10 McLemore, B F and J P Barnett 1968 Moisture content influences dormancy of stored loblolly pine seed *For. Sci.* 14.219-221

11 Vanesse, R 1967 Influence du sechage secondaire des graines de *Pseudotsuga menziesii* (Mirb) Franco sur leur germination a 25°C *Bull Rech Agron Gembloux* 2 551-568

12 Wang, B S P 1974 Tree-seed storage *Dept of Environ , Canad Forest Serv* Pub No 1335, 32 p

SEEDLING PRODUCTION IN THE EASTERN U.S.A.

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It is a distinct pleasure to share with you some seedling production techniques which I have observed, and indeed practiced, over the years. All of these observations will be geographically from Nebraska east to the Atlantic Ocean.

Assuming this is your first venture into the sexual propagation of plants, spend some time on researching the topic Every volume in the Proceedings of our Society gives us several articles on seed propagation. In Volume 29, there were two splendid articles, one by Tom Wood (3) (GB & I Region) and one by Hugh Steavenson (2) (Eastern Region), both presented at the Western Region meeting in 1979 at Sacramento, California.

One can go back to the first meeting of the Society in 1951, and read Dick Fillmore's (1) words on this topic After a review of IPPS papers, then purchase this book. "Seeds Of Woody Plants In The United States," Agriculture Handbook #450, Supt. of Documents, US Printing Office, Washington, DC 20402 (cost $13.60). This book covers seed data of 188 genera and is the true epitome of seeding procedure and information. After reading this book, you will be asking questions of your fellow propagators. At any of the IPPS Regional meetings, all program chairmen allow time for any questions — on any plant propagation topic. I also hasten to add, please remember the old adage that there are NO dumb questions! Sometimes the answers leave much to be desired, but never be embarrassed in asking questions. One final comment before we discuss some specific fundamentals — please keep records on all practices This information will be very valuable in future years. You can note, on this form, data pertaining to seed source, cost, amount sown, cutting test/percentage, density sown, seedling count, and size (as 1-0). You cannot have too

much recorded data in your files; record tracking is very, very important.

In the time remaining, I would like to cover some basic prerequisites that should assist in producing fine quality seedlings, and they are as follows:

Seed Source. The important factor is to locate as many private collectors as possible Unfortunately, they are a vanishing breed of people, but there are a few remaining. You must know the source — geographic origin — of the seed you are sowing. For example, *Acer rubrum* ranges from the Canadian/U.S. border southward to Texas. Genetically, the seedlings produced from Florida mother-trees and those from Maine mother-trees are very similar, but they most certainly do not grow the same! You shall see the difference in the two seed lots by growth rate, time of fall color, winter hardiness, etc. I have often felt that the incompatibility problems with this species are seed-source related. For an acceptable source of seed, collect locally or use private collectors.

Seed Handling. Most seed you shall be sowing will benefit from fall seeding, with just a few exceptions. With most species, fall sowing allows the seed embryo to experience warm fall soil conditions, a cold winter, and germination in the spring. Unfortunately, we have seeds which offer a complexity of characteristics: seedcoat dormancy (impermeable seedcoat) as found in *Cercis, Gledistia, Robinia,* etc.; immature embryo dormancy, as found in *Cotoneaster, Tilia,* etc. The knowledge and understanding of stratification and scarification is very important to achieve economic seed bed stands. Included under the broad topic of seed handling is seed storage. The perfect conditions would be storage controls set at 34 to 36°F with 20 to 30 percent relative humidity. With proper storage conditions, you can have a back-up of one year's seed supply, which is very comforting during a seed crop failure year.

Seed Bed Preparation. Prior to the actual preparation of the seedbeds themselves is the very careful consideration of site location. Our industry has suffered countless lost dollars due to seedlings being completely destroyed due to "frost pocket" sites. The soil itself is of primary importance, and due to the intense culture of a high plant population per acre, utmost consideration has to be devoted to soil building and fertilization. I urge all of you starting, or perpetuating, a seedling production program to give much thought to organic's. This concept of green cover-crop plow-down and liberal manuring could well be the difference in harvesting your crop as a 1-0 or 2-0. The financial benefits of a 1-0 are quite obvious. The final step in bed preparation is to work the soil properly

and establish the proper grade to assure drainage. I caution you to spend some time with this function, and save money down the line. Seedlings do not grow well with "wet feet" — in fact, they well could, and do, perish.

Seed Bed Sowing. Your choice in sowing seed is basically two-fold; you can either drill or broadcast. Your decision (or the decision dictated to you) will be based entirely on soil type. In the lovely Platte River Valley of Nebraska, drilled seed is ideal Conversely, in the beautiful first row of hills adjacent to the Mississippi River, flood plain (in northeast Missouri) you broadcast because of soil crusting. With either condition, all seed beds should be mulch covered. The material used as mulch can run the gamut from bark-sawdust mulch, to sand, to oat straw. Use the material easily available in your area to be cost effective. Your seed bed density is extremely critical. To wit. If you are new to seed propagation, and your employer instructs you to produce *Pyrus calleryana* seedlings for understock *only*, your seed bed density is at a much different sowing rate that for a normal 1-0 seedling crop. Few propagators realize that proper seed bed population is mandatory to produce the plant size desired. The plant propagator must have direction from management to yield 25 seedlings per square foot, or 10 plants per square foot. Always remember that plants per square foot are determined by the seeding rate only — thinning of beds is not only expensive, but generally very impractical.

Seed Bed Maintenance. In my opinion, the most critical seed bed maintenance period is thirty days after germination. The one single thought on the seedling propagator's mind in April/May is the possibility of a late spring freeze. We are all a bit more knowledgeable now, and many seedling growers have installed solid-set irrigation systems which is an insurance policy for late freezes, and for irrigation during the growing season.

Other normal cultural seed bed practices would include fertilization and weed control. Your fertility program has to be predicated upon soil samples analysis. In this light, might I suggest that you retain a laboratory that specializes in nursery clients as opposed to the local grain elevator who will send your soil sample into a lab who will give you the information for growing 150 bu/acre corn! That certainly is not applicable to growing *Taxus cuspidata* (Syn.: *T. cuspidata* 'Capitata') seedlings! You have a valuable tool in controlling weeds by the proper usage of herbicides, but be careful! Hand weeding costs in seed beds can be horrendous — miscalculation of herbicide application can be failure! If you are inexperienced in the

herbicide product, please test prior to blanket application One traumatic experience you do not need, are seedlings killed by herbicides. A very safe product for grass control is Dacthal (75W) applied at the rate of 16 lbs/AIA every 30 days after the first "true" leaves are formed. Finally pest and disease control are best managed by a preventive program. After an insect, such as leaf hopper or spider mite, has infested your seed beds the damage is done Preventative spray is an excellent insurance policy.

The preceding words hopefully pointed out a few of the challenges of the sexual propagation of woody ornamentals. I can definitely assure you that the fruits of your labor shall be rewarding. Speaking, of course, for myself there is no greater exhilarating experience than evaluating germinating seedlings to herald in another season. Yes, you shall err, but don't make the same mistake twice — profit from the mistake!

Our nursery community has plenty of room for good, competent, seedling propagators. The personal satisfaction you receive in walking uniform vigorous-growing seed beds is truly unequaled. You will experience a tremendous feeling of personal satisfaction, and deep gratification in knowing you have done your job in a competent manner. Henry David Thoreau said it well with the words, "In this fresh evening, each blade and leaf looks as if it had been dipped in an icy liquid greenness. Let eyes that ache come here and look. . ." The challenge of seedling propagation is one of exhilaration. I trust that many of you shall have the opportunity to meet the challenge, and if it turns out to be sublime to know it by experience

LITERATURE CITED

1 Fillmore, R , 1951. A general review of woody plant propagation *Proc Inter Plant Prop Soc* 1 40-50

2 Steavenson, H , 1979 Maximizing seedling growth under midwest conditions *Proc. Inter Plant Prop Soc* 29 66-71

3 Wood, Tom, 1979 Nursery Production In England *Proc Inter Plant Prop Soc* 29 54-59

MODERATOR HART: Now, are there any questions for our panel on seedling production?

VOICE: Question for Chris Heaman. Do you do any testing or enhancement of the seed clones on your Douglas fir? Once having selected some of these do you do any testing with them — or anything else? What I am trying to get at is — it is orchardism in the wild. You are selecting only a few plantings. How about a bad disease attack? You may be in trouble then.

CHRIS HEAMAN: We hope to keep a broad enough base to look out for that. We don't want a narrow genetic base; we want to keep a broad base. Douglas fir has a lot of variation present We haven't had any major diseases so far, but we hope we have a broad enough genetic base to buffer us if we do suddenly get into disease problems. That is what we are concerned about all the time, keeping our genetic base large enough, although it is all right to have a narrow base in certain areas In the southeast U.S. they have planted entire plantations from a single seed origin. That's fine to invest in a small area, but you don't want to invest that way in a large area.

AL NEWCOMB: Ralph Shugert — What do you feel about grading seeds for size?

RALPH SHUGERT. My only experience in grading for size is when I was drilling through a Planet, Jr. Then size is very, very important. In my broadcasting of seeds — mostly ornamentals — seed size, as long as the cut test told me what density I want to sow, was immaterial. But I do know, getting back to the records, if you set the plate in a Planet, Jr., let's say 32 for *Prunus tomentosa*, then next year you have a guide to go buy, but you must check that plate because you might then need a plate 34 or 36. My experience has been, particularly in the *Prunus*, that seed size will vary every year.

JOHN HART. Question for Chris Heaman. I was involved for quite a while in a breeding program in Michigan. We found that there wasn't a real good juvenile-adult correlation because since you are growing in a container, competition is a lot different in this soil medium where the natural environment is lacking. What have you found along those lines?

CHRIS HEAMAN: We are certainly not too happy about using any juvenile assessments of our tree's performance. We are looking at field performance for growth; we are talking about getting 10 year's data in the field when the trees are about 10-to-15 feet high. We are not making assessments in the nursery.

JOHN HART. Do you also do nursery trials from seed to help avoid any kind of dominance effect? If two seedlings are grown in a greenhouse and one has already taken off, then when it is planted it is going to keep a certain increment above the other one and remain taller.

CHRIS HEAMAN: Well, this is why we are waiting to 15 years for assessments to get away from such effects. We do not have very good information yet on how long that sort of a nursery effect lasts. But it is certainly a thing we need to look

at, I agree We don't want to jump to conclusions on common effects, or nursery effects, or non-genetic effects.

VOICE: Question for George Edwards. Last year we had a number of seedlots of *Abies concolor* where any stratification would reduce the germination percentage quite a bit. Did you see such a variation in your studies from crop year to crop year?

GEORGE EDWARDS: Not with *Abies* although that kind of response has been reported in other species — in the East, particularly. In red pine and white spruce, I have noticed that stratification will — this is talking about collections from individual trees — behave this way If you have four individual trees, tree A one year may respond well to stratification — that is, you get better germination but the following year seeds from that tree may not respond. Other trees will reverse their status, but some trees continue to maintain a good yearly response to stratification. Dormancy, using the term dormancy very loosely, does vary from one crop year to another. In terms of *Abies concolor*, you are talking about stratification bringing down the germination percentage. We have noticed that in a number of our seed lots Stratification tends, as I mentioned earlier, to boost early germination. So the germination curve takes off in a hurry. But then it suddenly levels out — you don't get any further germination. So, a month or two months after you sow the seeds, you have actually fewer seedlings produced than from the unstratified seed I am not sure there is a single or a simple answer to that situation. It has been related to disease — it could be physiological, but we don't understand it.

MODERATOR DOUG CHRISTIE: I would now like to introduce the next panel, speaking on the general subject of container production.

WEED CONTROL IN NURSERY CONTAINERS

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Several herbicides are available for use in nursery containers. Each one differs from the others in the weed spectrum it controls, the way it behaves in the container growing medium, and its tolerance by nursery plants.