SESSION II

SEED ORCHARD MANAGEMENT, PROBLEMS AND PROGRESS

MODERATOR: W. L. BEERS, JR .

OBSERVATIONS ON TWO-YEAR RESULTS OF THE SEED ORCHARD SURVEY (S.O.S.)

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The yield and quality of seed from southern seed orchards were poor in 1969 and 1970. These poor results attracted the interest and promoted discussions among researchers and orchard managers. Viewpoints expressed were that these results could have been due to environmental factors, cone and seed processing techniques or wide variations in measurement procedures. Diverse methods of data collection and procedures of handling between orchards as well as the wide geographic distribution of orchards made valid comparisons difficult. It seemed necessary to devise a standardized sampling method in order to establish base means for comparisons and to identify possible universal orchard problems.

With this in mind, the Southern Forest Tree Improvement Committee appointed an ad hoc committee on seed orchard seed yield and quality. The ad hoc committee then proposed a survey of southern seed orchards to identify problems, to indicate research needs, and to indicate immediate applicable orchard management procedures to improve seed quality and yield. The survey began in the fall of 1971 as a three-year cooperative project between interested orchard owners and the U. S. Forest Service. The results presented here are some highlights from the first two years of operation of this project.

METHODS AND MATERIALS

Each participating orchard manager selected 2 ramets from each of a minimum of 5 clones to represent the orchard. The following data was recorded: The total number of non-insect damaged cones (by visual inspection) from each ramet, the number of bushels this represented (to the nearest 1/4 bushel), the number of insect damaged cones, age of ramet, and insect control measures applied. The cone collector randomly selected 10 non-insect damaged cones from each ramet and sent them with the above information to the Eastern Tree Seed Laboratory at Macon, Georgia. (A series of slides was used with the talk).

At the laboratory, the cones of each ramet were placed in individual drying boxes and subjected to 24 hours drying at 110°F in a 100 bushel capacity kiln. After drying, the seeds were extracted by hand, dewinged, counted, x-rayed and germinated. Only 100 seed per lot were x-rayed and these seed were always the first replicate in the 400 seed

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germination test. The seeds were germinated on cellulose paper in plastic boxes at 72°F with 16 hours of light for 28 days. Loblolly seed were prechilled on the medium for 30 days at 34°F before germination. Counts were made every seven days. A seed was considered germinated when the seed coat was lifted from the medium.

From the data submitted and laboratory analysis, the following information was determined and reported to the cooperator: Number of cones per bushel, total number of seed extracted per 10 cones, number of seed per cone, percentage of insect damaged cones collected, x-ray analysis of 100 seed sample, full seed germination, number of lots showing seed mold in test, and notes on observations about cone arrival and germination test. The number of seed/cone was determined by dividing the total number of seed extracted by the number of open cones plus one-half the number of half opened cones. For this report, additional information was computed to provide a comparison of yield and quality between orchards. In using this data, orchard managers must recognize that there are age and size differences between orchards as well as differences in management. This new item is the number of viable seed per tree extracted from cones which were visually considered to be free of insect damage.

Our discussion today will include some overall summaries and observations as well as sectional summaries. The orchards were categorized into eastern, central and western groups. The eastern includes the Carolinas and Virginia; central encompases Georgia, Florida, Alabama and Tennessee; while the western includes Texas, Louisiana and Mississippi. The slash (Pinus elliottii) data is from 2 orchards in the east, 24 in the central and 3 in the west, while loblolly (Pinus taeda) is from 12 in the east, 7 in the central and 6 in the west.

RESULTS AND DISCUSSION

The slash pine results are the average of 29 orchards in eight states from Virginia to Texas, while the loblolly averages are from 25 orchards in 9 states. Cones from a total of 528 slash ramets were received the first year but only from 456 the second. A total of 674 loblolly were received the first year and only 568 the second year. While most of the ramets not sampled the second year were reported to us as not producing cones, we based our summary on the assumption that all of the unsampled trees had no cone production.

Let's look at the results of several scored factors including cone opening at the Lab, cone and seed yield, insect damaged cones and x-ray analysis of seed, germination, insect control and finally, the number of thousand viable seed per tree.

Cone Opening

Cone opening, in general for both species the first year was good with the exception of the first cones received, They were immature. Cones from the first ten slash orchards received in 1972 arrived at the Lab between September 15 and 22. Although they were not necessarily from the same orchards, the cones arrived in 1972 during the same time period as the cones from the first 10 orchards for 1971; however, slash pine cone opening in 1972 was less than 50% in all cases. The problem seemed to be caused by a combination of factors. The cones of many samples were definitely immature; some, when finally opened, were found to contain nothing but immature seed or just wings. Some cones had insect damage of a magnitude which prevented the cone from opening. No such problem was noted with loblolly pine which had better than 8 out of 10 cones opening both years. Although only non-insect damaged cones were to be submitted, 3 percent of the cones from first year ramets and 5 percent of the cones from second year ramets submitted had visual insect damage.

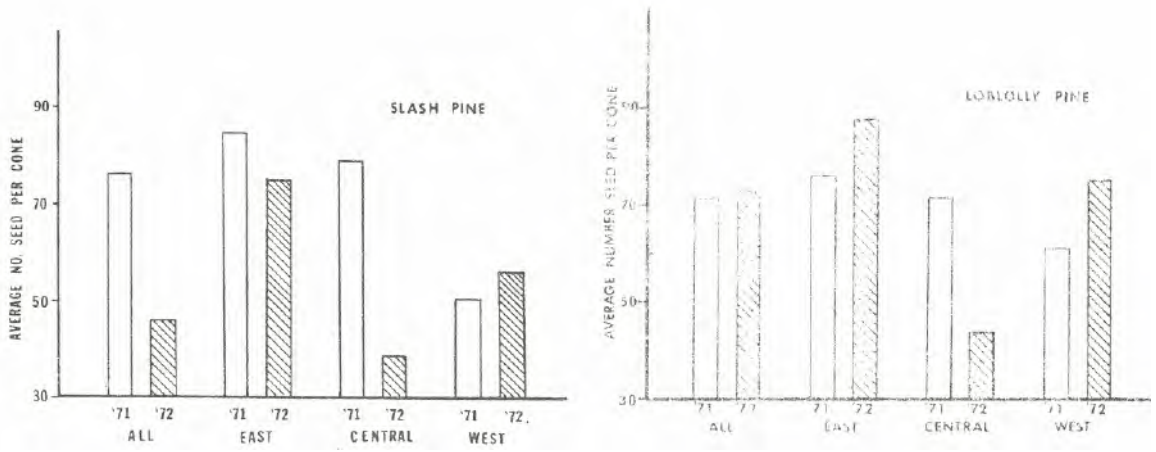

Figure 1. A (Slash pine) and B (Loblolly pine). Mean seed per cone extracted at the Eastern Tree Seed Laboratory. Data given for all orchard collections and by regions to be compared with the mean potential of 163 for slash and 150 for loblolly.

Let's look at a few bar graphs. In Figure 1 the average number of seed/per cone is shown. Note overall average from all orchards on left - note year differences. Note general decrease from East to West for slash pine. For loblolly the differences were not as great.

Figure 2A shows the --
Average number of cones/tree - slash pine showed some year differences and an East to West decline.

Figure 2B shows the --
Average number of cones/tree for loblolly pine.

Note that the Central Area was greatest in '71 but '72 showed the East to West decline.

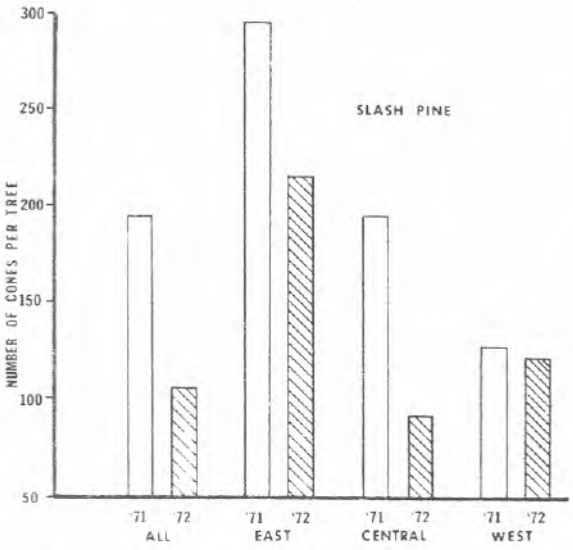

Figure 2A. Cone production of selected slash pine ramets as reported by the orchard managers.

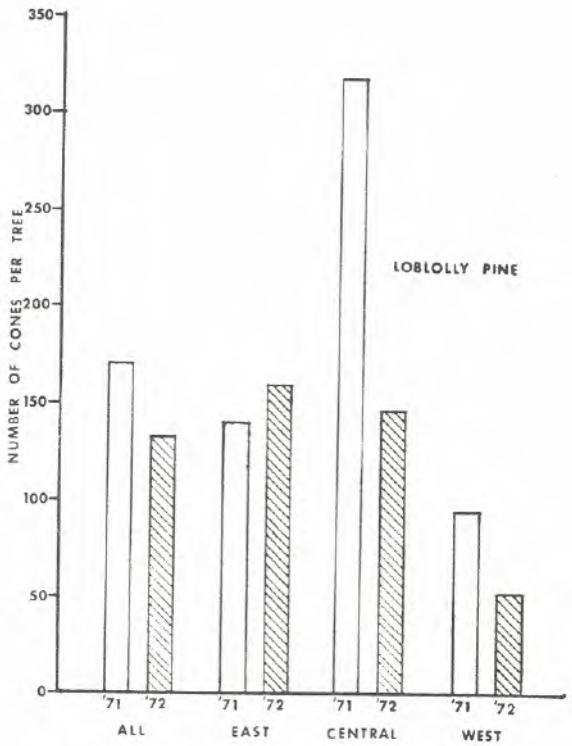

Figure 2B. Cone production of selected loblolly pine ramets as reported by the orchard managers.

Let's look at some graphs of the effects of insect control measures on seed and cone production.

In Figure 3A --
For slash pine, note control vs treated effect the overall and the yearly differences.

Note difference in seed yield for control and treated and the difference between the 2 years.

Figure 3B shows the results for loblolly pine.

Cone and seed yield both were improved by treatment both years.

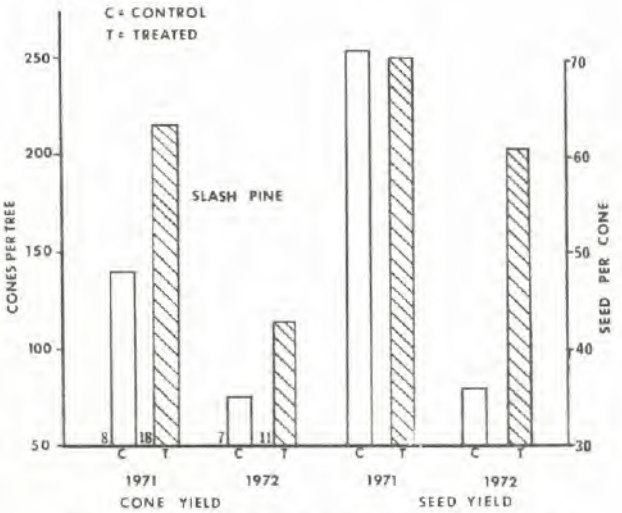

Figure 3A. Comparison of slash pine cone and seed yield from treated and non-treated trees for two years. Numbers at left base of bars indicate the number of ramets included in averages.

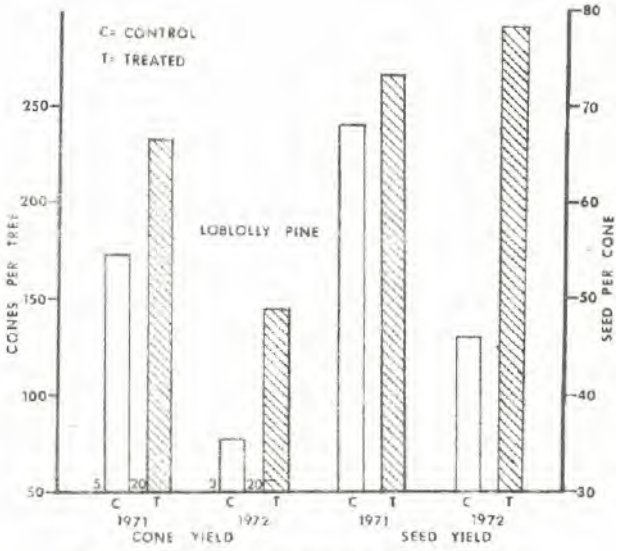

Figure 3B. Comparison of loblolly pine trees subjected to insect control measures with non-treated trees on cone and seed yield for each year of the survey. Numbers at left base of bars indicate the numbers of ramets included in averages.

Viable Seed Per Tree

Thus far, we have discussed observations and determinations from field and laboratory data. None of these measurements are adequate for comparing orchards though, since they all have built in bias. Comparisons of production using cones per bushel do not reflect the number of viable seed per bushel. Also, comparisons based on seed weight (seed per pound) do not allow for differing percentages of empty seed. Seed size also varies with source thus biasing any comparisons between the eastern and western sources.

A new measurement was developed which will reduce the biases previously mentioned; however, it does not permit accurate comparisons of orchard production. There are still the factors of ramet age, size and actual orchard management which will affect orchard seed production. The new measurement is the number of thousand (M) viable seed per tree. The formula for computing it is:

$$\text{M viable seed/tree} = \frac{\text{calculated non-insect cones}}{\text{seed/cone}} \quad \frac{\text{collected}}{\text{(No. of ramets involved in calculations}} \quad \frac{\text{(actual germination)}}{\text{(1000)}}$$

Although these computations should allow for better comparisons, one must remember that these figures only reflect the mean of those clones submitted and have the constraints just mentioned. (Size, age and orchard management).

Seed yield on this basis was 3 times greater for slash pine in 1971 compared to 1972 while only a slight difference was noted in loblolly (Fig. 4A & 4B). This measure followed the same trends as noted in cones per tree (Fig. 1A & 1B). The seed production in 1971 was about the same for both species.

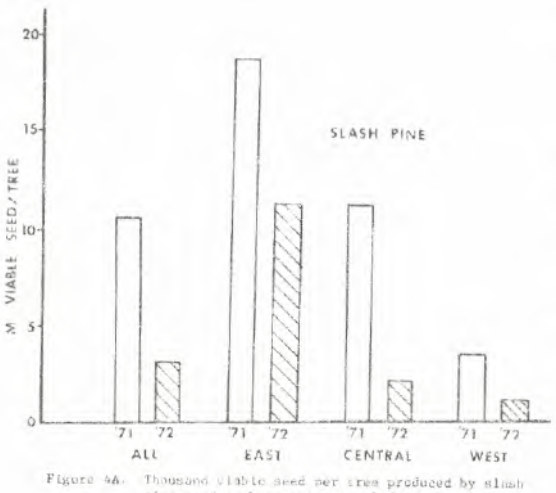

Figure 4A. Thousand viable seed per tree produced by slash pine seed orchard trees sampled in the seed orchard survey.

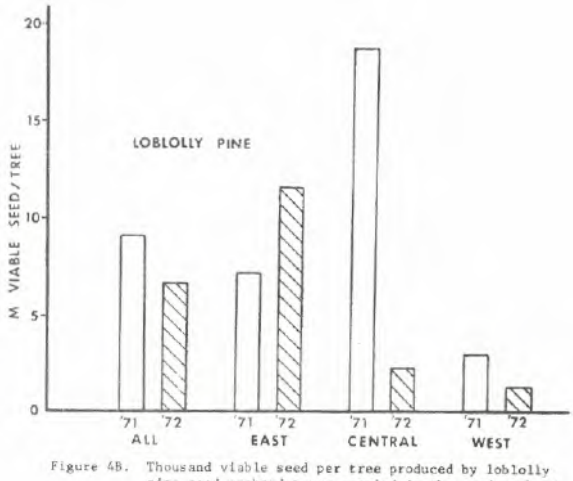

Figure 4B. Thousand viable seed per tree produced by loblolly pine seed orchard trees sampled in the seed orchard survey.

If we consider potential seed production/cone for slash to be 160-170 seed/cone and for loblolly to be 150+ seed/cone, then one can see what potential seed production has been lost due to other factors including poor pollination and selfing. See Figures 5A and 5B.

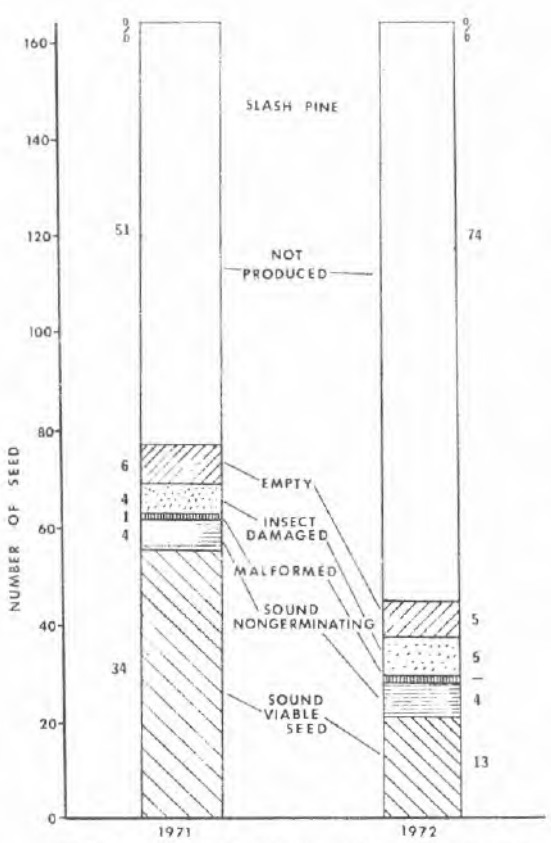

Figure 5A. Summary of slash pine seed production per cone. Data based on laboratory findings and assumption that each cone has a potential to produce 163 see

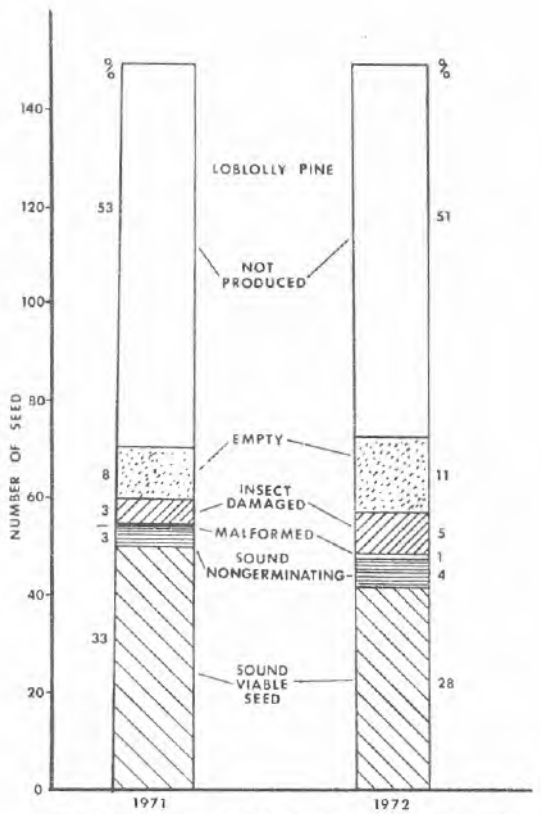

Figure 5B. Summary of loblolly pine seed production per cone. Data based on laboratory findings and assumption that each cone has a potential to produce 150 seed.

Let's consider now a summary of findings on the seed which was extracted:

--A reduction was observed in cones/tree and seed/cone for slash pine in 1972, while the number of cones/bushel held the same. This indicates that there was no influence on cone size caused by a drastic change in the number of cones produced per tree or in the amount of seed they contained.

--No difference was noted in loblolly cone seed yield for the 2 years. An East to West reduction was noted for seed and cone yields.

--X-ray analysis of the seed indicated that the largest percent of seed was in the empty category followed by identifiable insect damaged seed.

---Actual germination percent was low for both species but full seed germination percent was good. Germination percent was increased further by removing all insect damaged seed. This emphasizes the importance of proper cleaning of seed orchard material.

--Comparison of seed from trees receiving insect control measures to those receiving no treatment showed:

(1) Insect control increased cone yield.

(2) Insect control increased seed yield in 1972 but had a negligible influence in 1971.

--Selfing, known to occur in seed orchards, can be a contributor to poor seed set. S.O.S. data cannot detect this factor.

--A possible measure of comparison between species is thousand (M) viable seed/tree. This measure followed the same trends as cones/tree.

Recommendations to date are:

(1) Orchard managers should use an insect control program and they should use it every year to minimize insect damage.

(2) Proper cone and seed handling insures maximized seed viability.

(3) Harvest only fully matured cones. Screen them carefully for insect and disease damage. For survey purposes, send only insect free cones to the Lab.

Good seed gives good results, poor seed poorer results and junk is junk: