LATEST ADVANCES IN SEED RESEARCH AND THEIR IMPORTANCE TO NURSERY PROGRAMS

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What one thing most interests a nurseryman in his nursery program? Without a doubt it is seed germination because he is anxious to get the correct seedling density. Before sowing the seed, he has a sample tested and then computes the sowing rate. He may need a pregermination treatment for some species and, if birds are a problem, the seed will be treated with repellents. There is close surveillance of the seeding operation, of weather conditions, and the irrigation procedures during the germination period. Some relaxation comes after germination is complete, especially if an inventory shows that the planned for seedling density was achieved,

Reliable test information is needed to produce good quality seedlings. For example, we have 2,000,000 seedlings worth $5.00 per thousand. Let us be conservative and say that 5 percent of the seedlings are culls because of poor density. That is $500 lost, which is enough to pay for about 40 seed tests and it would take only a small fraction of this amount to pay for sizing the seed.

The Eastern Tree Seed Laboratory has a seed research program in addition to the service testing program. In order to provide the best testing service possible, the Laboratory makes it a practice to keep abreast of and, where possible, use the latest research findings.

CONE AND SEED COLLECTION

White pine.--Last fall the Eastern Tree Seed Laboratory cooperated with the U. S. Forest Service's Chittenden Nursery to determine if cone storage methods affect germination. Each of two cone lots was divided into three sub-lots and stored in bins on the floor of a shed, in trays in a shed, and in trays in the open. A cone sample was taken when cones were placed in storage. Cones were sent to the Laboratory where the seed were extracted by hand. Table 1 summarizes the results. Storage in bins reduced germination. This indicates that cones should be held in trays prior to extraction rather than in piles on a damp floor.

Sycamore.--The Southern Hardwood Laboratory reports that late collection, February or March, of sycamore seed after natural stratification on the tree does not appear to be as satisfactory for pregermination treatment as fall collection and artificial stratification. Lack of moisture is probably the reason for this.

Table1.--Germination of seed from two white pine cone lots before and after storage at various places

Lot identification		Time sampled1/	
		When stored	After storage and extraction
		Full seed germination percent	
1	bins, floor (cone shed)	92	45
2	"	88	70
1	trays (cone shed)	92	95
2	"	94	97
1	trays (open)	92	98
2	"	85	94

1/ Collected and stored on September 21 in Michigan; seed extracted and sampled first week in November.

Longleaf pine cone maturity.--Work by McLemore and Derr, Timber Management Research Center, Alexandria, Louisiana, showed that cone maturity among 23 longleaf trees followed the same order in two successive cone crops. This indicates that in a group of longleaf trees, the relative order of cone ripening is the same each year. This could be quite useful in making collections from seed production areas and seed orchards. A realistic approach in selecting an optimum cone collection date would be to determine the order in which cones ripen among individual trees. After trees are ranked, this guide could be used in collections from the same trees in subsequent years. Although this study was on longleaf pine, the pattern may also hold true for some other species.

SEED STORAGE

Southern pine seed.--A 5-year storage study of longleaf, slash, loblolly, shortleaf, and white pine seed was conducted at the Eastern Tree Seed Laboratory to determine optimum storage temperature and seed moisture content necessary for successful storage.

Germination tests of seed with 6, 9, 12, and 15 percent moisture content were made after storage at −5°, +5°, 15°, 25°, and 35°F.

Results showed that control of both moisture content and temperature are important factors for satisfactory seed storage. Seed moisture content is the most important factor. The loss in germination at the 12 percent moisture content level was small, but large enough to recommend that seed have a moisture content between 6 and 10 percent for long periods of storage. Also, this allows a safety margin should something happen that allows moisture content to rise.

A temperature of 20° to 25° is recommended for long periods of storage. If seed moisture content is maintained below 9 percent, then seed of longleaf, slash, loblolly, shortleaf, and white pines can be stored satisfactorily for 5 years at 35°F. However, a storage temperature of 20° to 25°F. is preferable because the loss would be less if moisture content did rise to unsafe levels. Seed of these species can be stored with a moisture content of 12 percent if temperature is 25°F. or below; however, 9 percent or below is recommended as a safety precaution should temperature go above freezing. Although shortleaf seed can be safely stored for 1-year under any of the conditions, a moisture of over 12 percent is not recommended because the viability of other species decreased when stored under these conditions.

A study was set up in cooperation with the U. S. Forest Service's W. W. Ashe Nursery to determine if storage of longleaf, slash, and loblolly pine seeds in sealed steel drums was as effective as storage in polyethylene bags inside steel drums. After 5 years, there is no difference in germination between the two methods.

Sycamore seed.--Sycamore seed have maintained viability after 5 years of dry storage at 20°F. in a plastic dish.

Sweetgum seed.--The Southern Hardwood Laboratory has stored sweetgum seed for 5 years at 42°F. without undue reduction in viability.

PREGERMINATION TREATMENTS

Citric acid.--It has been found that soaking redcedar, black cherry, and baldcypress seed in a 0.1 percent citric acid solution from 2 to 4 days often increases the total germination. We've been able to increase germination of black cherry from 57 to 89 percent, and redcedar from 29 to 90 percent with citric acid soaks. In no case have we found citric acid to be detrimental to the seed. It is suggested that these species be soaked in a citric acid solution prior to stratification. The pulpy material must be removed from redcedar and black cherry seed soon after collection.

Sweetgum.--Another study at Stoneville was begun to determine the best stratification period for sweetgum seed. For the seed lots tested, it appears that seed of this species will germinate equally well after a short stratification period (about 2 weeks) as after the customary 30-day stratification period.

Polyethylene bags.--The use of polyethylene bags is rapidly gaining acceptance as the method to use when stratifying seed. The Eastern Tree Seed Laboratory found it to be as effective as peat moss for periods of 60 days or less. It will probably be as effective for species requiring longer stratification periods. The seed should be checked for drying and the addition of small amounts of water may be necessary. During stratification, bags should be turned once or twice weekly.

As stated earlier, reliable test information is necessary for a successful nursery operation and the following discussion includes many of the techniques and procedures used by the Eastern Tree Seed Laboratory. Seed are tested under the optimum conditions known for good germination, but not all the seed that germinate under these conditions will produce a field or nursery seedlings. Because this is the case, the nurseryman must set up history plots or use some other reliable method to accumulate data for determining a correct correlation factor to be used in relating laboratory and field germination or survival. We usually call this factor the expected survival and it will be specific for the nursery site on which it has been determined.

MOISTURE CONTENT OF TEST MEDIA

Seed can be tested for germination on a medium of sterilized sand and perlite, sand and vermiculite, or peat. Some laboratories use blotters, however, the other media permit better evaluation for abnormal seedlings and insure better control of moisture. The latter is an important factor for successful germination.

Sand and Scotch pines germinate best when a small amount of moisture is used in the germination media. Too much moisture will drastically reduce germination. On the other hand, water can be used as the test medium for sycamore seed.

TEMPERATURE

Temperature control during a germination test of unstratified seed is essential to determine the maximum germinability of a seed lot. A difference of 4°F. can cause a significant difference in germination. If seed are stratified, germination temperature is not as essential because the germination process has progressed to the point that germination is not retarded as much under these less than optimum conditions.

LIGHT

Many species of tree seed must have light for successful germination. This is why tree seed should not be sown very deep. They don't require a high light intensity, but the duration of the light is important. If tests for germination are to be conducted properly, the need for and amount of light must be determined for each species to be tested.

WAYS TO ESTIMATE SERB VIABILITY

There are several quick methods that can be used to estimate seed viability.

Tetrazolium.--When seed are soaked in a tetrazolium chloride solution, the live tissue or parts of the seed will turn red. The chemical reacts with living tissue and forms a red or pink color. Dead seed or parts of the gametophyte tissue and embryo that are dead do not react with the tetrazolium. After training and experience, a seed analyst can use this method to estimate seed viability.

X-ray.--Limited study has been done to determine seed viability by use of X-ray in this country. After more study of radiographs in relation to germination, it may be possible to estimate seed viability by use of X-ray. Further investigations have shown that when seed are placed in a barium chloride solution, the dead tissue in the seed will absorb the barium chloride. When X-rayed, the dead tissue will show up much lighter than the live tissue on the radiograph. X-ray can also be used to determine the extent of damage to seed by insects, extraction, etc.

Embryo excision.--We can estimate seed viability through embryo culture of some of the more dormant species, such as sugar and white pines, maple, and ash. The embryo is removed from the seed and placed on blotter paper in a closed container. If the embryo elongates, turns green, and begin to grow, it is viable. If it begins to deteriorate immediately, it is dead.

These quick test methods do not tell us how many seed will germinate abnormally. Also, there are decisions to make when there are borderline cases as to whether the seed had enough life to germinate and produce a seedling. These methods are valuable tools, however, and can be used when there is not enough time for a regular germination test prior to sowing. Also, with perfection, they will be useful in determining the reasons for reduced seed germination.

We still have many problems to solve in seed collection, processing, overcoming dormancy, pregermination treatments, and germination. Can we get seed to germinate without light? Can we determine what causes

dormancy and find a way to overcome it? Wouldn't it be nice to have all the seed germinate over a 2-day period? These are some of the problems that we hope to someday find answers to with the help of basic seed physiology research.

SUMMARY

Reliable test data and close surviellance of all nursery operations are important for getting planned seedling density. Seed must be collected, cleaned, and stored with care if seed quality is to be maintained at a high level. Pregermination treatment methods are important and must be determined for each species of seed.

In seed testing, pregermination treatments, moisture content of test media, temperature during the germination period, and light requirement must be determined for each species tested.

Ways to stimulate seed viability, in addition to germination tests, include tetrazolium staining, X-ray, and embryo excision.

DISCUSSION TO: LeRoy Jones

Q. What is the best method to reduce moisture in your seed before you store them?

A. (Jones) Generally, they are about right as they come out of the extraction process. On a humid day, they will pick up a lot of moisture though. One way is to use a cold room with a source of dry heat blown over them by a fan. Another way is to spread them out on a tarp in the sun. A moisture meter will help determine when it is low enough.

COMMENT

We had trouble getting our loblolly to germinate uniformly this last two years. So this past year we used Jack May's comment--soaked them over night in a vat of ice water. We put it in a drum with a chunk of ice and we've been getting uniform germination.

A. (Jones) This will help if a lot is not normal--the kind that doesn't show need for stratification. In this soaking, they imbibe water and they are ready to go.

Q. Do you have any figures on the rate of yearly deterioration once you reach the point of deterioration in storage?
A. (Jones) No, if you have the right moisture content of the seed lot and store it at the correct temperature and store them in air-tight containers, you will not get any deterioration. We should not expect seed to deteriorate in storage. We have just completed a 5-year storage study on longleaf and there was no deterioration. I saw the seedlings of one lot of red pine seed this spring that had been stored for 30 years and it was just the same germination that it was when it was stored.

Q. In other words, you can keep it indefinitely?
A. (Jones) I don't know about that, but I know it has been kept for 30 years.

COMMENTS by Mr. Darby:

We have had quite a bit in storage and had noticed that sometimes the germination decreased 1 percent a year.

Q. The sycamore seed you germinated in water, was it stratified seed?
A. (Jones) This particular seed was not stratified.

Q. How long did it take to germinate?
A. (Jones) About 10 to 14 days.

COMMENTS by Mr. Swofford:

Sometimes some outfits are faced with an administrative decision on seed --whether they are going to keep it or not because of loss in storage. Seed gets old and they have to make an administrative decision to throw it out and write it off.

Q. What percentage of viability can a man stand and still save his seed? How long can you go and still be worthwhile keeping?
A. (Jones) This is a decision you have to make. Some people don't believe in holding seed below 50 percent. Also, it is dependent on supply and demand. If you can't get any more of that seed, you're not going to throw it away.

Q. The answer to that would be a germination test, wouldn't it?
A. (Jones) Yes, definitely so.

COMMENTS by Mr. Russell:

W. F. Mann says that anything less than 70 percent is too low for field seeding. I suppose he also means that there is a decrease in seedling vigor when the germination of the lot is lower than 70 percent.

Preceding the nursery tour on the afternoon of the second day, personnel of the North Carolina Forest Service described a seedling sales promotion program they had initiated. Beginning sometime before and continuing into the planting season, one man devoted full time to this seedling sales promotion project. He visited schools, civic and service clubs, garden clubs, scout troops, and other organizations to talk about and foster tree planting activities. He stressed the merits of this conservation activity, the availability of good quality planting stock, the ease with which it could be obtained, and told how such stock could be ordered.

In addition to this personal contact work, other promotional items and media were developed and utilized. These included a movie on tree planting, newspaper mats of promotional materials, radio and T.V. spots, mail filler materials, etc. Although they had no figures to prove the "dollar returned" value of the campaign, the North Carolina Forest Service felt the program had noticeably aroused public interest and that it would serve to expand tree planting activities in their State.

A SUMMARY OF THE FINAL DISCUSSION PERIODS

The final session at both conferences was devoted to the presentation and discussion of numerous matters of concern to regional forest nurserymen. Since the same general topics were introduced for consideration at both conferences, this report combines and summarizes the discussions that took place.

Possible publication of an informal regional forest nurserymen's NEWSLETTER was brought before the groups. Comments covered items of costs, periodicity of publication, who would publish it, relationship of the Newsletter to Tree Planters' Notes, continuity, and subject matter to be included.

In general, both groups felt the publication of a Newsletter was a good idea. They felt it should be kept very informal and should in no way conflict with TREE PLANTERS' NOTES. It should be issued at least twice each year and should be all-inclusive in its subject matter content. The Regeneration Branch is to investigate the matter further.

Although no action was taken or requested, it was suggested the next nurserymen's meeting(s) would probably be held during the summer or early fall of 1966. Each state group was asked to give serious thought to the possibility that they might host a coming meeting. The suggestion was also made that an industry might want to host one of the meetings.

Several comments were made relative to publishing and distributing the proceedings. Attention was called to the various industrial displays and conference attendees were urged to visit and talk with the displayers. The literature display of some 50 different articles and publications of interest to forest nurserymen drew 60 requests for a total of 491 copies of these reprints and pamphlets. These were mailed as requested.

A letter of Greetings to former Branch Chief Floyd Cossitt was circulated for signature by his former associates and friends in Region 8.

Both meetings were adjourned as scheduled.