I wanted to make a comment regarding some of the potentialities of some of the Scotch pine rust diseases. We have one important disease of white pine as you all know. Scotch pine has at least three rust diseases in the Northeast, one of which is potentially damaging, especially to Christmas trees. The other two perhaps can be disregarded. But anyone who is contemplating a development of Scotch pine for use as Christmas trees should not lose sight of the so-called "Woodgate Rust" or "Eastern Gall Rust" because this rust disease is one of the few true rust diseases which does not have an alternate host. It passes from one pine tree to another and the occurrence of these galls on a young Christmas tree will certainly ruin it, As to its occurrence, within the last three years we have found it in at least thirteen counties in New York State. There's still a question as to how rapidly it will spread and how important it will be, but I think that its something worth noting at the present time.

HUNT - I have a question for Dr. Hocker, Would you mention what advantages you anticipate in choosing balsam fir seed from only one stand?

ROCKER - I wasn't involved in the selection. Apparently, the selections were made in a stand which had a large number of green trees, and selection, as far as I can determine, was based entirely on color.

STAIRS - I have a question for Mr. Rollins. In the conversion of seed production areas from natural, uneven-aged stands, what is your criteria for establishing a selection differential?

ROLLINS - Well, I'll answer for Maine; right now were just trying to hold the line. In other words, we are taking what are apparently average or above average stands as seed production areas and consider this an improvement over randomly collected or open market seed.

STAIRS - It appears to me that the problem of uneven-age classes must be considered here. The larger trees or "superior trees" may simply be the oldest trees in the stand.

ROLLINS - Well, seed is collected throughout the stand; so were not actually selecting the larger trees of the stand. Were taking growth on the stand.

STAIRS - I think the question of identifying a selection differential remains an important consideration. If you have many age classes represented in a stand how do you determine the age factor in selecting the "bigger and faster growing" trees?

ROLLINS - I presume you are speaking now of thinning these stands. Well, usually in the thinning, the trees are in a thicket, they're practically all the same size and presumably the same age. You find out as you cut the trees that you are thinning whether or not they are in fact the same age. To be precise you could count the growth rings on the stump. Although you cannot know without boring that the trees to be left are the same age as those cut.

STAIRS - Wouldn't you prefer to use even-age plantations for this purpose where possible?

ROLLINS - Plantations are very easy to work in, but we know there are very few plantations in Maine where the source of seed is known. All we can evaluate is how they're doing now. Perhaps this is enough.

HUNT - Let me help Al out here a little bit if I may. The seed collection stands that we visited in Maine included a planted area. I believe the Newry plantation is such a stand, so the value of an even-aged stand of rapid growth is recognized. It's always a compromise when you are looking for seed, whether you are going to look for a specific improvement or whether you're just going to assure yourself of an easily gathered supply from a source you know grow well in Maine. As far as I know, seed supply and not improvement per se, is the motivation behind the choice of the area mentioned. By nature, the seeding-in of an area should result in enough vigorous trees of any one age to compare growth rates within that one part of the stand. Thus, some areas of the stand should approach this even-age concept.

Perhaps more care should be taken to determine the actual age of the selected trees by boring or an internode count, so each selection represents the best young tree in each group. In this case, thinning was necessary to increase or maintain seed production from open-grown trees. I believe you mentioned, Al, that seed supply is yr major objective. When you do get enough seed, you will certainly be looking for superior individuals to achieve some genetic gain. These seed production areas are an interim program.

CALLAHAM - May I make the observation that I think it's unfair to ask about the selection differential in the seed production area. In the first place, most of us in the West regard seed production areas as interim, short-term areas on which seed is to be produced in the next ten to twenty years. Quantity of seed production from a known source is the main criterion.. Of course, known source represents a genetic gain over the kinds of materials that we are presently putting into our nursery. You could call this genetic gain of one kind. It's not the kind you were asking about when you asked for selection differential.

SCHREINER - I agree with Bob, particularly where we must deal with uneven-aged coniferous or hardwood stands. In hardwood stands, particularly, we often have a wide range in age and further confounding of growth differences by a wide range of tolerance between various species in a mixed stand. But we are also interested in tree form, disease and insect resistance and general fitness, Where we do not have plantations we can't be too precise in our selection of trees to be left in seed production areas. If we are fortunate enough to have plantations, fine, But if we don't have plantations what are we going to do; sit back and say we can't do anything? Not if and when a so-called "crash program" is wanted by the forester manager, be he private, state or federal, But let's not forget that this is not the degree of genetic improvement that research is aiming at.

GENYS - Apparently, some of us are interested in genetic tree improvement while others go along with any type of seed-collection areas. Seed collection or stand improvement for development of seed trees is rather a part of silviculture. I still think that our major goal is tree improvement, not silviculture. There is no point of avoiding such term as "selective differential", used by Dr. Stairs, or terms used by other geneticists.

CALLAHAM - I think we must distinguish in talking about seed production areas and seed orchards, and genetics research, In the first case these people are concerned immediately with seed production problems, They need seed or their nurseries yesterday. In such cases, we are concerned with at least getting the proper source and getting reliable seed sources, This is genetic improvement over the kinds of seeds they have to plant in the nurseries today. True, we as geneticists are concerned with questions of selection differential and heritability; they have

to go hand in hand in order to talk about genetic gain to be expected in seed orchards in the future. But it is proper in a tree improvement meeting to talk about seed production areas where we are merely trying to improve the source and reliability of seed production for present-day nursery requirements.

CLEMENTS - I'd like to make one further comment there. For example, on the Allegheny Forest there may be 750,000 acres (I'm not sure of the total acres of the forest); the timber management men and the district rangers are scouting all of the red pine on the Allegheny. They wind up with probably fifty acres as potential seed producing area. The geneticists evaluate those, and he boils it down to twenty acres, I consider that fairly good selection. This is the same in the white pine and other species on down through the other forests, We are screening the whole forest in order to get these limited acreage.

SCHREINER - Well, Clem, that's drastic screening, and at present the best way to get the job done; but you may still be selecting your best sites rather than your genetically best stands. This you can't rule out. If your foresters were on that forest long enough to really know that they've found a stand that is doing exceptionally well for its site, O.K. but how many of our foresters have lived with their forest long enough to know it that well?

CLEMENS - The local forest employees are helping find the stands that have been outstanding on the forest, Some of them have been there fifteen to twenty years, They are really the guides in finding these better stands within the forest.

GERHOLD - I'd like to add to the previous discussion this one more point, I think we need to re-emphasize that we re not comparing practical objectives of seed production areas and theoretical considerations involving selection differential in natural stands-, We're concerned with two different practical objectives, one a short-term objective and one a longterm, practical objective, to which the selection differential applies. I think it's not a question here of research versus practicality. Both of them are practical considerations.

HUNT - The idea that research should be the prime motivation of a meeting such as this one is all right, but lets look at the relationship of silviculture to tree improvement research. It seems to me we've had a wealth of research that is not currently applicable to silviculture. Silviculturists have not been the driving force for this research and, because of various economic conditions, cannot always apply the research results. Only when a silviculturist requests genetic gain in seed or some improvement over that he can buy from Arkansas or Japan, will he be ready to apply a proven research concept. I believe that we have to demonstrate this in our own backyard. This is why such practical discussions have a place in a meeting such as this one.

HOCKER - In selecting seed production stands, how do you insure a range of sites is present in the selection of areas? Can you locate stands on a range of sites or do you take them as they come? Our experience has been that in the initial selections of plus trees we select from the best sites, In 6 out of 9 selections the site index for white pine was 65 feet or higher--average site index is 62 feet,

HUNT - To be frank, this has not been thoroughly considered; however, I recently read an article that reported the best sites tend to produce the best progeny. The theory stated that progeny from outstanding trees growing on the best sites often had sufficient variation to be able to grow on poor sites as well as the progeny of outstanding poor-site trees. If we are prejudiced by exceptional performance on the better sites, we are not necessarily limited to such a site for the improvement of a specific characteristic. We should not, expect our selections to

be unable to grow on the poorest sites, unless these poor sites are so isolated from good sites that different evolutionary changes might be represented in either area. So far as I know, this has not been demonstrated for the species we were working with. I hope to be corrected if there's an exception.

IBBERSON - I'd like to ask Clyde how they're converting or how they're contending with these natural stands on the areas that are converted; first, how are you removing them and then second, how do you contend with the natural sprouting and seeding on those areas?

HUNT - So far we've completed work on only about ten acres. The mechanics for rouging the areas, keeping them clear and somewhat free of competing or re-invading vegetation, are as follows: Most of the work has been done under contract with a logger who is particularly careful to make sure that the tree marked to remain will not be damaged. We try to leave 30 to 60 trees per acre. These should be evenly spaced, while still exhibiting the best characteristics. Most states are also doing this first, through a commercial sale, The marked material that is merchantable is sold, then using least-cost labor, all competing vegetation is brushed out until only the best trees are left in the area. This has been accomplished by mist blowing, poisoning, normal mowing with a Gravelley tractor, cutting and reducing the material to chips - there are all sorts of possibilities. Virginia has been clearing the area of undesirable trees, disking and burning all the slash so they have only bare mineral soil and as few as seventeen trees per acre. This probably represents the most intensive method to insure that the trees are free of competing vegetation.

RUMPF - In selection of superior trees, in addition to external characteristics, how many people are taking into account specific gravity, fiber length and so on?

HUNT The National Forests are submitting core samples to the Forest Products Lab at Madison, Wisconsin. This will tie in with the southern pine study already established to furnish information about specific gravity variation throughout the South. In Maine, such information has been gathered for the five major species of softwoods including white pine. These studies locate variation and geographical differences within the species. This information is available to all wood using industries. Does this answer your question?

RUMPF - No. When you are selecting your superior trees for use, obtaining scions for development of a seed orchard, is any attention paid to specific gravity, fiber length, wood characteristics of these trees?

HUNT - Very little attention is being given to these wood characteristics in the Northeast. Selected trees may not be notably superior in wood quality. I don't feel wood-using industries have clearly stated which characteristic they consider most important. I believe we should first select for improved growth rate and stem form. This type of improvement could be economically utilized whether preference is for greater lumber strength or for springwood fibers. As I understand, increased growth rate has rarely been shown to adversely affect specific gravity as the springwood-summerwood ratio (or percent) remains rather constant. For a given age, on a given site, rapid growth rates represent not only an increase in ring width but an increase in ring count at any particular height above the ground (such as d.b.h.). The rapid growing trees reach this height first, then tend to produce denser wood with each successive annual ring. At any particular height the cross section of the slower growing tree would have greater proportion of juvenile wood than the rapid grower. For the present specific gravity hasn't been my prime consideration. We can always make a secondary selection for fiber length or other important characteristics.

STAIRS - In the New York program we are taking a large increment core for determination of specific gravity, springwood-summerwood ratios, fiber lengths, and extractives from many of our selected trees. At the same time we often select a codominant tree of average growth rate for comparison. Here we are simply interested in determining the effect of increased growth rate upon wood quality, and its relation to our selection program.

SOWERS - Well, our selections of Virginia pine in Virginia and West Virginia for the seed orchard are checked out by the N. C. State-Industry Tree Improvement group. For each tree that we submit they take a large increment core and they get all the data on specific gravity and fiber length and so forth. When they send the report back to us, each tree will be labeled to "use", to "not use" or to "use if necessary". That, however, is their grading, and we do as Clyde says, we don't throw out any of those select trees, but we are retaining them for possible future use. We are using trees which are proven high-yielders and if high specific gravity and long fibers can be selected within the high yield specifications, we select for them next.