MODERATOR FURUTA: Thank you Roy. Our third speaker on the panel is Mr. O. A. Matkin. He has been involved in the area of soil mixes for probably more years than he's willing to admit at this time. Matt:

SOIL MIXES TODAY

O. A. MATKIN

Soil and Plant Laboratory, Inc.
Santa Ana, California

In the last 10 years there really haven't been any new innovations. There has been a great deal of change from systems "by guess" to systems "by design." It was well over a decade ago that a "system" was proposed. The purpose at that time was to remove guesswork, chance, and frequent misfortune from the procedure of growing plants, particularly in containers. Since that time there has been a startling and worldwide change in philosophy and procedure in the preparation and handling of growing media. Although the approach has fostered the use of ingredients which contain *no* soil, its utilization has led to greater understanding and more intelligent use of "natural" soils.

Reference is made, of course, to the UC System of Producing Healthy Container Grown Plants. It is still available as *Manual 23* from Agricultural Publications, University of California, Berkeley, California

The early development of suitable growing media for containers was greatly hampered by man's inability to recognize the fundamental differences between field and container growing. Too much emphasis was placed on fertility and too little on soil structure.

The modern grower recognizes that the soil mix is comprised of both physical and chemical properties and is not the complete answer to all of his production problems. He has become increasingly aware of the influence of the many other environmental factors. The very best soil mix can still leave the door open to disaster if sanitation, for instance, is disregarded. This philosophy was the principal purpose of the UC system approach. There are many adaptations of this basic approach that are currently in popular use. These are briefly reviewed as follows:

Container nurserymen have generally leaned toward media high in low cost organic materials such as sawdust or bark, blended with sand or sandy loam. This results in a lightweight mix for economy in shipping and also has substantial advantage in ease of maintaining low salinity because of high water infiltration rates. The physical properties of these mixes are conducive to excellent root growth.

Mixes of this type have become increasingly popular for roof deck plantings in overstructured landscape.

Pot plant growers have also altered their growing media from the prosaic "topsoil", manure, and peat to mixtures of sand, peat, and possibly wood residual. Perlite, pumice, or vermiculite are frequently substituted for part of the other ingredients. The currently popular "Cornell mix" of peat and vermiculite or peat, perlite, and vermiculite is an excellent example. Where ballast in the container is required, growers frequently substitute sand for part of the Cornell-type mix. The outstanding feature of the peat-perlite-vermiculite mixes is that they may not require decontamination before use if handled in a sanitary manner It is interesting that many Midwestern universities still recommend mixes of soil, sand, peat, and perlite composition. It is possibly a sign of progress that these recommended mixes have at least dropped the "well-composted manure" component from most of their formulas.

For **propagation**, media selected have generally been of a reliable composition as opposed to soil mixes; thus, the propagators have apparently recognized the benefits of good physical structure long before this principle was applied to container growing. Thus, we find propagators have been using sand, perlite, vermiculite, or peat moss and combinations of these for many decades. Certainly there is nothing really new in rooting media unless it be the prefabricated blocks, trays, or slabs that are attaining some popularity. The newest approach is that of direct rooting in well-aerated growing media so that transplanting is avoided. This procedure is quite popular in poinsettia and pot mum production.

In **cut flower growing**, beds of soil are generally used. These beds may be of conditioned native soil or may be completely synthetic and similar to nursery container mixes or pot plant mixes Since the soil volume is substantial, an effort is usually made to employ native soil, particularly if ground beds are used. A typical program for this type of growing medium is to add large quantities of organic matter such as peat moss, sawdust, or bark and perhaps mineral amendments such as perlite, pumice, or calcined clay. The objective is obviously one of diluting the silt and clay of native soil to such a degree that the desired physical properties are attained Perhaps the newest approach in bed growing is that of using completely inert material such as sand, pumice, or scoria as the growing medium and depending entirely upon fertilizer supplied in the irrigation water to maintain appropriate nutrition. This is neither a new approach nor a departure from the UC principle Sand and gravel culture have been tried for many decades and have been consistently used in research. The primary difference in modern use is that the leachate is discarded rather than returned for reuse. This greatly reduces the disease hazard and has been found to be quite economic. There are some obvious advantages to the inert

medium system in that it is easy to decontaminate by steam or fumigation, and there are no problems from unexpected chemical or biological reactions. The greatest effort in this direction has been at Colorado State University.

An industry is developing which deals in custom soil mix preparation and perhaps this is new in that it replaces the old "topsoil" dealers It has great potential not only for nurserymen, but for landscapers Many of the wood residual producers are simplifying the process by including all fertilizers in their product so the user has only to blend sand or soil with it to attain a mix of balanced nutrition.

Finally, the use of more reliable growing media has permitted remarkable advancement in knowledge of and methods for nutrition control.

MODERATOR FURUTA: Thank you, Matt. Now we come to the portion of the program that says "Critique". Do we have questions or comments now for the soil mix panel?

BILL MORGAN: I would like to ask Mr. Matkin—has there been any work done in finding out what happens to plants which, we'll say, have been grown in a very coarse mix then are set out in the ground where they encounter an entirely different soil situation? Has any work been done on this?

O A. MATKIN: There's been a lot of experience. I'm not aware of a great deal of academic work on the subject, but this has presented, admittedly, a serious problem. Of course, when you're transplanting any container-grown plant into a natural soil, you have no choice of the natural soil and so the problem can exist whether the plant is produced in a heavy soil, a light soil, whatever, depending on what it is transplanted into So I think one has to use a little bit of good judgment when he is planting his container-grown plants into a landscape situation. The main problems that arise are those of moisture relations, in our experience. We frequently find that the artificial porous mix placed in typically loamy or clay type soil, presents a very serious problem in maintaining appropriate moisture. The biggest problem is that the root ball is covered up with the native soil and then water is applied to the native soil The plant dies, and you examine the root ball and find that it is bone dry. This is just a little lesson in the physics of moisture movement in soils—that the heavier soil, or smaller pores in the natural soil, tend to act like a blotter and, therefore, do not release water to the coarser textured root ball. We, in general, when working with landscapers, always specify that the root ball of any specimen plant shall be left exposed at the top during the establishment period; all water supplied shall be placed in a basin on

that root ball only, not on the native soil. Thus the water has to flow through the root ball before it enters the native soil. This, then, insures that this root ball, which contains all of the roots the plant has, will get water; and it avoids this problem of drought in the midst of ample moisture.

JERRY MAILMAN: I would like to ask Dr. Paul the name and number of the Agricultural Extension Bulletin which he mentioned.

JACK PAUL: It is University of California Agricultural Extension AXT—113. It is a for sale publication, incidently—($2.00).

RALPH PINKUS: I want to address my comment to the people that are making up these soil mixtures. I feel that one of our duties as growers and as plantsmen is to give a plant to the public that will become a thing of beauty and not require extreme care; and we are addressing all of our efforts right now to preparing a container soil mix that we can water every day and flood the place and still have the plant grow. But when the people get it, they have a big problem. They don't water every day. They put the plant in a clay or a loamy soil and the water drains right through and they might water only once every three days. Our losses are higher than they should be from this type of plant. I think some effort should be made to give the buyer a plant in a soil mix that will hold moisture a little longer, so I would like to propose this question—what can we do or how can we work in a direction that will give us this type of soil to use and still have it to be suitable for our growers? In other words, good for the producers and good for the growers. And I'll give it back to Mr. Matkin.

O. A. MATKIN: Thanks a lot. This is a serious problem, admittedly. I think we're now seeing certain growers coping with this to a degree, particularly growers of specimen-sized plant material. They are frequently converting as they get past this critical stage of the liner, the one gallon can and maybe the 5 gallon can; they begin to phase out of our beautiful synthetic mixes and they either incorporate some native soil or they may go completely to a substitution of a clay and/or silt-containing soil for the sand in the growing medium. I believe that this is a reasonable and logical approach because when the containers become larger, the soil column depth becomes sufficiently great that we are not bothered by this water-logged situation that occurs at the bottom of the shallow container, which may encompass the entire container. So this would be, at least, one method of approach to solving this problem.

DAVID RUDÉ: In this history, this evolution of soil mixes, I see where you've taken it from the traditional focus, where it is commonly termed the "muck and magic" soil mixing and then through the U.C. System, but I feel that we've left out a very important stage here, the John Innes soil mixes, where they did incorporate and did find an all-purpose medium but utilizing soil as one of the prime ingredients. Soil—peat—and sand. Now when we're facing this interface problem

of establishing plants from our containers, maybe we should look into the John Innes soil mixes as a base—as a means of standardization.

KENNETH PERRY: I'd like to direct a question to Dr. Branson. I would like to know whether there is any comparison between native peats in Northern California and the Canadian sphagnum peats, as far as nutrient holding properties are concerned.

ROY BRANSON: Sphagnum peats are considered to be superior to other types of peats for this nutrient holding ability and for other reasons as well. Some of the native peats that you see around the Sacramento—San Joaquin delta area in central California have a great deal of salinity, which is a considerable disadvantage; this does not exist in peats coming from more northern areas where they're subject to more rainfall.

BILL CURTIS: I don't think Ralph got his question answered, because for every specimen tree that's grown in a big tub or a big box, there are thousands of small plants sold. The people that buy the gallon and the two gallon sized plants are the ones who are having the problems. We are not having problems with the big plants. Well, I'd like to have an answer about what soil mix we can put in those gallon cans so that when we sell plants the buyer is not going to lose them after they are set out. How should we handle them to avoid losses?

O. A. MATKIN: Very carefully! Any small plant requires attention, and moisture must be supplied to that limited root ball. It's being moved from a condition of care—to, supposedly, a condition of reasonable care in the maintenance stage during establishment. I think that the big problem is teaching maintenance people how to take care of plants. Basically, no matter what mix they are grown in they require care. Now that's maybe not the kind of an answer you want, but the more I see it, the more I'm convinced that this is true. The more I see plantings going into a landscape, the more convinced I am that the landscaper frequently is taking overgrown root-bound plants and trying to get a finished appearance too soon. We shouldn't plant landscape materials with the idea of its being a finished landscape in a new construction. We plant with the idea of its developing into something of beauty. And personally, I would much rather plant liners than gallon cans because I think, in the end, I'll have bigger and better plants which can be taken care of better if they are planted carefully, with the top of the root ball exposed, by simple sprinkler irrigation for quite a long while.

VOICE: I think that one of the main things that we're missing here possibly is just a little bit more education in regard to the planting of these plants. Most people who are planting them should know more about it and, if they don't, we need to spend more time telling them. A great deal can be done by using a suitable buffer mix. In other words, if we are using a definite light mix in the container, and we're trans-

planting into a heavy soil, a larger hole can be dug and a combination of the heavier soil and the lighter mix can be applied around the root ball as a buffer zone; this will get the plant roots moving between the one condition into the other. This procedure can accomplish a great deal.

BOB WARNER: I would like to ask what place the slow-release fertilizers have with the mixes in supplying nutrients for a period of time?

ROY BRANSON: Slow-release fertilizers that contain nitrogen, I think, have a place in soil mixes which are of the modified U.C. type, those which do not have much in the way of nutrient holding ability. They're not widely used yet, but the results of some trials in California indicate that they can be useful for this purpose. When it comes to slow-release fertilizers which contain phosphorus and potassium, particularly phosphorus though, then I don't think they have a place in soil mixes because, regardless of the soil mix type, there's a pretty good retention of phosphate; but when it comes to nitrogen, slow-release materials can have some use in these mixes which tend to lose a lot of nitrogen.

BRUCE BRIGGS: I have two questions for Dr. Branson. You mentioned two ingredients that hold considerable moisture—that you considered were high level holders of moisture. Could you please inform us what two these are?

ROY BRANSON: The mix which was able to go longer without irrigation, was a mixture of peat and redwood. That was the one mix out of the dozen.

BRUCE BRIGGS: What was the proportion?

ROY BRANSON: The proportion was 60% redwood, 40% peat. Now I don't know what other proportions might give the same thing, but it was interesting to see that out of all of the dozen mixes, that was the one which had a longer moisture-release period by about twofold over the others.

BRUCE BRIGGS: After you put the mix together then and soaked it, did it again drain to become a fairly good growing medium; was the air porosity at a level so the plant could grow at a normal rate—or did you go that far?

ROY BRANSON: All of these plants were grown for months in these mixes and they grew well in that particular mix. They grew well in others too, but there was no problem with that particular mix.

BRUCE BRIGGS: My other question—maybe you would like to answer it, or maybe the others would like to—we have noticed in Washington for a couple of years, and we notice it even in California, but not as bad as up our way—that if we grow gallon cans can to can, the plants seem to respond; they grow fast. But as soon as we make the

move to do the spacing we seem to have a period of maybe 30 days when the plant ceases to grow. There are always more problems with disease, more problems with the foliage not looking nice. It's also a problem when the plants are moved from a wholesale yard into the retail yard, because they also are spaced further. Is this because the plants are reacting adversely to the handling or because they are not being handled properly?

ROY BRANSON: Tok wasn't on the panel, he was a moderator, but I think he is the best person to answer this particular question. Let me turn it over to Tok.

TOK FURUTA: I was looking for Dick Harris. I think he should address himself to this question. No? Andy Leiser?

ANDY LEISER: No, I can't answer your question, Bruce, because I haven't noticed this problem with things not looking so good when you space them—unless they have been extremely crowded in the gallons. Under our hot weather in central California, when you space them, you can get some leaf scorch if all the leaves have previously been heavily shaded; just like moving something from a lathhouse out into the full sun. There is a problem, and this is one Dick Harris could discuss very well, that is the heat build-up to the root system Can to can—the cans shade each other as well as the foliage. You set them out separately and—Dick, you ought to answer this, you did the work on this, not me.

DICK HARRIS: I think, normally, when the plants are spaced further apart, you should have less of a problem with disease because air movement is better. You can get more rapid drying if moisture is contributing to a disease problem. Normally, as far as the soil temperature is concerned, in a gallon can we find that there may be temperatures, even in November in California, of 115° F., 1" from the edge of the can and 3" down from the top; half of the soil in the container would be outside of that zone. In other words, we're sort of in the middle of the volume of soil and we are getting a reduced plant growth at 90-95° F. soil temperature and killing at anywhere from 110-115° F. With a single can completely exposed, we can get soil temperatures in November, in black gallon cans, up to 120-123° F. So root injury or root death in containers can be a problem just from high soil temperatures.

ANDY LEISER: You know, Dick, maybe part of the problem that looks like disease—perhaps they think they're getting root rot or something—but it's the temperature killing the roots.

BRUCE BRIGGS: This is the point that I was wanting to make. This is mostly a care problem. When you are in warm conditions where you do have trouble with the heat burning the roots, then should we not change our water system and rather than water once a day, water three or four times a day or go into a mist system watering? Would this be a better growing condition than we are using now?

DON DILLON: Dick, in connection with your soil temperatures in containers what effect, if any, have you found in changing the color of the container to reduce temperature?

DICK HARRIS: If you either shade the side of the container with a piece of wood or tin foil, or even paint it white, you can drop the temperature 8-10° F.; this certainly could get it out of the lethal range. One of the other confusing things is that for the first few days after root killing, dead roots can absorb moisture just as well as live roots and so, initially, there shouldn't be any wilting even with killed roots.

HERMAN SANDKUHL: Has there been any noticeable problem of root suffocation with the U.C. mixes? The reason I ask is that we have had an experience with a group of dwarf apple trees that we haven't been able to figure out and I've heard of several other people having problems in developing a sour sap or root suffocation condition with the U.C. mix; I was just wondering if there's something wrong with the U.C. mix or something we might be doing or something we might have done wrong to create this situation. We noticed it in the winter months—they came out of it in the spring, but the trees just fizzled out right at this point.

MODERATOR FURUTA: I would say this—there seems to be some evidence—and I'm sure there is no reason to dispute this—that quite a few plants are sensitive in varying degrees to whatever happens to be in the type of wood product you use, be it redwood or some of the others, but particularly redwood. In one case, there has been serious losses of some of the deciduous fruit trees, such as peaches and cherries, when the trees were heeled-in or planted into a soil mix that contained redwood sawdust, but where they were put into other mixes, or just into the ground, or into sand, there were no serious losses. If there were no losses, then there were symptoms that suggested diseases, and so on. While we do use a lot of sawdust, I don't think we should overlook the fact that many plants could be sensitive to this and you may be getting some effect from this.

O. A. MATKIN: Just one point that came up here the other day that intrigued me was the fact that we do have a waterlogged zone in any container and one might ask himself—what about, say sawdust being in an anaerobic situation vs let's say, peat moss? Quite probably the peat moss is not going to do any appreciable decomposing because that's the way it was formed. But these wood residuals present something of a problem and we've been thinking seriously about this, not for containers, generally not at all in containers, but rather in landscape situations where organic amendments that have not been subject to anaerobic decomposition are placed under the root ball where they may well become waterlogged; I think there are some potential problems there. Maybe this is a part of what your problem was. I can't say.

HERMAN SANDKUHL: I think I may have figured out a possible answer to my problem and that is, when these dwarf trees were put in the containers they were not filled with the medium as much as we generally use. I think we fertilized just at the point when the new roots were coming out on the trees and possibly we had some root damage from the fertilizer.

I would like to make another comment here in reference to the U C mix and the selling of plants in it to a customer. The customer, the landscape man, as far as I'm concerned, if he hasn't got enough wits by now to do a good landscaping job and bring plants through in a U.C. system propagating medium, he should get out of the business. Basically, the home gardener is where I think we are having a lot of trouble and I think why we have the problem is because there is not enough knowledge transferred from the nurseryman to the home gardener. The nurseryman does not get this through to the customer who's buying the plants. There is a trick about it—the planting and getting proper compaction of the new soil and I just can't overemphasize the use of slow release fertilizers. I just wish there were available more of them in smaller packages so that you didn't have to sell a good customer a $15.00 sack of fertilizer to plant a half a dozen plants

TOK FURUTA: I should like to change the direction of the discussion. Someone has asked me if there was a person here who might comment briefly on the patent that now exists on the meristem culture of orchids.

CHARLIE HESS: I know a little bit about it because Wes Davidson, who is very involved with the American Orchid Society and—upon his retirement is working for them—is studying the legal aspects of a patent which an individual took out on the use of meristem or mericloning as a technique for the reproduction of plants. Now, I believe he has a patent on the meristem culture of orchids; in the initial patent request, he had also wanted to list all other plants, but I think the patent lawyers removed it because he didn't have evidence of using it for other plants. So it was specifically limited to this one case and I am sorry I can't tell you exactly what the status of this situation is now. I know that there was some consideration of either opposing this by the American Orchid Society or else the actual purchase of the patent from the individual who obtained the patent on it. So it's an interesting development in the field of plant propagation.

RALPH SHUGERT: Speaking in this regard, if someone required additional information, they could write to Ray Brush, American Association of Nurserymen, Washington, D.C. Mr. Brush stays abreast of all plant patent acts and laws, proposed and current. Ray Brush would be glad to give you this information.

TOK FURUTA: This is not a plant patent. This is a process patent. This has been granted and is valid according to the lawyers

with whom I have consulted at the University. I guess it has not gone to court yet, and the only way it could be broken is by taking it to court.

THURSDAY EVENING SESSION

October 7, 1971

MODERATOR RICHARD MAIRE: We are fortunate to have tonight a presentation by Jolly Batcheller, complete with slides, on his recent trip to Australia and New Zealand to study various aspects of the nursery industry and horticulture in general in these two countries Jolly:

ORNAMENTAL HORTICULTURE IN AUSTRALIA AND NEW ZEALAND[1]

OLIVER A. BATCHELLER

Ornamental Horticulture Department
California State Polytechnic College
Pomona, California

As nearly 20% of the plants commonly used in southern California originated in the Australia-New Zealand area, I felt a study of (a) the nursery industry, (b) the plant materials they use, (c) the institutions training men for the horticultural fields and (d) arboreta, botanic gardens and municipal parks would be of particular interest and value to the Ornamental Horticulture Department and California State Polytechnic College, Pomona, California.

As I think back over the attitudes and philosophy of education as I perceived it in both Australia and in New Zealand, there is a great similarity to that found in Central Europe. It is quite distinct and different from that found in the United States, and one which I feel is better not only for the students but for the country as a whole. In both Australia and New Zealand it is recognized that all students are not college caliber and that all students do not learn either at the same rate or by the same means.

Our visit coincided with the final examinations, and we were privileged to be in on some family conversations regarding school and college exams. In several cases where the students and the parents were discussing a failure in a class, there was no shame or disgrace associated with the failure. In one case, it was apparent that the student was not ready to pass on to the higher level. Both parent and

---

[1]This presentation is a result of a sabbatical leave taken in Australia and New Zealand from September, 1970 to March, 1971.