CONSERVATION OF FOREST GENE RESOURCES: SEED BANKS AND SELECT TREE REGISTERS

Robert G. Hitt and LeRoy Jones[1/]

What program would be complete without its fat facts and frightening figures? I for one, want to insure success for this conference so let me wax wild now fora few minutes with my "fat facts" and "frightening figures."

The 1970 World Directory of Forest Geneticists and Tree Breeders lists about 1140 persons engaged in tree improvement work. Ninety-nine of these were listed under the U.S.A. category. While no claim was made for the list as being complete and totally accurate, it was probably 99 and 44/100% accurate! Of course, there were few listings of any of the non-professional and technician types who are so vital to this endeavor. Many of you are witnesses to this fact in that you were able to come to this meeting because you had a good man or two "back at the ranch" who could keep things running well in your absence.

As a matter of "fat facting", I'd just bet that on the average for each of you here there are at least two others not here who are involved in tree improvement work. This would include all types from laboratory technician to field crews and, yes - even graduate students! Thus, I've estimated a conservative figure of at least 300 man years being devoted to tree improvement work here in the U.S.A. Again, conservatively estimated, that's a 4.5-5 million dollar annual payroll only and if other costs of program operations are added to this, we're probably talking about a total expenditure on tree improvement work in the 10-12 million dollar range. These are truly estimates and may, in fact , actually be "lean facts" that need to be "factually fattened."

The same directory listed tree improvement work in progress with 100 taxons, 45 of which were under some type of improvement in the U.S This work was being done under 54 different subject categories - and mind you, these were 1969 compilations!

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Well, what does this all say? Simply this - a lot of manpower and money is going into tree improvement work. While it is not as fast moving nor are the results as quickly available as they are in some other types of crop breeding and improvement work, positive and economically rewarding results are emerging. Attending these efforts and rewards is an ever present danger - namely that of the loss of valuable germ plasm. It's true that most tree improvement programs attempt to preserve selected lines through grafting or other vegetative propagation means. Personnel changes and the passing of time combined with the vagaries of natural phenomena, insect and disease losses, etc. , all take their often small, but steady toll. I'd venture to say that a number of you here have already lost one or more genotypes which should have been preserved for possible future breeding work.

Two activities which we'd like to discuss here briefly today can contribute significantly to this omnipresent danger - that is, the loss of valuable germ plasm. The first of these is concerned with the preservation of typical seed of selected trees, species, origins, special hybrids or what have you. LeRoy Jones pulled together the presentation on this subject.

The storage of tree seed as a means of conserving germ plasm has received little attention anywhere in the world. The same was true for crop plants until recently. In fact, the valuable germ plasm of many crop plants has been lost over the years. Of the clovers introduced into the United States during the past 70 years, only 2 percent of the original lines are available today. Original parental lines for over 65 percent of the introduced oats have been lost and 90 percent of the soybeans.

Through man's selection and breeding of plants over hundreds of years, certain desirable qualities were often unwittingly sacrificed -- take , for example , the ability to resist a certain disease. The progenitors of many of today's crops were the only sources of these qualities - some are now gone forever.

In the preservation of forest tree germ plasm the situation is not yet as critical. Many species have limited ranges; however, management practices, urbanization, and land use can uproot primitive plant communities all too quickly. What should we do to conserve endangered germ plasm which may contain characteristics that may be valuable at some time in the future?

Tree germ plasm may not be lost as rapidly as agriculture crop plants germ plasm may be, but it may be wise to give more attention to

gene preservation, whether it be through natural areas, live tree banks, seed banks, or a combination of these.

Let us go back to the agriculture crops to review what is being done to preserve the seed of valuable selected cultivars of plants. The Agriculture Research Service opened the National Seed Storage Laboratory in 1958 at Fort Collins, Colorado. The establishment of the Center had the support of various Federal, State, and private agencies throughout the country.

Preservation of germ plasm at the Lab is accomplished through the collection and storage of seed of known value. All agronomic, horticultural, forest, and aesthetic types are qualified for storage, but only seed are stored. There is no charge. Research people may submit obsolete varieties, current varieties, breeding lines, and genetic stocks. Once in the Laboratory, the seed becomes the property of the Federal Government and are available to researchers in the United States when the Lab is the only known source.

Germination tests are run on incoming seeds. They are then placed in one of the eleven cold storage rooms. The crop characteristics of the seed stored are recorded on accession cards. They enable the Lab, through a computer program , to locate seed having certain crop characteristics for which they receive requests.

Periodically over the years, the seed are tested for germination. In the event that deterioration does occur , contracts are made with a seed-producing agency to replenish the stock with seeds obtained from controlled plantings of present stocks. Under the storage conditions at the Lab, regeneration of crop seed is not required sooner than 10 to 20 years after storage.

Tests have established that we could store many kinds of tree seed for much longer periods -- perhaps 2 to 4 times longer. No tree seed are presently stored in the National Seed Storage Lab; however , it is possible to store tree seed under the present setup.

We may want to seriously consider storing seed from some special areas, or seed with special characteristics. For example, the Loblolly pine seed from the Silver Springs, Florida area, seed from trees with special marker genes, or insect or disease resistant materials.

The National Seed Storage Laboratory has a detailed policy statement concerning seed accepted for storage, information required, who can receive seed from storage, objective for storing seed, and treatment

during storage. Storage application forms are provided by the Lab. For further information, or if you have special seed which needs to be stored for possible further use, you may wish to contact the National Seed Storage Laboratory, Agricultural Research Service, Fort Collins, Colorado 80521.

Dr. Louis N. Bass is Head of the Laboratory. (Copies of a Storage Application Blank and the policy statement about the Laboratory are in the Appendices.)

If you think material should be placed in storage, the Southern Forest Tree Improvement Committee may consider a subcommittee to develop guidelines -- in fact, it may even be desirable to have a National Committee for this purpose.

The second kind of activity suggested as a means of helping to preserve valuable germ plasm is that of compiling a regional or even national register of selected forest trees that have been identified and/or used in tree improvement efforts. While the register will not insure preservation of desirable genotypes in any true sense, it can help by making the traits and characteristics of all registrants common knowledge. If plant material is then distributed from these selections for inclusion in a number of breeding programs, the likelihood of a complete loss of the genotype is reduced since through seed or vegetative propagation it would be established in a number of localities. Cross referencing via the system would permit recovery from surviving sources.

A proposal for the compilation of a southwide select tree register is not a new one for the Southern Forest Tree Improvement Committee. The subject was discussed at both the 1955 and 1958 meetings. The discussion in 1958 indicated it was not practical to attempt to draw up a register at that time.

Numerous comments and suggestions followed. Responding to a request by the Southern Forest Tree Improvement Committee in 1963, the U. S. Forest Service, Division of State and Private Forestry , through their Regeneration Branch reinvestigated this need in early 1964. A questionnaire (Appendix C) was sent to all the Southern State Foresters. In addition, industrial organizations, private foundations, and the universities and colleges throughout the south known to have active tree improvement programs were contacted. The purpose of the questionnaire was to determine the desires and needs of all the agencies involved regarding the compilation of a southwide selected tree register.

Sixty-nine (69) questionnaires were distributed. Fifty-nine (59 or nearly 86 percent of the questionnaires were returned. The distribution of the questionnaire was as follows:

11 - to State Foresters
13 - to Universities and Colleges
41 - to industrial and other organizations
4 - for informational purposes only

The main question on the form was "Would your organization be interested in and willing to cooperate in the compilation of a southwide inventory or register of selected forest trees being used in tree improvement work? Yes_____ No____ ." Qualifications for the "yes" and "no" answers were numerous.

The State Foresters' returns were:

11 - questionnaires sent
10 - questionnaires returned
6 - "no" votes of which several were qualified
2 - "yes" votes
1 - interested
1 - not sure

The Schools of Forestry voted thus:

13 - questionnaires sent
13 - questionnaires returned
3 - "no" votes
10 - "Yes" votes
3 - had tree improvement programs
7 7 - no tree improvement programs

Forty (40) questionnaires were sent to Industrial Organizations. Thirty-three (33) of these were returned. The replies were most accurately tabulated as follows:

Have tree improvement program - want register compiled	5
Have tree improvement program - do not want register compiled	10
Have no tree improvement program - want register compiled	11
Have no tree improvement program - do not want register compiled	7

Considering all returns from all sources, the "do's" don't and the "don'ts" do. Here's what the overall tally showed:

Had tree improvement program - wanted register compiled	6
Had tree improvement programs - did not want a register compiled	16
Had no tree improvement program - wanted a register compiled	21
Had no tree improvement program - did not want a register compiled	11
	54
Had a program - thought register of questionable value	4
Had no program - were only interested	1
Total returns	59

Exactly one-half of the tabulable replies favored the register , one-half opposed it. Of those favoring the register , only 22.2 percent (6 of 27) had active tree improvement programs and could contribute to the register , or to put it another way, over 77 percent of those favoring the register couldn't actually contribute to it. Based on the survey , it seemed inadvisable to undertake compilation of the register at that time.

The response to the question "What additional special entries would you suggest be included?" gave some idea of the problems existing or anticipated as the tree improvement programs developed. Numerous comments suggested that wood properties (tracheid length, cell wall thickness, etc.) be included in register data. Progeny tests and testing were mentioned as was hybridization work. Several respondents suggested the need for more site data relative to the select tree's location.

A report on the survey was presented to the Southern Forest Tree Improvement Executive Committee meeting in June 1964.

And, so here we are - ten years later and coming at you again with this same question - would this organization be interested in and willing to cooperate in the compilation of a southwide (or even a nationwide) inventory or register of selected forest trees being used in tree improvement work? Let me repeat, while the compilation of a register will not fully insure preservation of desirable genotypes in any true sense, it can help by making the traits and characteristics of all registrants common knowledge, assist in their broader propagation and utilization and thus reduce the likelihood of complete loss of genotypes to natural or other causes.

These, Mr. Chairman, are the "fat facts", frightening figures and two questions:

1) Wouldn't it be worthwhile to start storing some of our southern forest tree germ plasm via their seed in the National Seed Storage Laboratory at Fort Collins, Colorado?

2) How about establishing a Regional or National Select Tree Inventory? Computerization makes this quite possible in today's world.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE

National Seed Storage Laboratory — Fort Collins, Colorado 8052

STORAGE APPLICATION
Storage Location

Room _____ Rack _____ Drawer _____ Date _____

From _____

Address _____

Kind of Seed _____ Origin _____
Amount submitted _____

Botanical Name _____

Agronomic or Horticultural variety name _____
Synonyms _____
Identification numbers _____
Crop year of seed _____
Is the seed available in commercial channels? _____
Do you plan to maintain this variety of stock? _____ How long? _____
May other research men obtain this seed from you? _____
Can arrangements be made with your administration for the increase of new stocks in case of depleted stocks or drop in viability? _____
Person and/or agency authorized to enter such increase agreement:
Name _____ Position _____
Address _____

Laboratory No. _____

Serial No. _____

SPECIAL NOTICE

The policy under which the Laboratory operates requires documentation. Special attention should be given to this section.

References to published descriptions: _____

_____

_____

_____

_____

_____

Please enclose copies of the above references.

THE ABOVE INFORMATION IS NEEDED FOR OUR PUNCHED CARD SYSTEM AND SHOULD BE SENT WITH THE SEED.

APPENDIX B

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

NATIONAL SEED STORAGE LABORATORY
Colorado State University Campus
Fort Collins, Colorado 80521

POLICY STATEMENT

1. The Laboratory is a Federal facility and all seed accepted for storage becomes Federal property.

2. Only seed will be accepted for storage.

3. Valuable seed stocks will be accepted by the Laboratory from Federal and State institutions, commercial seed interests, and private individuals. The basic criterion for acceptance is its **potential use** implant breeding and genetic studies or fundamental biology. Information as to history and genetic composition and complexity is required for the retrieval of certain genotypes.

4. Any bona fide research worker of the United States, its territories and possessions, may receive seed from collections stored at the Laboratory subject to the restrictions in Item 6. However, seed will not be provided by the Laboratory if available commercially or in working stocks of research agencies. The Laboratory will suggest sources of supply.

5. The Laboratory will have no responsibility in relation to commitments with foreign countries. All requests from foreign sources will be channeled through the proper administrative office, where decisions in relation to foreign countries will be made.

6. Both public and private donors of specific lots of valuable seed stocks or seed of new varieties, who wish to do so, may retain for a period not to exceed five years the exclusive right to withdraw or permit withdrawal of portions of such seed provided the optional restriction is clearly indicated at the time the seed lot or sample is deposited. No seed collection may be withdrawn in its entirety. After such time limit has expired, and on seed lots or samples deposited without this restriction, all seed deposited in the Laboratory shall be available to any bona fide research worker, whether public or private, of the United States, its territories or possessions.

7. The Laboratory will not hold bulk supplies or seasonal stocks; **it is not** a warehouse or seed distributing center. Rather, it is a germ plasm bank for valuable stocks to be held over the years **for the use** of research workers when needed.

8. The Laboratory will issue periodic inventories of the stocks held in storage to inform research workers of material available.

9. Only clean seed of reasonably high germination is acceptable for storage. If seed of low viability (below 60-65% germination) is received, it will be held on a tentative basis until the donor is able to provide replacement seed of higher viability (75% germination or better).

10. No charge will be made by the Laboratory for the service of furnishing seed. The Laboratory will use every care in keeping good records, but it is not responsible for errors which may occur in the original documentation. The varietal name supplied by the donor will be accepted by the Laboratory.

11. When seed has been accepted officially, the Laboratory will be responsible for the increase of stocks if, during storage, viability drops to a point where there is danger of loss of the accession or stocks have become depleted as a result of seed distribution.

12. The Laboratory will not assume responsibility for replenishment of stocks if the accessions received are subminimal in quantity or viability. However, if obsolete varieties are received not meeting the preceding acceptable standards, the Head of the Laboratory in consultation with the appropriate specialists in the Agricultural Research Service may make arrangements for increases.

13. The principal objective of the Laboratory is long-time holding of valuable seed. Research projects will be carried on at the Laboratory related to the Laboratory's objective, i.e., physiological and pathological problems in seed viability and longevity.

14. The acceptance of seed of a commercial variety by the Laboratory shall not be considered in any way a Federal endorsement as to the value of the variety.

In addition to the above policy, recommendations have been made as to what constitutes "valuable seed." It is recognized that such a definition will vary greatly depending upon the significance attached to the present commercial value of the crop involved and the individual research worker's evaluation whether he be a geneticist, horticulturist, agronomist or pathologist. However, the following categories of crop seed will be **accepted** by the Laboratory:

New Varieties:
All newly released varieties, whether of private, public or commercial origin, including reselections from varieties continuing in current use.

Current Varieties:
Varieties currently in use and under registration by respective crop group organizations, or otherwise documented as to specific origin and distinguishing characteristics. In this group would be included those varieties approaching obsolescence which have been superseded by new or currently popular varieties.

Open-pollinated Varieties:
Stocks representing earlier varieties or types of specific crops which have been or will be replaced in the commercial field by hybrids.

Inbred Lines:
Parental lines of known genetic composition widely used in combination for hybrid production.

Obsolescent Germ Plasm:
Samples representing holdover material from earlier research programs and of no immediate interest.

GENETIC STOCKS:
Includes materials of academic and genetic interests such as marker genes, mutants, translocations, monosomics, trisomics, and other chromosome aberrations. Replenishment of such stocks, if in a heterozygous state, will remain the obligation of the donor. With the latter type of stocks the Laboratory serves only as an insurance against loss.

Plant Introductions:
From Regional and Federal Introduction Stations or other agencies as seed is increased beyond "working stocks."

Differential Host Varieties:
Used or being used as differential hosts for differentiating pathogenic races.

Virus Indicator Plants:
Used in indexing plant viruses.

Physiologically Useful Species:
Used in physiological studies or physiological assays.

All inquiries as to minimum quantities of seed required for specific crops, documentation, condition or quality and other routine information should be addressed to the USDA, National Seed Storage Laboratory, Colorado State University Campus, Fort Collins, Colorado 80521.

APPENDIX C

QUESTIONNAIRE ON A PROPOSED SOUTHWIDE SELECT TREE REGISTER

1. Would your organization be interested in and willing to cooperate in the compilation of a southwide inventory or register of selected forest trees being used in tree improvement work?

   Yes No

2. How or for what purposes would your organization use the register?*

   (a) For information regarding possible exchanges of plant material_____

   (b) For information regarding possible cooperative testing, breeding, etc. _____

   (c) Other purposes, including_____

   _____

   _____

3. Individual tree entries would include all the standard information, such as height, diameter, location, specific gravity, grader's name, etc. What additional special entries would you suggest be included?*

   _____

   _____

   _____

   _____

*Answers to these questions will help determine the type of data recording system to be used.

4. Should an informational meeting be held (a) prior to _____, (b) during the processing of , or (c) upon completion of the final register_____? OR should we skip the meeting, get the job done, and report on it at a coming southwide tree improvement meeting_____

5. Does your organization need or know of any other forest tree improvement services which the U. S. Forest Service, because of their regional representations, should render or make available? If so, please list briefly_____

_____

_____

_____

_____

_____

6. Would you be interested in receiving an informal Tree Improvement Newsletter from time to time regarding local, regional, and national tree improvement items? Yes No