

fastened bands next summer as well as the slotted bands. We feel in our operation bands are much more feasible than clay pots, considering cost, weight and labor expense.

That very briefly is our procedure in handling rooted cuttings in bands. In summation, we believe the most critical phase of mist propagation is not the rooting period, but rather the hardening-off process from the time the rooted cutting is removed from the mist house until it is established on the plantband. We feel the extra shade, and careful watering, during this critical time to be extremely important.

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MODERATOR MAHLSTEDDE: Last, but by no means last, it gives me a great deal of pleasure to introduce to you a fellow who I am sure you all will be hearing more about in the years ahead. As a graduate student at Michigan State University he has been doing some very interesting work in the field of Plant Propagation. Here to discuss "A New Approach to the Problem of Rooting Cuttings under Mist" is Mr. Dale Sweet. (Applause).

A NEW APPROACH TO THE PROBLEM OF ROOTING CUTTINGS UNDER MIST

MR. DALE SWEET

Michigan State University, East Lansing, Michigan

I would like to discuss a few points about the propagation and survival of difficult-to-root plants. There are certain fruit stocks which we are particularly interested in from the standpoint of being able to root them economically on a commercial basis.

The mound or trench layering method of propagating fruit stocks is laborious, necessitates the use of heavy equipment and takes a lot of crop land out of production. Consequently, for the propagation of such material as the Mahaleb Cherry, which has to be clonally propagated, it would be desirable to have a simple method of rooting cuttings. This project has been under study for the last two or three years at Michigan State.

Our research has made use of a combination of several techniques and practices currently in use. One is the mist technique. Another one is the polyethylene tent method of propagation; and the third is the use, especially in Europe and certain hot, dry areas of the United States, of air washing for cooling greenhouses.

This past summer, after considerable study, not only of the literature, but also of the propagation operations in mist beds in the south, we came to the conclusion that we would have to manufacture an atmosphere, possibly with controlled wind movement in which to root cuttings of these difficult-to-root plant types. With this in mind we constructed an experimental rooting chamber. The first step involved the selection of suitable greenhouse bench, one which was approximately 25 to 30 feet long.

This bed need not have been in the greenhouse. A frame six inches deep was built for the two mediums, ie. German peat and No. 1 vermiculite. These media were used in parallel fashion with a central partition along which a line of V-shaped mist nozzles were regularly spaced.

Eighteen inches above the bed, supported on uprights and cross wires was a tent of two mil. polyethylene film which extended down the length of the bed. The film did not have to be fastened down. One end of the chamber was allowed to remain open, while at the other end a 10 inch exhaust fan occupied the opening. One percent evaporation is all that is required to lower the temperature in polyethylene tents; this, of course, was done by the use of the fan. This typical air washing technique also made use of an excelsior pad, which caused a certain amount of static resistance. However, with the 10-inch fan, which was slightly oversized for the size tent we were using, there were some five or six changes of air per minute. We estimate that this size fan would work better on a 30 or 40 foot bench than it would on a 20 or 25 foot bench.

I would like to point out some of the temperature relationships in this particular experiment. The temperature record for the greenhouse on July 25 for the entire 24 hour period shows an extreme in the middle of the day and a low at night. The temperature in the vermiculite medium averaged about two degrees warmer than that in the German peat. Both media were approximately 2 to 5 degrees warmer, half the period, or 12 hours of the 24-hour period than the air temperature. Over the entire 24-hour period the temperature fluctuated in the actual area of the leaf only 12 degrees. In July we had extremely high temperatures during which a maximum of 83°F. was recorded in the leaf area of the cuttings under the tent compared to 110°F. recorded on several occasions in the greenhouse proper. There was not only a noticeable difference in temperatures but it was significant to note that by air washing a very uniform temperature was maintained in the atmosphere immediately surrounding the cuttings.

For rooting comparisons we used a variety of cutting material including peach, several clones of Mahaleb cherries and the EM VII apple rootstock. The Mahaleb clone began rooting in about 15 days. Within 25 days we had 98 percent rooted. If these cuttings were allowed to remain under the mist for periods of 35, 45, or 52 days we obtained a graduated decreasing survival. In other words, cuttings allowed to remain under mist for 52 days when transplanted would remain in a state of suspended dormancy during which they showed no signs of activity. This was true of cuttings of other plants such as the peach.

Cuttings of East Malling VII surprised us, since we were accustomed to a 6-8 week period required to root laved shoots. I was quite disturbed at first because after three weeks I had nothing but callus and after four weeks callus plus a few roots. Shortly after I decided that I would take them out and as I began removing them I found that they all had rooted. A few were potted while the remaining were left in the bench. Within six weeks these cuttings had produced large balls of roots fully 3-4 inches in diameter. Half of these cuttings were placed in a cold storage to satisfy the rest period while the remainder were placed in 4-inch pots. At the present time there is about two feet of growth on

the Mahaleb cuttings which were transplanted after 25 days in the rooting medium.

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MODERATOR MAHLSTEDDE: Thank you Dale for a very interesting discussion. The time has now come for questions.

MR. HUGH STEAVENSEN: I would like Mr. Congdon to describe the stratified rooting medium that he is using.

MR. CONGDON: We prepare our beds in May well before they are able to be used in June or early July. The beds which we have used the previous year are excavated by using a Ford tractor fitted with a rear bucket. The loam which is left is then fortified with a 5-10-10 formula of a commercial fertilizer. It is then leveled off at the desired height. A one-inch peat moss layer is then spread over the soil and rolled down with a heavy lawn roller. In connection with wetting the peat moss we have found that the only practical way to prepare it is to purchase it a year in advance, placing it under the eaves of a building where it remains until use. After the peat has been rolled, about an inch and a half of sharp sand is applied over the top of the bed. The depth of this sand layer varies somewhat with the type of material we intend placing in the bed, since we want to have the cutting completely pierce the sand medium and contact the peat.

MR. STEAVENSEN: I presume you use German peat?

MR. CONGDON: That is correct.

MR. WELLS: Not a question but a comment on the preparation of peat. We prepare it using either a spreader or a gasoline powered hammermill. We fix a hose on the entrance to the machine, turn it on, shovel peat into the mill and it comes out moist and shredded. Four men, for example, shredded 50 bales of the Jumbo size bale in three hours.

MR. TONY SHAMMARELLO: I would like to ask Mr. Sweet if he could tell us a little more about the leaching of nutrients from cuttings under mist?

MR. SWEET: We have had several reports, not just our own, but from Europe as well, that there is considerable loss of nutrients from plant during a heavy rainfall, as well as from cuttings propagated under mist. From our experiments with radioactive isotopes considerable quantities of phosphorus, nitrogen and very large quantities of potassium, in some cases as high as 75 percent in four hours time are evidently leached from the leaves.

Another aspect of this problem was uncovered recently when we took sections of leaves from cuttings which had been under mist for 15 days and compared them microscopically to sections of leaves from cuttings which had not been under mist. The leaves from the fruitstock cuttings which had not been propagated under mist were full of nutrients; the palisade layer in particular. The stem, on the other hand was highly meristematic and apparently did not contain an overabundance of nutrients. When we looked at sections of leaves from cuttings which had been under the mist for 15 days the palisade layer, as well as the other

tissues of the leaf were completely devoid of food. The cells in the leaf, however, as indicated by the condition of the nuclei were very meristematic. Sections of the stems of these mist propagated cuttings appeared to be completely full of nutrients.

From a comparative test with strawberries we concluded that there was a rather large transfer of nutrients from the blade, down the petiole and finally into the stem. This could be interpreted to mean that possibly the stem of a cutting propagated under mist is serving to store the food materials early, thereby aiding the rooting of the cutting. I might point out in conclusion that this is just an idea which we will have to substantiate.

DR. NITSCH: I would like to ask another question of Mr. Sweet. Would you comment on this dormancy induced by mist?

MR. SWEET: I cannot say that it is a case of true dormancy. It apparently is a physiological condition mediated by the number of days that the cutting is allowed to remain under mist. Another point that I would like to mention in passing is the formation of a considerable number of flower buds on cuttings held under mist for a long time. This possibly could be tied up with the accumulation of foods and nutrients in the stem of the mist propagated cutting.

MR. HANCOCK: I am amazed at the results obtained by Mr. Sweet in his wind tunnel. Last year Mr. Bailey reported on a humidification system which makes use of compressed air and a jet of water. Would Mr. Bailey like to comment on his observations?

MR. VINCENT BAILEY: Our humidification system is the common Binks system and is used in conjunction with our summer propagation schedule in the greenhouse. We have noticed that temperatures are somewhat lower in houses equipped with this system.

MODERATOR MAHLSTEDDE: Are there any other questions about mist equipment or the technique of mist propagation?

MR. WALTER CHESPAK, JR. (New Brunswick, N.J.): Has any work been done on the grafting or budding of plants under mist?

MR. CHARLES E. HESS, JR.: In 1953 when we were working with a misting cycle of one minute on, nine off, we made a number of grafts and compared mist with the double sash and open bench systems. We found that we obtained less callus formation on the grafts which had been placed under mist. When the graft was removed the slightest pressure on the scion would dislodge it. We think possibly that we might have had difficulty because of the large volume of mist which was being applied. In the process we were slowing down callus formation which resulted in a very poor union. I think with grafting we have to reach the point where we are humidifying instead of misting.

MODERATOR MAHLSTEDDE: If there are no more questions, I wish to express my gratitude to all those who have participated in this afternoon's program. Mr. Fillmore, will you please take over.

President Fillmore resumed the chair.

PRESIDENT FILLMORE: There will be a business meeting immediately following this brief recess. Only those who are members are entitled to vote and to participate in the discussion.

Brief recess.

FIFTH ANNUAL BANQUET

Following the banquet, President Richard H. Fillmore called the meeting to order and introduced the speaker of the evening, Dr. William E. Snyder, Department of Horticulture, Rutgers University, New Brunswick, New Jersey.

Dr. Snyder presented an illustrated talk entitled "Some Horticultural Impressions of Europe."

At the conclusion of this discussion, the Fifth Annual Meeting of the Plant Propagators Society adjourned *sine die* at 10:00 p.m.