The problem of imbalance in the water/oxygen relationship is intensified with misting. Excess water applied to maintain cutting turgidity, needs to be carefully avoided. Short blasts of mist at proper intervals should be the mode of application. Misting intervals of thirty seconds or longer, applied with time-clock regularity, may be cause for over watering and water/oxygen impalance.

This past season our nursery management students set up a series of tests with various media to demonstrate the points I have outlined. All cuttings were carefully selected for uniformity. The cuttings were misted with short blasts. the intervals between misting under the control of the 'Mist-a-matic'. The sand used in these demonstrations contained 25% very fine sand and silt. An average grade of sphagmum peat was used as well as horticultural grade perlite and #4 vermiculite. The species used in the demonstration were *Rhododendron obtusum, Cotoneaster microphylla,* and *Pyrocantha coccinea.* Twenty different media blends and straight materials were used. Sand, when used alone, produced the poorest results on all three species. Peat alone produced somewhat better percentages of rooting than sand alone. When peat in a blend of an equal volume of perlite or vermiculite, or a mixture of peat, perlite and vermiculite were used, the best results followed.

This test does not rule out the choice of sand as a good rooting media, but it does indicate the value of a clean sharp sand, free of very fine sand and silt. It also indicates a satisfactory alternative to washing the sand available to us. Further work along this line must be done to substantiate the concept of the water/oxygen balance imperative in a rooting medium.

MODERATOR REISCH: Our next speaker on the panel is a fellow citizen from Ohio, Mr. Richard Bosley, who will speak on ground bark as a growing medium.

GROUND BARK — A CONTAINER GROWING MEDIUM

RICHARD W. BOSLEY
Bosley Products
Mentor, Ohio

Introduction

The use of wood residuals, as a container medium, is becoming quite popular. Many nurseries are using proportions running as high as 80-100%. This utilization of wood residual materials has been made possible by the development of methods of stabilizing the product against nitrogen withdrawal from the growning medium.

I wish to acknowledge the great service that Dr. O. A. Matkin and his Soil and Plant Laboratory, Inc., has made to the industry as a whole and more specifically to our nursery in the development of wood products into suitable growing media.

Past Proceedings

For your information you might like to check the 1963 Proceedings of the International Plant Propagators' Society which contained an article entitled "Ground Bark as a Growing Medium for Container Nursery Stock" by F. A. Rigby. I will try to bring you up to date on what has happened between then and now.

What Are We Looking For?

What are we looking for when selecting a container medium?

1. Physical and chemical characteristics.
2. Availability
3. Cost
4. Disease Problems?

Physical Characteristics

Let's talk first about some of the physical and chemical characteristics of organic amendments that we might be looking for and bark specifically.

One of the first physical characteristics that comes to mind is the aeration and drainage factors. The sudden water logging of a medium previously only moist will kill the roots of most plants, with or without parasites. The continuous development of roots provides, among other things, the essential means of adjusting to a changing environment. Perhaps a better approach though is to have a medium which is difficult to overwater or will assume adequate air within the medium shortly after a heavy rain or irrigation.

Good drainage can be achieved with course material, either organic or inorganic. The next factor we might consider though is moisture retention and this will limit the particle size. We might say then why not use just the right size of sand? It is cheap, won't break down and can be made clean.

The fertility retention capacity or cation exchange capacity of most sand is very low and so you would have trouble keeping the plant fed.

A number of factors then point to using an organic amendment in our growing medium. Many growers have used sphagnum peat for many years with good results but at a rather high cost and after a wet year in Germany, questionable availability. After rather extensive investigation we were encouraged to use ground bark as the organic constituent in our can mix.

We use bark from two sources that have a mixture of about 30% oak, 30% maple, 20% cherry, some birch, no elm or walnut as these two woods are not suitable for paper making. Both of the mills we get bark from produce paper products and are careful to remove the bark from the log without any wood content. Most of this bark is from growth about 5-8″ in diameter and is usually smooth, on the log, rather than old shaggy material.

One of the first problems becomes reducing the particle size to the 85% in the 0-⅛" size needed. It is best to encourage the mill to do this as the equipment can be expensive and have high power requirements. At the Tom Dodd Nursery we did see an old silage hammer mill doing a very good job of reducing pine bark so this might be a possibility. Once you have the particle size the next problem becomes satisfying the nitrogen.

N Treatment

I would like to stress at this point that there can be great differences in bark from one source to another. The two sources we get bark from are only 150 miles apart and both use second growth native hardwood. One source we have to treat with much more nitrogen than the other, one has a pH of 8.35 and the other 4.6 with a very high potassium (2880 ppm) content. I would like to *stress* that if you try bark do it on a limited trial basis and with the help of either the university extension service or a laboratory. The precise control of nitrogen will determine, most likely, how successful you will be.

There are several ways that bark can have its nitrogen requirement fixed. The best way is that developed by Dr. Matkin of the one minute exposure, in a closed auger to a measured quantity of anhydrous ammonia (NH_3). Pine bark for instance would require about 3-6# of anhydrous ammonia and upon emerging from auger would be ready for use. The total nitrogen content of the product will be 1.5% based on dry weight. The treatment cost would be about 60c a yard for nitrogen. The rate is about one yard a minute but the equipment might cost several thousand dollars. The resulting nitrogen is neither leachable or available to the plants until the bark breaks down which is very slow.

Another method of nitrifying the bark is with bloodmeal. We have used this method in the past and although it is the most expensive form of nitrogen (anhydrous ammonia being about the cheapest) and it smells bad, it can be used at once as a medium. Rates of 10-20# per cubic yard would be a starting point. The other material we have used is urea although if you are growing azaleas you must be alert to the possibility of a biuret poisoning problem if you continue to use slow release fertilizers on your crop. All of this seems like a lot of trouble to go to but take a close look at your peat cost compared to a cost of say $2-2.50 a yard delivered for bark (1c a gallon using 100% bark).

Old Bark

Old bark often has a *higher* nitrogen requirement. Stick to fresh material which will be more consistent and less trouble.

Cation Exchange Capacity

The nutrient retention, or binding power, of a material is dependent upon a capacity commonly termed "Cation Ex-

change Capacity." Organic amendments have a relatively low nutrient retention capacity compared to the typical loam soil. In comparison to sand though the organics have a fairly substantial cation exchange capacity and thus will enhance nutrition retention in a mix.

Root Rot

The question will arise in your mind — will I need to sterlize the bark? There is the distinct possibility that it will contain pathogens as the logs most likely contacted the soil in their journey to the mill. In the case of the use of urea to nitrify bark we stock-pile it for a week and have noted 125° temperatures in the stack. Perhaps we could boost this to 140° which would kill the undesirable pathogens. In the case of the closed auger treatment surely the exposure to an atmosphere of ammonia gas would do the job.

Our Mix

You might be interested in what mix we came up with at the Bosley Nurseries using bark. The figures are based on one yard:

¾ yard bark (0-⅛")
¼ yard medium sand
20# blood meal
1½# triple superphosphate
20# dolomite lime (high magnesium)
10# calcium carbonate
1# iron sulfate, ferris or ferric

I give you these figures with considerable reservation because you should determine by test and/or trial what level of additives you need.

Volume

Let's look at the bark availability and see if it will still be around 10 years from now. There are two main sources that you can look to and they are paper and veneer mills. The Mobile, Washington and Clarke Counties surrounding where you are sitting have an estimated annual wood chip consumption of 411,630 cords. The use in this area is great enough that serious studies have been made regarding direct field to factory transportation of wood chips by pipeline. Growth of new wood is greater than consumption. Air pollution promises to rule out burning the great volumes of bark in the future.

One of the paper mills we get bark from produces 580 cubic yards a day or almost ⅔ of our annual consumption! They get a heat value of about 50c a yard, if they burn it. But they can only burn about 80% a day leaving about 100 yards a day to be hauled away somewhere! A plant barking a 40′ log 2′ in diameter will produce 240 tons of bark in an eight-hour day. A plywood plant producing 207,000 square feet of ⅜"

plywood per day may fill 10 boxcars with bark at the same time. We feel that bark is widely available and will be for a long time. That it is a good growing medium when properly treated and it is worth your while to try it. There is great concern as to what to do with all this bark in this country and Finland. Its agriculture suitability seems a much sounder approach which could materially reduce air pollution in certain areas.

MODERATOR REISCH: Are there any questions for the panel?

VOICE: I noted in Ken Reisch's paper that he stated that the rooting of cuttings in air was not commercially feasible. However, I remember last year some excellent slides presented by Bruce Briggs showing the rooting of cuttings in air which appeared very interesting to me.

BRUCE BRIGGS: At this time I agree that the practice is not sound commercially but I would not say that in the future the practice is not sound. The techniques have not been worked out to the point where you could have assembly line production. When you attempt to root cuttings in air you run into problems such as you would with any new medium. Some of the problems you can't even anticipate. We need to have research on the type of equipment necessary to keep the air moist around the base of the cuttings and we also need work on temperature control.

CASE HOOGENDOORN: I would like to ask Dick Bosley how long it is before the bark breaks down and doesn't he run into a problem of nitrogen deficiency?

DICK BOSLEY: We add nitrogen to the bark before it is used. The amount of nitrogen to be used to satisfy the breakdown requirement has to be determined by trial. If this is properly determined, it will satisfy the needs caused by breakdown and you can proceed with a normal nutritional program for the plant material. The bark is very long lasting and this is one of its desirable characteristics.

CASE HOOGENDOORN: Could you not use old bark that has already decayed?

DICK BOSLEY: Our experience has been if you use old bark from the bottom of large piles that it actually takes more nitrogen. Also, there is a problem that there are more fines. It's best to stick with fresh bark and you have a more consistent product to work with. With the older bark you don't know exactly how old it is and it would be necessary to run a test on each batch.

VOICE: I would be interested in knowing the cost and the source of the bark that you use.

DICK BOSLEY: The cost is between $2.00 and $2.50 per cubic yard. I don't have the exact figures but probably 50c per cubic yard of that cost is for the bark and the balance is for trucking.

AUSTIN KENYON: With the mixture of ¾ of a yard of

bark per yard of mix and 20 pounds of blood meal how long must it be composted before it can be used?

DICK BOSLEY: It can be used immediately.

AUSTIN KENYON: Is the bark which is priced at $2.50 a yard ground when you receive it?

DICK BOSLEY: Yes, it is ground.

HENRY WALKER: Do you have any problems in transplanting to permanent locations when using the bark medium? Does the bark tend to fall away from the plant after it is taken from the container and does the plant have any difficulty becoming established in soil after having been grown in the bark medium?

DICK BOSLEY: In order to grow in a container you must have a medium which provides the proper aeration and drainage. These requirements are not always totally compatible with the final field soil. There is a great need for public education on how to plant container-grown plant material. It has to be handled a little bit differently than balled and burlapped plant material. We get good root distribution in the container and so there is no problem at all of the medium falling apart. The problem lies in the interface between the container medium and the soil in the final location. With some soil types the water does not seem to go through this interface.

E. STROOMBEEK: Do you have to check the pH of each lot of bark or does it seem to settle down after the nitrification process?

DICK BOSLEY: Nitrification seems to raise the pH and fertilization tends to lower it. We run a pH determination each time a fertility reading is taken.

RALPH SHUGERT: Our final session this afternoon deals with new plant introduction. Al Fordham of the Arnold Arboretum is moderator.

MODERATOR FORDHAM: Our first presentation is by Ed Mezitt who will describe rhododendron P. J. M.

RHODODENDRON P. J. M.

EDMUND V. MEZITT
Hopkinton, Massachusetts

Rhododendron P. J. M. is a hybrid of *Rhododendron dauricum sempervirens* and *Rhododendron carolinianum* made in 1940. It is very floriferous blooming every single year on every stem, and its winter foliage of rich mahogany tones is very attractive.

Propagation is not entirely without some difficulty. Being an early grower similar to Rhododendron mucronulatum but also a woody type, it cannot be treated as a softwood cutting during the summer but must be started before the buds develop too much in the fall. If top growth starts before the roots, the