

A SOUTHERN PINE SEED ORCHARD IN
THE LOWER RIO GRANDE VALLEY OF TEXAS

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Abstract.--An experimental seed orchard of loblolly (Pinus taeda L.) and slash (Pinus elliottii Engelm. var elliottii) pine was established in the lower Rio Grande Valley near McAllen, Texas which is well outside the natural range of these species. The majority of ramets were planted in 1976 with additional material established in 1977. Flower counts made from 1979 through 1982 indicate that a higher number of loblolly flowers per ramet were produced in the South Texas Orchard than in an operational orchard established at the same time in southern Arkansas. Seed analyses did not show the presence of insect pests common to orchards located in the species' natural range.

Additional keywords: seed production, flower production, orchard management.

Forestry industry, public agencies, and universities are heavily involved in efforts to improve commercial tree species through selection and breeding. Progress is being made and production seed orchards are common throughout the United States.

Smith (1975) reported some South African seed orchards have achieved seed yields for southern pines which are several-fold above those obtained within the southern pine region of the United States. Earlier flowering in South Africa may offer a time advantage of up to 30 percent. These advantages are economically significant and would appear to justify use of this concept to maximize return on tree improvement investments. However, political, social, economic and logistical considerations lessen the attraction of the South African programs.

This paper summarizes efforts to establish a southern pine seed orchard in a sub-tropical environment. A limited review of this effort was earlier published by Richmond and McKinley (1986).

ORCHARD ESTABLISHMENT

Serious review of the technical aspects of a proposal to duplicate the South African program was begun in 1976 by a group of cooperating organize-

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tions 2/. Several prospective areas in the United States were considered before a site was selected in the lower Rio Grande Valley of Texas. Primary criterion was a sub-tropical climate outside the natural range of loblolly and slash pine. The area is located near McAllen, Texas and is approximately 400 km from native southern pines.

The orchard was designed with a wide geographic representation of genetic material. Five loblolly blocks and one slash block were established with each block containing clones from a single region (Table 1). Clones were selected to provide a range of poor to good female flowering behavior. Scion material was provided by members of the North Carolina State University Tree Improvement Cooperative, the Florida Tree Improvement Cooperative and the Western Gulf Forest Tree Improvement Program.

Table 1.--Genetic composition of the South Texas seed orchard at time of establishment (1976-1977).

<u>Species</u>	<u>Geographic Origin</u>	<u>Number of Ramets</u>
Loblolly	Southeast Texas	45*
	North and South Carolina	36
	Maryland-Virginia	45*
	Mississippi-Louisiana	43*
	Arkansas	43
Slash	Texas-Louisiana-Florida	45
	Total	257

* One non-grafted seedling included in this total.

The orchard was first planted in June 1976 with a total of 140 trees. A spacing of 9.5 m x 9.5 m was used. Although summer planting is not recommended, the orchard was established at this time in order to avoid delay. To provide for perhaps earlier and better pollination, "pollinator clones", known to be high volume pollen producers, from the appropriate region and species were interplanted in 1977. A total of 117 of these additional grafts were used.

ORCHARD MANAGEMENT

while a considerable number of problems were expected as in conventional southern pine orchard management, several unexpected difficulties were encountered in the experimental area.

2/ Cooperating organizations included: Arkansas Kraft Corp., Champion International Corp., International Paper Co., Kirby Forest Industries, Inc., Olinkraft Corp. (now Manville Forest Products Corp.), Owens-Illinois, Inc., Nekoosa Papers, Inc., Potlatch Corp., Boise Southern Co., Temple-Eastex Forests, Texas Forest Service, and Weyerhaeuser Co.

The strong prevailing east to southeast wind was observed to have an adverse effect on the young trees. Many trees began to lean with the windward faces of developing crowns abnormally sparse and open. Temporary relief was gained by erecting burlap shields on the windward sides of young trees. These shields required considerable maintenance and appeared to become less effective as the trees grew.

The original irrigation system consisted of impact type sprinklers on five-foot risers. However, a water supply high in mineral content combined with the need for frequent watering (rainfall averages 56 cm/year) resulted in a calcium and sodium deposit on tree foliage. This problem was alleviated by replacing impact sprinklers with individual ground level bubble emitters at each ramet.

Other treatments included the application of elemental sulphur to all ramets to lower soil pH and the soil application of mycorrhizae to several ramets demonstrating poor vigor. Nitrogen fertilizer as ammonium nitrate was applied to part of the orchard in 1981 and 1982 in an effort to stimulate flower production. Fertilization also included the application of triple-superphosphate to improve tree growth.

FLOWER PRODUCTION

Female flowers (strobili) were observed in 1978. Counts of female flowers were made from 1979 through 1985 (Table 2), although the 1982 through 1985 counts were estimates as the trees were so large that it was difficult to see all flowers. Flower production varied by geographic source with the Louisiana-Mississippi and Arkansas loblolly producing the most flowers. As is commonly observed in the natural range of the two species, slash pine produced fewer flowers at these early ages than loblolly. Slash data was, therefore, not further analyzed.

Early production of female flowers was obtained in the South Texas Orchard. However, the data do not readily indicate if this production is more abundant than that expected in orchards established within the natural pine range. To compare loblolly flower production, data were obtained from the Potlatch Corporation orchard at Warren, Arkansas. This orchard is located within the natural range of loblolly pine. It was also established in 1976 and represents a geographical contrast to the South Texas location. While identical treatments were not applied to the two orchards being considered, both orchards were managed to stimulate early growth and flower production.

Flower counts for the Potlatch orchard were from a 20 percent sample of the total 16 ha. for the years 1979-1982. Flower counts for the South Texas orchard were from the 100 percent tally. Results indicate that higher loblolly female flower production was obtained in the South Texas orchard (Table 3). Specifically, 1982 data demonstrate that the South Texas orchard produced about 15 times more flowers per ramet than the Potlatch orchard and produced 22 times as many flowers per ramet when the Arkansas block is compared to the Potlatch orchard. These results are similar to those of Schmidtling (1978) who reported that an increase in cone production of loblolly orchards could be expected in the more southerly latitudes. It is believed that a significant reason for more flowering in South Texas is the presence of

Table 2.- Flowering summary for the South Texas seed orchard for years 1979-1985.

	1979	1980	1981	1982	1983	1984	1985
<u>Loblolly</u>							
Southeast Texas							
No. Ramets	35	30	25	25	24	25	25
Mean Flowers/Ramet	3.7	10.2	11.5	42.7	38.3	198	241
North and South Carolina							
No. Ramets	20	17	16	14	13	15	14
Mean Flowers/Ramet	1.4	5.8	4.6	36.6	38.5	168	273
Maryland-Virginia							
No. Ramets	38	31	31	29	29	31	31
Mean Flowers/Ramet	2.4	6.5	8.8	29.1	42.1	116	141
Mississippi-Louisiana							
No. Ramets	34	32	32	32	30	32	32
Mean Flowers/Ramet	9.4	23.8	21.3	69.2	64	287	313
Arkansas							
No. Ramets	37	36	34	32	32	35	35
Mean Flowers/Ramet	6.8	23.1	31.5	66.5	69.2	371	419
<u>Slash</u>							
Texas-Louisiana-Florida							
No. Ramets	33	31	30	27	27	29	29
Mean Flowers/Ramet	1.0	2.7	2.1	19.5	32.1	83	123

Table 3.--Flowering comparison for loblolly pine in the South Texas seed orchard and Potlatch Corporation seed orchard for years 1979-1982.

	1979	1980	1981	1982
<u>South Texas seed orchard</u>				
No. Ramets	164	146	138	132
% Ramets with Flowers	63.4	77.4	83.3	97.7
Mean Flowers/Ramet		5.0	15.0	17.3
				51.2
<u>Potlatch Corp. seed orchard</u>				
No. Ramets (20% sample)	464	464	464	464
% Ramets with Flowers	23.7	9.5	33.0	29.3
Mean Flowers/Ramet		1.0	.3	2.1
				3.1

multiple whorls of flowers in the same flowering season. This phenomenon has not been reported in more northern orchards and was fairly common in South Texas.

SEED PRODUCTION

To evaluate potential seed production, a pollination study was begun in 1979. The purposes were to determine if foreign pollen was reaching the orchard in sufficient quantity to result in pollination and to determine if seed or cone insects were present in the orchard.

Results of this study for 1979, 1980, and 1984 are presented in Table 4. Although both slash and loblolly were treated only the loblolly data are presented due to a relatively low survival of slash cones. While these data are not definitive, they do suggest that little, if any, pollen reached the orchard from outside sources.

Table 4.-- Summary of South Texas seed orchard loblolly pollination study for 1979, 1980 and 1984.

Year	Treatment	No. Cones	Mean Seeds/Cone	Mean Filled Seeds/Cone
1979	Tagged Only	0	-	-
	Bagged Only	0	-	-
	Mass Pollinated	37	33.6	21.5
1980	Tagged Only	7	0	0
	Bagged Only	0	-	-
	Mass Pollinated	41	52.6	42.5
	Bagged/Pollinated	50	10.7	8.1
1984	Tagged Only	398	21.8	15.8
	Mass Pollinated	661	26.2	18.5

Cones were collected each year with seed extracted for radiographic analyses. Examination indicated that no seed or cone insects were present in the orchard.

SUMMARY

The experimental orchard was begun by a group of cooperating organizations in 1976. While several unexpected problems arose in management of the orchard, it is believed that the establishment of an operational orchard in this or similar location is feasible.

Loblolly flower counts made from 1978 to 1985 indicate that the experimental orchard produced considerably more flowers than a comparable orchard located in southern Arkansas. However, a detailed comparison is not possible due to different genetic compositions in the two orchards. Genetic material from Louisiana-Mississippi and Arkansas regions produced the greatest number of female flowers per ramet in the experimental orchard. A pollination study

suggested that a minimal amount of outside pollen was present. Radiographic analysis of seeds did not show any seed or cone insects.

These results suggest that pine seed orchards in South Texas or other subtropical climate may produce sufficient flowers to encourage further development, particularly when the lack of natural seed predators and contaminating foreign pollen are considered.

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