were gathered in late November, wounded, treated and placed in containers on an open greenhouse bench. In about six weeks all had rooted, with the larger cuttings producing apportionately large root systems.

The following is an example of the odd and sometimes perplexing things that may occur in plant propagation. On the 22nd of May, 1959, the director brought a branch of *Viburnum opulus* 'Notcutt's Variety' to the greenhouse. The plant was destroyed by vandals over the weekend and had lain in the sun for a couple of days. Spring growth had just begun and the new shoots were about ½ inch long — it was badly wilted and appeared hopeless for propagation. If anyone else had made the request it no doubt would have been tossed into the trash as soon as he rounded the corner. However, we made 15 cuttings comprising 3 sets of nodes. In two weeks, to our astonishment, extensive roots appeared at all nodes both above and below the medium, along the stem and even on the leaf ribs.

The propagation of woody plants difficult to root would have been a simpler topic fifteen or twenty years ago than it is today. A long list of subjects considered impractical to root at that time are now propagated commercially as routine practice. It has been said that with the advent of anti-biotics the science of medicine emerged from the dark ages. It may also be said that technological advances have accomplished much the same in the science of plant propagation. Root inducing substance procedures, intermittent mist and polyethylene chambers have been developed to a high degree of perfection. Many of the great strides made during recent years may be credited directly to this organization, the International Plant Propagator's Society.

MODERATOR HESS: Thank you, Al, for a fine presentation. Our next speaker is Tom Pinney, Jr., one of the Society's most progressive nurserymen who utilizes sound production techniques, cost accounting procedures and who has contributed tremendously to the Society and the industry. Tom will tell us about the propagation of birch.

THE PROPAGATION OF BIRCH

THOMAS S. PINNEY, JR. AND GENE W. PEOTTER
Evergreen Nursery Co., Inc.
Sturgeon Bay, Wis.

Our nursery has sold Birch to the nursery trade for the past 100 years. During this time we have had many complaints and unhappy customers because the stock was collected and had notoriously poor root systems with crooked stems. The situation finally became so disturbing, and the demand was so great, that we decided that we must meet this problem with positive thinking and somehow develop a program of mass producing Birch in the nursery. As a result, 6 years ago

we embarked on a vigorous program to solve the problem of commercially growing Birch in our area. This was a team effort from the start. Everyone in our organization understood the value of developing such a program and added ideas and constructive criticism. We received many helpful hints from our yearly attendance at the Plant Propagators Society meetings and from our friends in the florist industry. There is nothing new or revolutionary in the techniques we employ in this program. Rather, I believe, the success has come from the proper utilization of techniques already well established in our industry, the willingness of our people to learn from their failures and their desire to constantly improve the program.

GREENHOUSE CULTURE

The first step in the successful propagation of Birch is the collection of viable seed. A germination test is the most accurate measure of viability of a specific seed lot. The Birch seed crop varies from year to year and we attempt to collect several years supply when it is available. The seed is stored in either polyethylene or cloth bags which are kept in large steel barrels at 35-40 degrees F.

In January or February a second germination test is made to determine the best lots for seeding. The seedling media is prepared by mixing 2 parts of our transplanting mix and 1 part sharp sand. Both the transplanting mix and sand have been steamed previous to mixing. We will describe the transplanting mix later. This media has excellent drainage properties. The seed is broadcast over the entire flat and the flat is then covered with a plastic film. These flats are placed in a germination box with bottom heat maintained at 65 degrees F by electric cables and thermostat. Germination takes place in 7-10 days. The seedling flats are then placed on the open bench where they remain for 14-21 days. During this time we will start them on a very low constant nutrient program. The net solubridge reading at the beginning is approximately .75.

Extreme caution must be exercised in not contaminating the seedlings with damping off organisms. In recent years we have used several commercial drenching solutions prior to seeding and start a preventative maintenance program after germination, with captan and other fungicides as needed.

After working closely with a large commercial florist, we finally developed a transplanting media that met our requirements. It consists of 60% peat moss, 25% soil and 15% perlite. The soil is a sandy loam. The perlite is recovered from our greenhouse operation from benches used to stick our cuttings. It consists of ½ Ryolex #6 and ½ Krum. Two and one half pounds of triple superphosphate is added per yard of mixture. The preparation is then steamed for 30 minutes at 180 degrees F. Since we are primarily concerned with the problems of aeration and good nutrient retention, we have at-

tempted to tailor the media to meet these requirements. We use the high percentage of peat moss to bolster the nutrient retention capacity of our rather low organic type soil. Both the peat moss and the perlite seem to give an optimum drainage situation. We have developed a perculation test using 6″ standard clay pots. The same pots are used each year and some of the previous years soil is saved for comparison. The pots are filled with the media and struck off even with the top of the pot. They are given four consecutive 250 cc applications of water. The temperature of the water used is approximately 55-60 degrees F. By the time the fifth 250 cc watering is applied, the media has been thoroughly soaked. We feel that a satisfactory perculation test occurs when all of the water in the last test has disappeared from the surface of the media in 35-45 seconds. These tests are made after steaming since this procedure may improve the perculation time by as much as 85%.

After the second true leaf becomes visible, the seedlings are transplated into 2¼″ square peat pots or strips. Each flat contains either 54 or 60 pots depending upon whether squares or strips are used. Three seedlings are placed in each pot, to form a clump.

After transplanting, the flats are placed in a shallow pan containing a dilute solution of nutrients and allowed to soak up from the bottom. The plants are then placed on benches in plastic greenhouses 16′ x 97½′. The fertility program is gradually increased until a net solubridge reading of 1.5 is obtained. A 20-20-20 type soluble fertilizer is used and injected through the line with each watering.

A preventative maintenance program for pest control is followed with applications of the combination of Isotox and Captan once a week. Occasionally specific pests are encountered and other pesticides are utilized. The temperature is kept between 65 and 75 degrees F. during the day and 55 to 60 degrees F. during the night. The temperature is varied depending on the type and amount of growth desired. The plants remain in these greenhouses for approximately 6 weeks, where they develop at a very rapid rate.

FIELD CULTURE

It is essential to obtain a high nutrient level in our nursery soils before transplanting the Birch to the field. This is accomplished by using a green manure crop of corn planted with a grain drill at the rate of 2½ bushels per acre. Sufficient fertilizer is added to insure good growth and tests have indicated we plow down as much as 6000 pounds of dry weight material per acre. We have found the corn to be an excellent indicator plant of major nutrient deficiencies. The area is then treated with dieldrin to eradicate any white grubs that might be present.

The peat pots of Birch clumps are then transplanted to

the field after all danger of frost is past, sometime after June 10 in our area. Prior to the actual planting, the area is pre-sprayed for weeds with 2 pounds of Sesone and ¼ pound of Diuron per acre. We have tried ¼ to ¾ pounds of treflan per acre with uncertain results. Care must be taken in use of herbicides at this time since the Birch are in an extremely active state of growth and are very susceptible to herbicidal damage. This past year we still did some hand weeding of the area.

We use four deep tiller shoes behind a three point hitch tractor to mark off the beds and rows. These shoes loosen the soil sufficiently in the rows to allow for easy pushing in of the little peat pots. Our beds are on 79″ centers with four rows to each bed, spaced 12″ apart. The large aisle is necessary because of the drooping over of the plants into the aisle toward the end of the season. A composted manure is placed in each row prior to transplanting.

Proper summer culture is vital to the success of this operation. It is important to keep as many growth factors at optimum as possible. Unfortunately we have not learned what these optimums are for many of the factors. Immediately after transplanting we begin a supplemental irrigation program. The water is applied through Skinner lines with automatic water motors attached. This system applies approximately ⅛″ of water per hour of operation. Depending upon the humidity, wind and other conditions, we apply approximately 1-1½″ of supplemental water per week. Our fine, sandy loam soil has excellent drainage, but unfortunately has a low water holding capacity. Throughout the entire summer we apply nitrogen in the form of ammonium nitrate once a week. Early in the summer we start 15 pounds of ammonium nitrate per 600 gallons of water and gradually increase this to 25 pounds. Our liquid fertilizer apparatus involves a 600 gallon tank, trailer, pump, tractor and boom. One man is able to operate this with reasonable efficiency. The 600 gallons of fertilizer solution is applied to 1400 running feet of bed or approximately 11,200 square feet. On the next trip the operator will apply clear water as a wash to the same area. When sufficient area has been fertilized in the above manner, the irrigation lines are turned on for approximately 1½ hours.

A preventative pest control program is the most desirable kind. However, during the past year we have been testing several systemics to control our major pest, Birch leaf miner. Presently we feel that Di-syston at 3 pounds per acre when irrigated in, is the most promising. Lesser rates of this chemical have not done a satisfactory job. Meta-systox-R has given erratic results. We have used 1½ pints per 100 gallons. In years past we have used DDT and Malathion, alternating these two chemicals on a weekly basis. This has given us very satisfactory control of the miner and other insects, but was a rather expensive procedure.

DIGGING

There are three major ways in which we begin to help nature harden off these very actively growing plants. First, we stop all fertilization on approximately September 10. Secondly, we do no additional watering after this time unless we have an extreme drought condition. Lastly, we undercut the Birch with our power digger on approximately September 30. If these procedures are strictly followed, we have had little or no difficulty in causing the leaves to drop on papyrifera and popufolia. Sometimes alba is a little more stubborn.

The lifting operation actually begins between November 10 and 15 depending upon how fast the hardening off procedure has developed. The plants are then dug twice with our digger blade in it's maximum lifting position and the plants manually lifted, tied into bundles and removed to our storage by trailers with aluminum houses.

GRADING AND SHIPPING

Unfortunately we still carry out the standard nursery practice of grading by hand. If we were able to grow all of the clumps with three evenly matched stems, our grading problem would be greatly reduced. However, many of them vary in size and must be pulled apart and put into their proper grades. This is a major problem as only 15-20% of the clumps actually have three stems that fall into the same grade category. The uneven development of the stems is one of the most perplexing problems to challenge our thoughts. Although we are not able to solve this problem during the first seasons growth, we have discovered it can be solved the following year by clumping in the field single or double stems from the same grade. This allows a further flexibility to the customer since he can plant as many stems per clump as he wishes and pattern them according to his own tastes.

Shipment can be made to the customer anytime after fall digging. By the end of March we have most of our orders shipped as we are anxious to do this before the onrush of our spring shipping season.

FIGURES

A brief look at figures numbered 1-5 will reveal some rather interesting data that we have collected.

The first figure, entitled "average growth rate of Birch stems", indicates the growth rate of the Birch stems in inches per day. The data is based on a representative sampling of 20 plants, including three varieties, involving 48 individual stems. Measurements were recorded once a week to the nearest .25 of an inch. The total population of the field included 35,000 papyrifera clumps, 10,000 alba clumps and 5000 popufolia clumps. The top line represents the tallest stem of each clump, while the bottom line represents the shortest stem of each clump. The middle line represents all of the stems involved

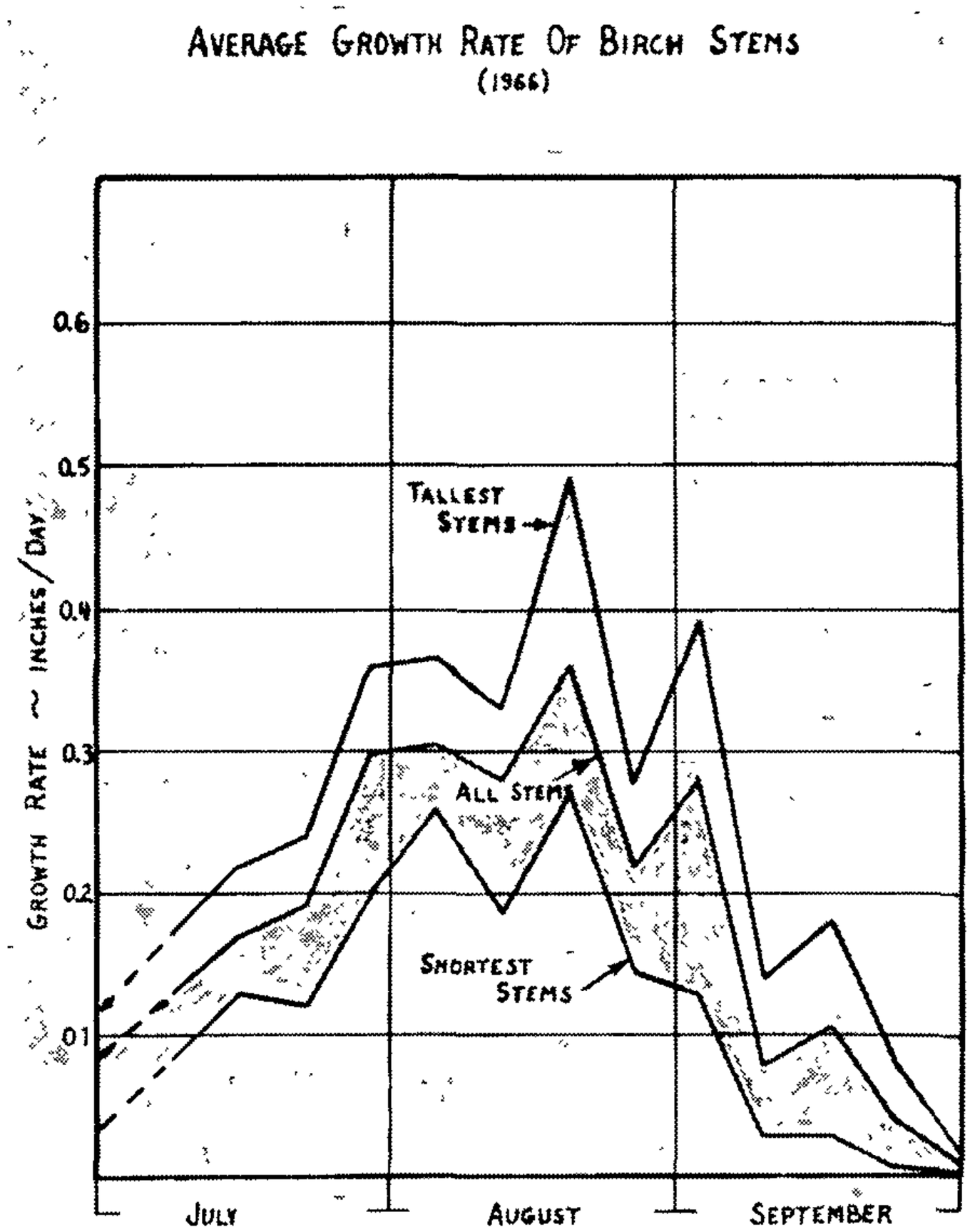

Figure 1

in the test. Some clumps measured had only 1 or 2 stems. Note how each line dips sharply during the third week of July, the second week of August and the fourth week of August. Each of these dips coincide perfectly with periods of water shortages to the growing area. This summer we experienced one of the most severe droughts that our county has had in many years. As a result, on these three weeks the water was rationed to the area. Notice that the growth rate was cut almost 50% during the fourth week of August. From past years experience, we can be reasonably sure that we would have achieved at least .60 of an inch of growth per day by mid to late August if we had not encountered the water shortage. The slight rise in growth rate during the second week of September is due to a natural rain that occured after we had ceased watering.

The second figure, entitled "average height of Birch stems", clearly points out that if the clump has uneven stem height when it is transplanted to the field, the problem will be accentuated rather overcome. Note the much greater spread at the end of September than when the plants were originally transplanted to the field. From this, we can see that the basic problem of uneveness occurs between the time of transplant-

ing to the peat pots and the time they are planted into the field.

The third figure, entitled "growth rate of the three Birch varieties", is very interesting because it confirms a suspicion we have had for a number of years. It clearly indicates that papyrifera is a much more vigorous grower than alba and popufolia, with us. Because we were suspicious of this in the past, we have even planted our alba first in our greenhouse production and therefore they often reach the field as a larger size. This poses an interesting question—now that we can prove that it costs more in our case to grow alba than papyrifera, can we successfully adjust our pricing schedule accordingly? This might take a little courage even when we have the facts.

The fourth figure, entitled "size distribution of graded Birch clumps 1965", is based on data recorded from the 1965 crop which involved 55,000 clumps. When viewing this chart, remember that it costs just as much to grow the 3-6" plant as it does the 4-5′ plant. I might point out that in our operation, the break even point is within the 12-18″ grade.

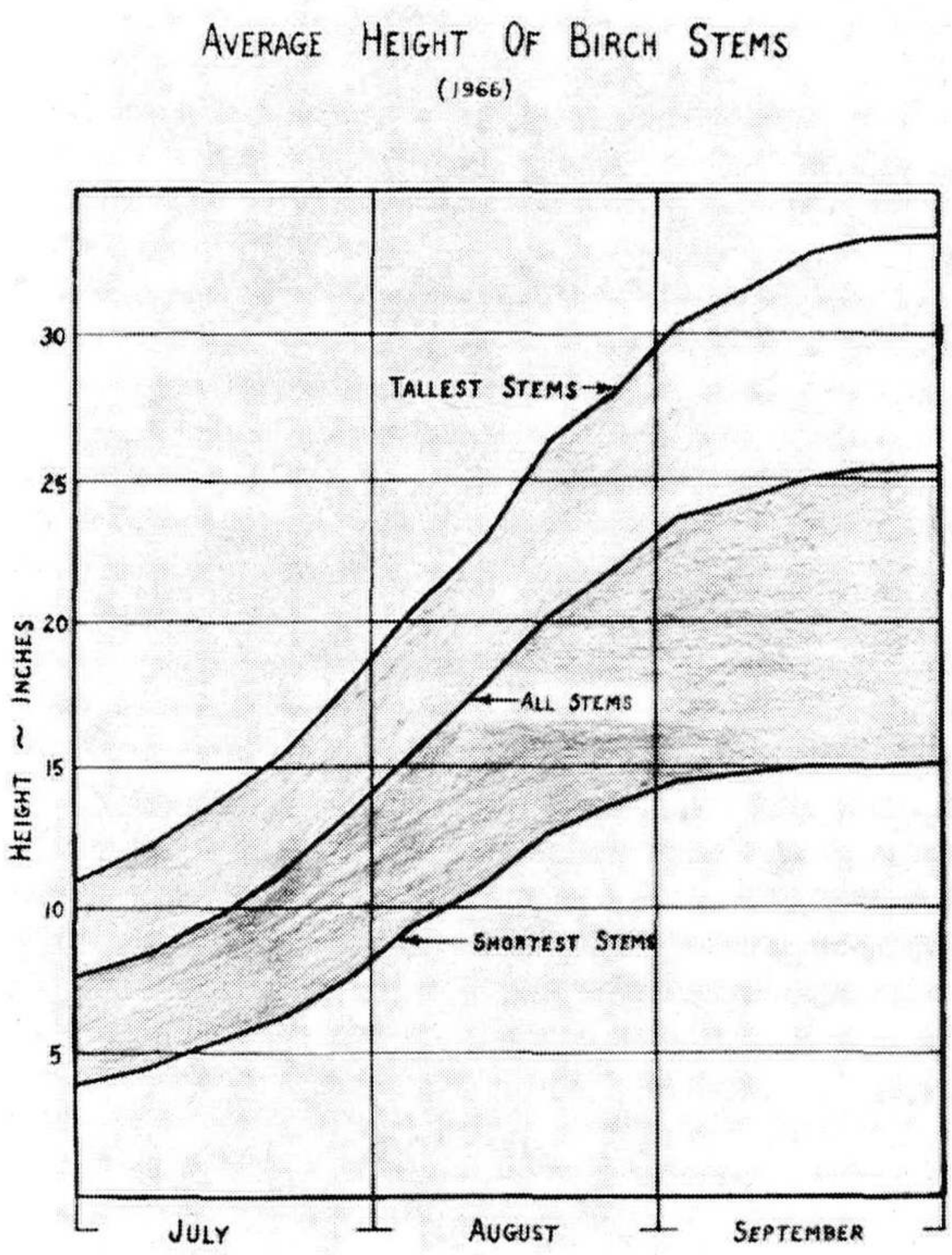

Figure 2.

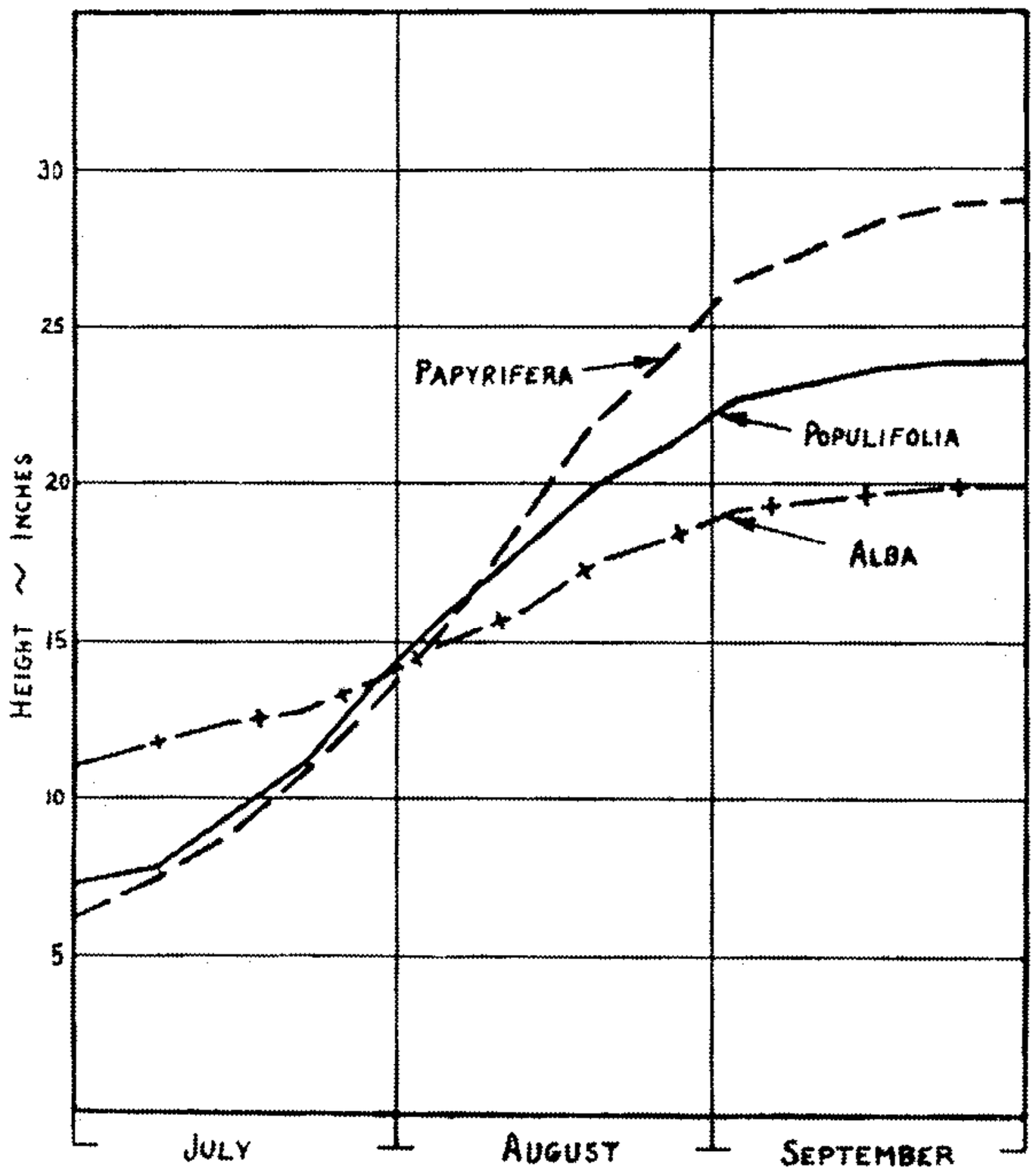

Figure 3

Figure number five, entitled "cost of Birch production by operations 1965" is relatively self explanatory. The 22.5% involved in grading is high, primarily because of the uneveness of the stems. This same problem comes back to haunt us over and over again. In looking at the distribution of direct labor, overhead and materials, it is easy to see that we start with a very small investment in materials, but put a tremendous amount of labor into producing this quality plant. We based our overhead on 250% of direct labor in the year 1965. The actual figure was 249%. It must be emphasized that this is based on *direct labor* and not total labor. Each year this figure varies as we develop our departmental P&L statements. The cost of production when broken down to dollars and cents has been within 2c per clump over the past three years.

SUMMARY

In conclusion, I would like to again emphasize that what success we have gained has been through a team effort of our whole organization and many helpful hints from people like yourselves and those in the florist industry. We have much to learn about the culture of plant life, especially it's nutrition. Certainly this program is not the ultimate—far from it, as there is much to be done yet and we hope to expand it into other areas of production.

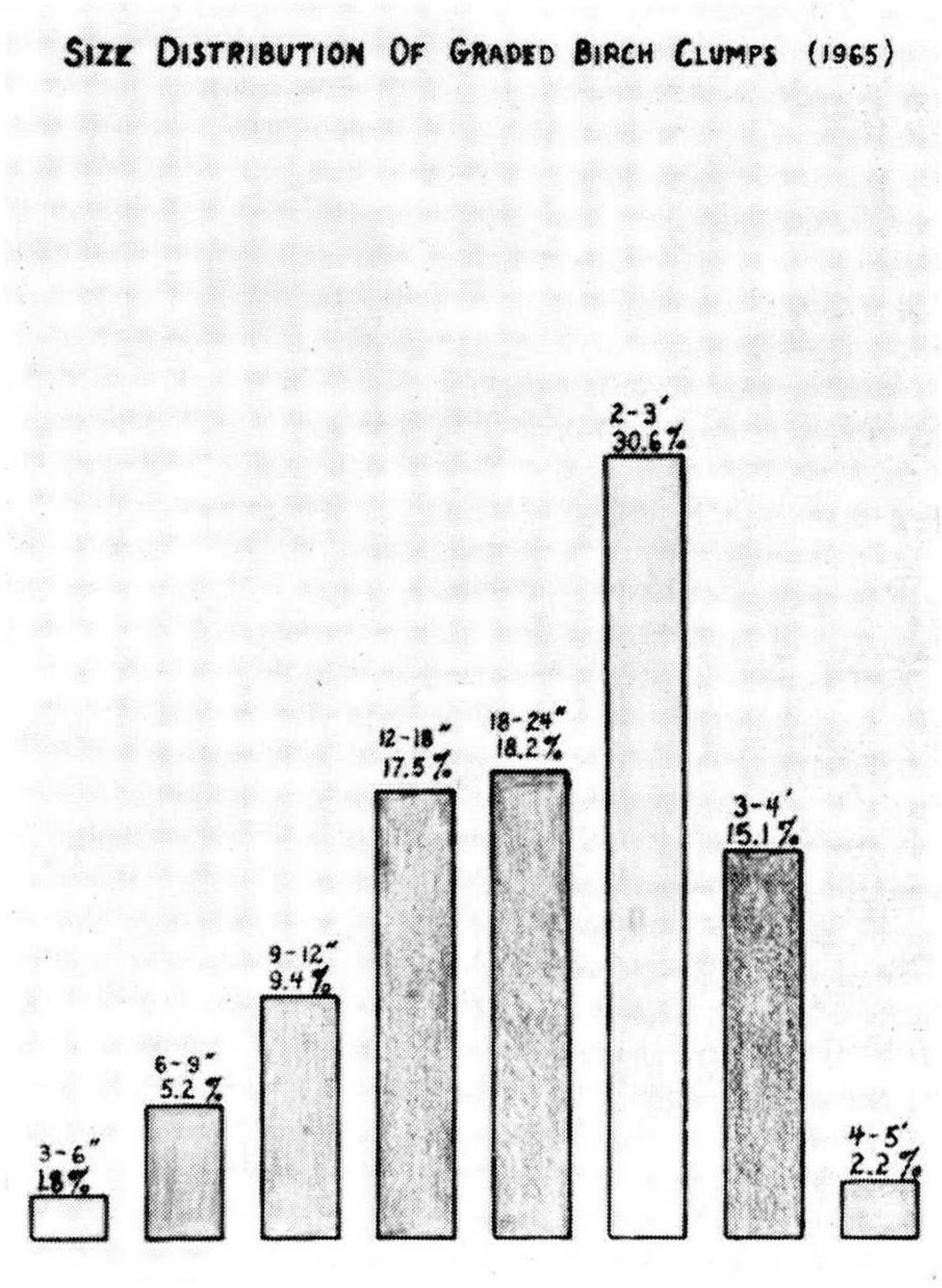

Figure 4.

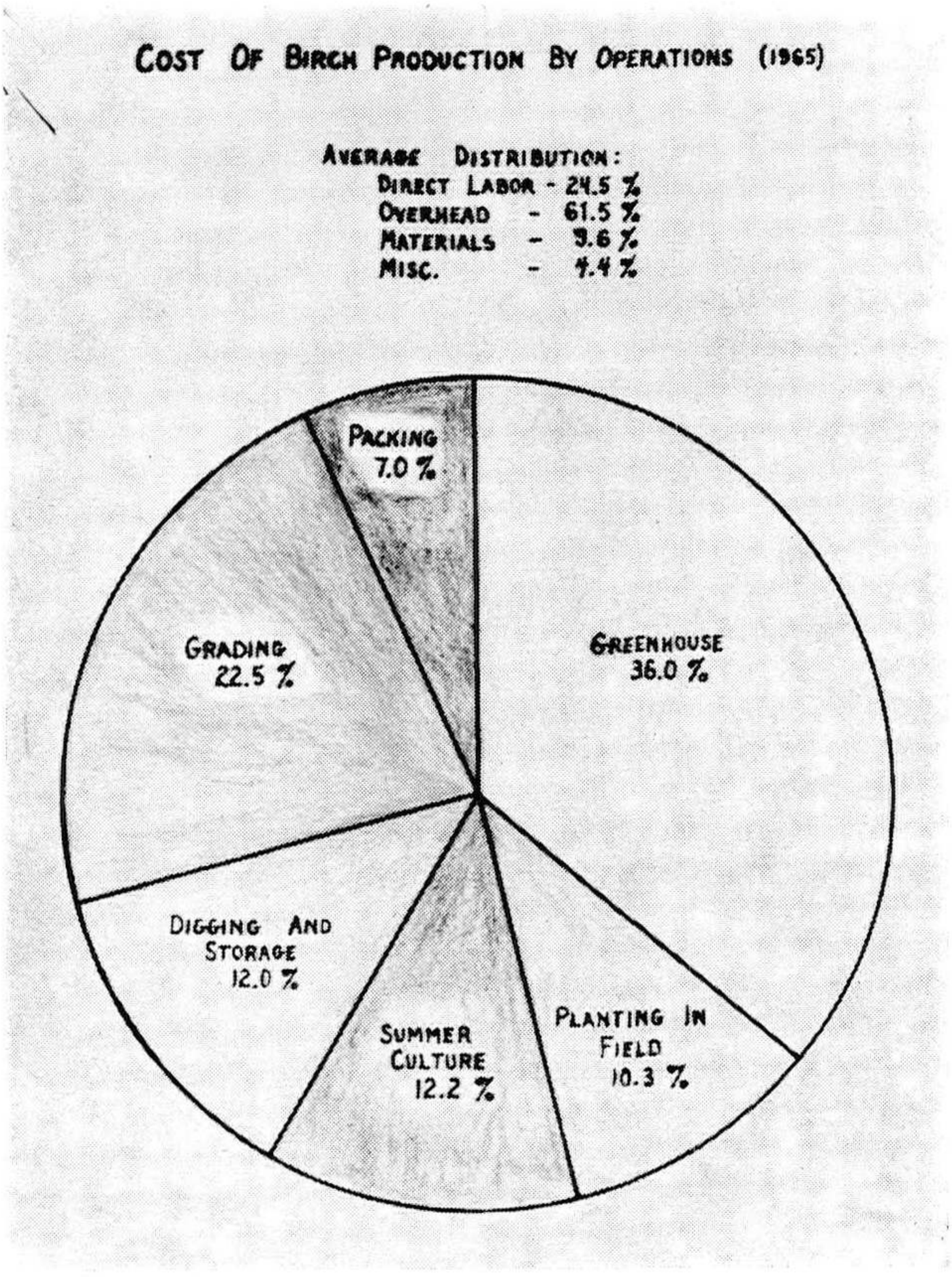

Figure 5.

MODERATOR HESS: Thank you, Tom, for an outstanding paper. Our next speaker is well known to all of us and is the father of President Pete. It is a real pleasure to introduce John Vermeulen.

PROPAGATION OF RHODODENDRON UNDER OUTDOOR MIST

JOHN VERMEULEN
John Vermeulen & Son, Inc.
Neshanic Station, N. J.

This topic was on the list of suggestions and as we had some limited experience in this field for 2 or 3 years I offered to tell you what little I know.

For some years we had given up the propagation of Rhododendron from cuttings as it interfered with other items to be propagated in October-November. But 4 years ago I was asked to trim some Rhododendron Mrs. C. S. Sargent in early