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# Seed To Seedlings

Georgia Forestry Commission

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Published By The

GEORGIA FORESTRY COMMISSION
P.O. Box 1077
Macon, Ga. 31202
1967

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# A REVIEW OF GEORGIA'S SUPERIOR TREE PROGRAM

## INTRODUCTION

Tree improvement, through the principle of genetics, had been discussed by foresters for many years. However, early tree planting programs were small in size, hence, they did not stimulate interest in this type work.

Landowners began to reforest cutover and non-productive forest acres on a statewide basis in 1929. Seed were collected at random, sown in forest tree nurseries and resulting seedlings distributed for planting. Little thought was given to the quality of trees that would make up Georgia's future forests.

As tree planters' requests for seedling stock increased, the task of collecting seed became a major undertaking. Nurserymen found it difficult to obtain enough seed to grow needed tree seedlings. Seed procurement programs were evaluated on the basis of quantity of seed collected rather than seed quality.

With increased competition from wood substitutes and higher manufacturing costs, it became evident that stepped-up tree planting programs would need better seedlings. Seedlings grown from seed which were mass collected in the wild, often produced low quality to average trees. Many plantations were substandard pointing to the need for improved or superior trees.

The economics of long-time reforestation efforts, both in capital outlay and land use, indicated that maximum returns must be obtained. These returns can be accomplished best through the use of planting stock of superior genetic quality.

Forest leaders began to plan how better trees could be produced in the early 1950's. Research workers had accomplished tremendous results in improving many agricultural crops, and it was thought that these principles should be applied to Georgia's forest trees. The big question was how to shorten the tree-to-seed cycle.

In 1954, the Georgia Forestry Commission initiated a Tree Improvement Program whereby Georgia's forests would be carefully searched, and trees of better than average quality located. The program was designed with the economical production of genetically high quality seed as its objective. Through selection and tree breedings, it was planned that genetically high quality trees would result.

The execution of the project was the responsibility of the Georgia Forestry Commission. The Southeastern Forest Experiment Station, U.S. Forest Service, agreed to initiate a plan for developing the orchards. The USFS and the Georgia Forest Research Council entered into a cooperative agreement whereby they would progeny test trees selected for use in the program.

Plans called for the establishment of seed producing orchards. Specifically selected trees would be grown in specially cared-for orchards. The seed orchards would provide the Commission with seed capable of producing trees having specific characteristics.

Through breeding and selection, it was thought that the greatest gains could be obtained in the shortest period of time.

Leaders in the initial undertaking were Dr. William A. Campbell,[1] laboratory chief, Forest Science Laboratory, Athens, Ga.; Keith W. Dorman,[2] project leader, Southeastern Forest Experiment Station, Asheville, N. C.; and Bratislav Zak,[3] pathologist, Forest Science Laboratory, Corvallis, Ore.

Guyton DeLoach, Forestry Commission director, 1949-60, made the decision to undertake the program, and provided funds for its operation. Dr. Leon A. Hargreaves, professor of Forestry, University of Georgia School of Forestry, Athens, provided early guidance to the program as the assistant director of the Forestry Commission.

[1]Leader, Athens-Macon Research Center, USFS, Athens, Ga., 1956
[2]Project Leader, Genetics, Athens-Macon Research Center, USFS, Macon, Ga., 1956
[3]Project Leader, Pathology, Athens-Macon Research Center, USFS, Athens, Ga., 1956

# Tree Selection

Workers were immediately faced with the problem as to what criteria were needed to select superior trees. A set of rigid selection standards were adopted and included the following characteristics:

1. Good height and diameter growth
2. Straight bole having little taper and lacking a tendency to fork
3. Small to medium size horizontal branches
4. Good, early natural pruning ability
5. Narrow size crown
6. Disease and insect resistance
7. Fruitfulness

Georgia Forestry Commission foresters were trained in the techniques of tree selection by Southeastern Forest Experiment Station and University of Georgia School of Forestry personnel. A Tree Selection Short Course was held at the University of Georgia to thoroughly familiarize Commission foresters with selection standards prior to proceeding to the field.

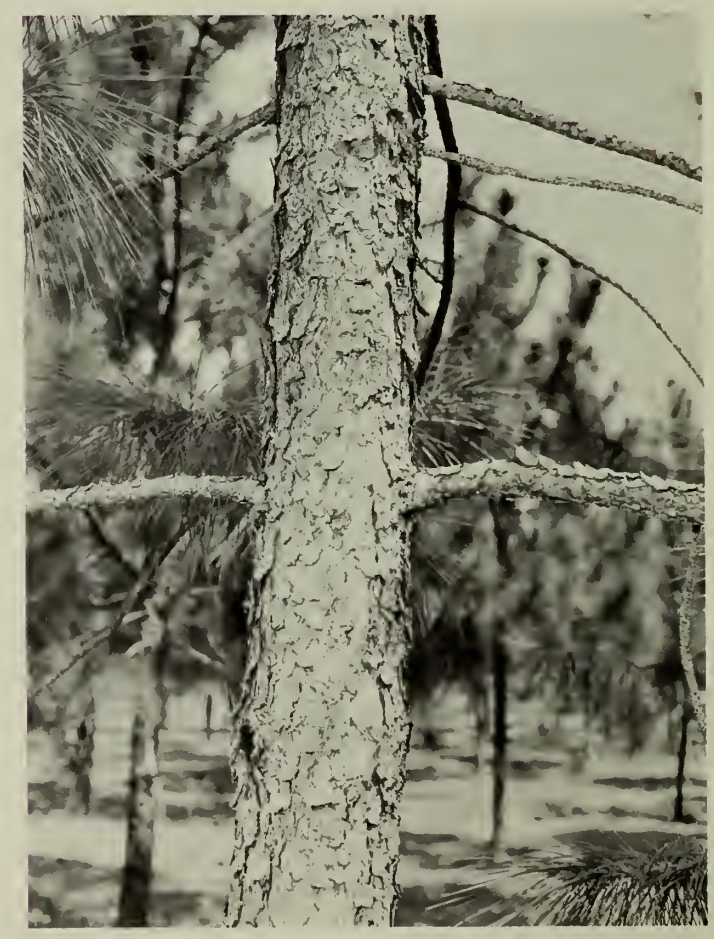
*Narrow Crown*



*Little Bole Taper*

## Desirable Traits

*Cone Bearing Ability*



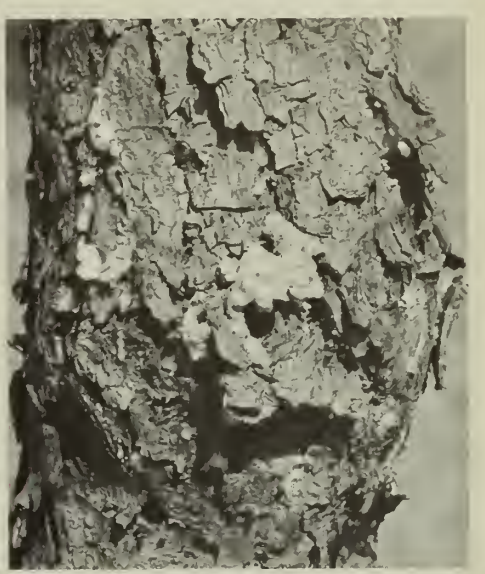
*Small Branches At Right Angles To Bole*

*Fast Growth*

*Early, Natural Pruning Ability*

*Tip Moth*

# RESISTANCE TO INSECTS AND DISEASES



*Dioryctria*


*Fusiform Rust*

B-69

Commission foresters located approximately 600 trees of superior form and vigor. Station personnel, working with these foresters, made a final field inspection and evaluation of selected trees. Specific clones were approved for use in the program.

Researchers discovered new factors to add to the original selection standards. Primarily, the specific gravity of selected trees has been found important. Trees having high specific gravity are desirable for lumber and other specialized products. The original Forestry Commission selections, and clones obtained from the Naval Stores Timber Production Laboratory, USFS, Olustee, Fla., have been evaluated for gum yielding ability.

Initially, selection was limited to slash and loblolly pine. Later, shortleaf, Virginia and eastern white pine were added to the program through a cooperative agreement with the Tennessee Valley Authority.

Future programs will include longleaf pine and a number of hardwood species.

*High Gum Yield*

# Seed Orchard Establishment

The selection of seed orchard sites required as much consideration as tree selection standards. Relatively flat, gentle sloping land, with soil of good texture and fertility, was needed.

With these site requirements in mind, the Commission established seed orchards at four seperate locations. The Horseshoe Bend Seed Orchard, in Wheeler County near Glenwood, Ga., was leased from the Union Camp Corporation. A second tract, the Arrowhead Seed Orchard, lying in Pulaski and Bleckley Counties, was leased from the Georgia Kraft Company. The Sandy Run Seed Orchard, near Davisboro in Washington County; and the Hightower Seed Orchard, in Dawson County near Dawsonville, Ga.; are Forestry Commission owned properties.

The Horseshoe Bend Seed Orchard is composed of three separate areas totaling 225 acres. One of these areas is jointly operated with Union Camp Corporation. The Arrowhead Seed Orchard contains approximately 300 acres. The Sandy Run and Hightower Seed Orchards contain 25 and ten acres, respectively.

Loblolly and slash pine were chosen for growing at the Horseshoe Bend Seed Orchard. The Arrowhead Seed Orchard is composed of loblolly, shortleaf and slash pine. In addition, various species of hardwoods and longleaf pine will be grown at this orchard. The Sandy Run Orchard includes loblolly and slash pine which were selected for use on the basis of three year progeny test results. Eastern white and Virginia pine are being grown at the Hightower Orchard.

*Forestry Commission seed orchards were established in soils, of good texture and fertility, that were well-drained.*

*The use of potted, grafted seedlings, for seed orchard establishment, proved successful; it also proved to be too slow for large scale orchard establishment.*

*At the outset of the Tree Improvement Program, Commission foresters selected 600 superior phenotypes. Trees selected possessed several superior characteristics based on rigid selection standards. This tree illustrates three desired characteristics, straight bole, small branches and narrow crown.*

*Scions are collected from selected parent trees. The selected cutting is grafted to seedling rootstock.*

Initially, the Horseshoe Bend and the Arrowhead Seed Orchards were planted with greenhouse grafted ramets. The first plantings were made in 1955 with some 15 acres of orchard established. Greenhouse grafted plants gave very good results. However, the handling of potted plants, on a large scale, was a laborious process.

In 1956, several thousand seedlings were planted in Horseshoe Bend and Arrowhead Seed Orchards for rootstock to be used in field grafting. Grafting was done on the seedling rootstock. It was learned that this method of orchard establishment was not adaptable to large scale operations because of weather problems. It was also difficult to properly supervise workers doing the grafting.

A third method of orchard establishment, seedbed grafting, was adopted. Seedling rootstock were grown in specially prepared nursery seedbeds with grafting carried out in Forestry Commission nurseries. This method of orchard establishment has proven highly satisfactory.

Grafting, in nursery seedbeds, is carried out in a relatively small area. Workers can be carefully supervised and grafts given the necessary after-care with a minimum amount of effort. When transplanting ramets to orchard locations, healthy, high quality plants can be selected. Orchards, produced from this method, are more uniform than orchards established through field grafting techniques.

The seedling seed orchard, at Arrowhead, is another method of orchard establishment. This type orchard was established using selected progeny. With the establishment of a seedling seed orchard, a second cycle of selection was begun utilizing progeny from selected parents. Orchards developed by this process will be carefully evaluated and periodically rogued to remove inferior trees.

The Forestry Commission seed orchards contain 459 clones. Each clone is represented by many individually grafted ramets. When completely stocked, the seed orchard will contain 47,290 grafted trees; all produced from the 459 originally selected parent trees.

*Seedlings are grown in specially prepared nurserybeds for use as rootstock in grafting.*

*The rootstock and scion are matched in size. An incision of two and one-half inches is made on the rootstock stem that is cleared of needles and limbs. The scion is inserted in the incision so that the cambium layers of the rootstock and scion match.*

*After the stock is bound, the seedling is covered with a polyethelene bag. An aluminum foil bonnet, or hood, is added. After six to eight weeks, the bags are removed. The outer bag reflects heat and the inner bag maintains a high humidity.*

*Grafted ramets, at one and one-half to two years, are ready for planting in the seed orchard.*

*The two year old grafted seedlings are transplanted to seed orchards. Each individual tree is identified as to origin. This provides for easier collection of detailed information concerning inherent characteristics, seed production and other technical information.*

*Seedling seed orchards are used to supplement seed orchards established from nurserybed grafts. As the trees mature, most of them will be removed leaving the top ten percent as seed producers.*

Large orchards are sub-divided into 2.3 acre blocks. Each block contains 400 ramets. Grafted plants are specially arranged within the 2.3 acre blocks to allow for maximum mixing of pollen and to reduce the chance of self-pollination. There are 20 clones in each block.

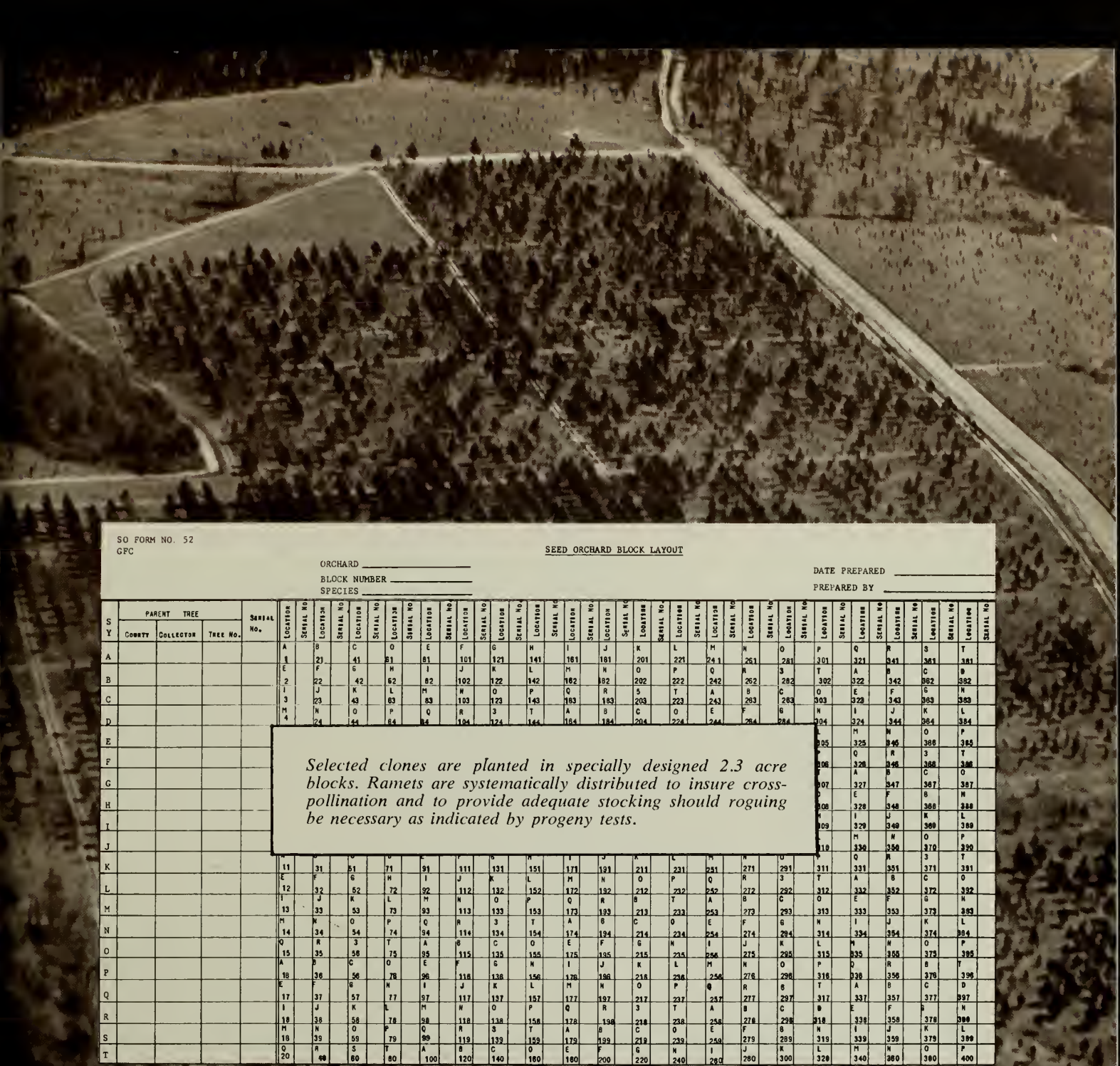
The present goal is the establishment of 290 acres of slash pine, 100 acres of loblolly pine and seven acres each of longleaf pine, Arizona cypress and yellow poplar. Eastern white, shortleaf and Virginia pine will occupy five acres each of orchard space. Forestry Commission seed orchards contained 36,531 living grafted trees at the end of 1966.

Through cooperative research, conducted by the University of Georgia School of Forestry, and sponsored by the Georgia Forest Research Council, Forestry Commission seed orchards development has been accelerated. Dr. Claud Brown, associate professor of Botany, University of Georgia, Athens, Ga., has assisted in the development of seedbed grafting techniques, Dr. Jack T. May, professor of Silviculture, University of Georgia, Athens, has contributed in the evaluation of orchard sites through his studies of soil characteristics.

*Improved seed, treated with bird and rodent control chemicals, are planted in Commission nurseries in March.*

*In November, of the same year, the Improved Seedlings are ready for distribution to Georgians for reforestation purposes.*

*A 400 foot isolation strip minimizes the chances of pollinating the trees with pollen of unknown sources. Species, which may produce pollen that would contaminate seed orchard trees, are removed from the isolation strips.*



SO FORM NO. 52
GFC

SEED ORCHARD BLOCK LAYOUT

ORCHARD _____
BLOCK NUMBER _____
SPECIES _____

DATE PREPARED _____
PREPARED BY _____

| SY | PARENT TREE: County | Collector | Tree No. | Serial No. | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No | Location | Serial No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | | | | A 1 | | B 21 | | C 41 | | D 61 | | E 81 | | F 101 | | G 121 | | H 141 | | I 161 | | J 181 | | K 201 | | L 221 | | M 241 | | N 261 | | O 281 | | P 301 | | Q 321 | | R 341 | | S 361 | | T 381 | | | | | | | | |
| B | | | | | E 2 | | F 22 | | G 42 | | H 62 | | I 82 | | J 102 | | K 122 | | L 142 | | M 162 | | N 182 | | O 202 | | P 222 | | Q 242 | | R 262 | | S 282 | | T 302 | | A 322 | | B 342 | | C 362 | | D 382 | | | | | | | | |
| C | | | | | I 3 | | J 23 | | K 43 | | L 63 | | M 83 | | N 103 | | O 123 | | P 143 | | Q 163 | | R 183 | | S 203 | | T 223 | | A 243 | | B 263 | | C 283 | | O 303 | | E 323 | | F 343 | | G 363 | | H 383 | | | | | | | | |
| D | | | | | M 4 | | N 24 | | O 44 | | P 64 | | Q 84 | | R 104 | | S 124 | | T 144 | | A 164 | | B 184 | | C 204 | | O 224 | | E 244 | | F 264 | | G 284 | | N 304 | | I 324 | | J 344 | | K 364 | | L 384 | | | | | | | | |
| E | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | L 305 | | M 325 | | N 345 | | O 365 | | P 385 | | | | | | | | |
| F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | P 306 | | Q 326 | | R 346 | | S 366 | | T 386 | | | | | | | | |
| G | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | T 307 | | A 327 | | B 347 | | C 367 | | O 387 | | | | | | | | |
| H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | O 308 | | E 328 | | F 348 | | G 368 | | H 388 | | | | | | | | |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | H 309 | | I 329 | | J 349 | | K 369 | | L 389 | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | L 310 | | M 330 | | N 350 | | O 370 | | P 390 | | | | | | | | |
| K | | | | | 11 | | 31 | | 51 | | 71 | | 91 | | 111 | | 131 | | 151 | | 171 | | 191 | | 211 | | 231 | | 251 | | 271 | | 291 | | 311 | | 331 | | 351 | | 371 | | 391 | | | | | | | | |
| L | | | | | E 12 | | F 32 | | G 52 | | H 72 | | I 92 | | J 112 | | K 132 | | L 152 | | M 172 | | N 192 | | O 212 | | P 232 | | Q 252 | | R 272 | | S 292 | | T 312 | | A 332 | | B 352 | | C 372 | | O 392 | | | | | | | | |
| M | | | | | I 13 | | J 33 | | K 53 | | L 73 | | M 93 | | N 113 | | O 133 | | P 153 | | Q 173 | | R 193 | | S 213 | | T 233 | | A 253 | | B 273 | | C 293 | | O 313 | | E 333 | | F 353 | | G 373 | | H 393 | | | | | | | | |
| N | | | | | M 14 | | N 34 | | O 54 | | P 74 | | Q 94 | | R 114 | | S 134 | | T 154 | | A 174 | | B 194 | | C 214 | | O 234 | | E 254 | | F 274 | | G 294 | | N 314 | | I 334 | | J 354 | | K 374 | | L 394 | | | | | | | | |
| O | | | | | Q 15 | | R 35 | | S 55 | | T 75 | | A 95 | | B 115 | | C 135 | | O 155 | | E 175 | | F 195 | | G 215 | | N 235 | | I 255 | | J 275 | | K 295 | | L 315 | | M 335 | | N 355 | | O 375 | | P 395 | | | | | | | | |
| P | | | | | A 16 | | B 36 | | C 56 | | O 76 | | E 96 | | F 116 | | G 136 | | N 156 | | I 176 | | J 196 | | K 216 | | L 236 | | M 256 | | N 276 | | O 296 | | P 316 | | Q 336 | | R 356 | | S 376 | | T 396 | | | | | | | | |
| Q | | | | | E 17 | | F 37 | | G 57 | | N 77 | | I 97 | | J 117 | | K 137 | | L 157 | | M 177 | | N 197 | | O 217 | | P 237 | | Q 257 | | R 277 | | S 297 | | T 317 | | A 337 | | B 357 | | C 377 | | D 397 | | | | | | | | |
| R | | | | | I 18 | | J 38 | | K 58 | | L 78 | | M 98 | | N 118 | | O 138 | | P 158 | | Q 178 | | R 198 | | S 218 | | T 238 | | A 258 | | B 278 | | C 298 | | D 318 | | E 338 | | F 358 | | G 378 | | N 398 | | | | | | | | |
| S | | | | | M 19 | | N 39 | | O 59 | | P 79 | | Q 99 | | R 119 | | S 139 | | T 159 | | A 179 | | B 199 | | C 219 | | O 239 | | E 259 | | F 279 | | G 299 | | N 319 | | I 339 | | J 359 | | K 379 | | L 399 | | | | | | | | |
| T | | | | | Q 20 | | R 40 | | S 60 | | T 80 | | A 100 | | B 120 | | C 140 | | O 160 | | E 180 | | F 200 | | G 220 | | N 240 | | I 260 | | J 280 | | K 300 | | L 320 | | M 340 | | N 360 | | O 380 | | P 400 | | | | | | | | |

*Selected clones are planted in specially designed 2.3 acre blocks. Ramets are systematically distributed to insure cross-pollination and to provide adequate stocking should roguing be necessary as indicated by progeny tests.*

# Seed Orchard Management

Cultural treatments include weed control, spraying for diseases and insects, pruning, roguing, cone collection and fire protection.

The carrying out of these management responsibilities falls directly upon the seed orchard superintendent. He initiates a management plan set by an orchard advisory committee.

A Tree Improvement Technical Advisory Committee periodically reviews the Forestry Commission's Tree Improvement Program and assists in formulating long-range plans. Sanford P. Darby, Commission Reforestation chief, is chairman.

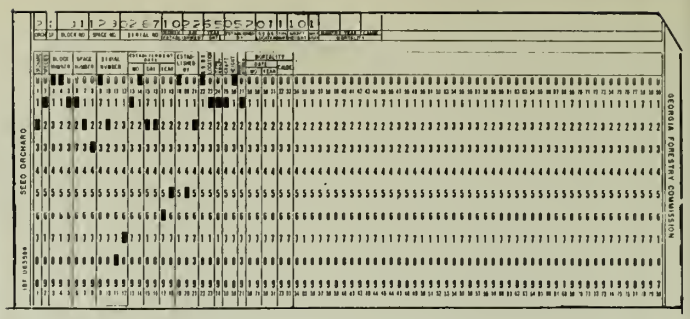
Through such reviews, new technical developments adaptable to orchard management are included in Georgia's program.

A complete file, of trees selected for the tree improvement program, is maintained at each seed orchard. These records provide a complete evaluation of each tree, and are kept up to date through data processing machines.

An annual tree inventory is made of each seed orchard. These data include the number of living ramets and an evaluation of them.

The committee members are Dr. Claud L. Brown, associate professor, Botany, University of Georgia, Athens; Keith W. Dorman, project leader, U.S. Forest Service, Asheville, N. C.; Dr. Roy Stonecypher, silviculturist, International Paper Company, Bainbridge, Ga.; Dr. A. A. Foster, supervisor, Forest Tree Improvement Section, Tennessee Valley Authority, Norris, Tenn.; and Barry Malac, general superintendent, Woodlands Research Department, Union Camp Corporation, Savannah, Ga.

Others are Dr. Jack T. May, professor of Silviculture, University of Georgia, Athens; E. P. Merkel, project leader, Forest Insect Program, Naval Stores and Timber Processing Laboratory, USFS, Olustee, Fla.; Dr. Mervin Reines, associate professor, Genetics, University of Georgia, Athens; and E. H. Sosbe, woodlands administrator, Georgia Kraft Company, Rome, Ga.



*The identity of each tree is maintained on data processing cards.*

*Field grafting yields good results in the development of small seed orchards. However, an uneven-aged orchard results when the program is expanded to the development of larger orchards.*

*Nurserybed grafting, the current method being used, is superior to field grafting in that it yields an even-aged orchard.*

*Greenhouse grafting, the use of potted stock, presented several problems. One was poor root development. This resulted from stock being grown in containers too long.*

*Successful grafting, whether field or nurserybed, depends on close supervision. Without supervised labor, results may yield improper grafted plants.*

*Incompatible trees result from an improper graft union. The end product is a bushy tree with poor needle and bole development with death occurring at an early age.*

## Controls

*A flame cultivator is used to control weeds. This provides for better equipment operation and easier accessibility for personnel. The collection of cones is also facilitated.*

# Progeny Testing

Progeny testing is the process of evaluating the degree of superiority of a selected clone based on the performance of its offspring. Its purpose is to yield data on which the selection of elite trees is based.

After the seed orchard is established and begins to produce flowers, the female flowers are bagged and pollinated, at a receptive stage, with pollen from male catkins. Several weeks after pollination, bags are removed from the female conelets.

It takes approximately two growing seasons for the cones to mature. They are carefully collected, and the identity of each controlled pollinated lot recorded. The identified seed are planted in a special nurserybed. At one year of age, they are lifted and planted in progeny test areas. The areas are laid out in such a way so that data collected on the trees can be analyzed mathematically and the poorest and best parents identified.

Progeny testing of the Horseshoe and Arrowhead Seed Orchards involves pollinating all clones with a mixture of pollen from 12 to 15 different clones in the orchard. An indication of how each clone will perform will be obtained when progeny tests are completed.

After progeny testing, trees that don't meet the test standards will be rogued.

Dr. John C. Barber,[1] project leader, Institute of Forest Genetics, USFS, Gulfport, Miss., laid the initial ground work, and carried out basic research in progeny testing in the Forestry Commission's seed orchards.

[1]Project Leader, Genetics, Macon Research Center, Macon, Ga., 1960

*The seed orchard trees are cross-pollinated in an effort to determine what characteristics are passed from one tree to another.*

*Progeny tests yield data that is used to evaluate the seed orchard clones and permit identification of the elite trees.*

*The tree flowers are bagged to prevent cross-pollination.*

*The trees, at approximately eight years, are bearing cones. The cones are collected and seed extracted. These seed are producing the Improved Seedlings in Commission nurseries.*

# What's Ahead

What's ahead; seed of known genetic origin. Georgia's tree improvement program is designed to achieve this goal.

In 1964, Georgia was the first State to produce improved loblolly and slash pine seedlings on a large commercial scale. Through 1966, 10,267,000 improved seedlings had been distributed to Georgia landowners. In approximately ten years it is anticipated that all distributed loblolly and slash pine seedlings will be produced from seed orchard seed.

Georgia's program has progressed to where consideration can be given species other than loblolly and slash pine. In the future, emphasis will be placed on the following:

1. Cherrybark Oak (Quercus falcata var. pagodaefolia)
2. Chestnut Oak (Quercus montana)
1. Northern Red Oak (Quercus borealis var. maxima)
4. White Oak (Quercus alba)
5. Longleaf Pine (Pinus palustris)
6. Yellow Poplar (Liriodendron tulipifera)
7. Sweetgum (Liquidambar styraciflua)
8. Sycamore (Platanus occidentalis)
9. Black Walnut (Juglans nigra)

The selection and breeding of various tree species must continue if Georgia is to have a successful dynamic program. When new superior trees are located, they will be added to the program. If Georgia is to maintain her forestry leadership, she must continue to seek out the best trees produced by each generation.

Georgia's foresters have passed the discussion stage and are actively engaged in a program that will yield better trees. The program results will provide better products for future generations and trees of high quality known genetic origin that will insure maximum economic returns, the program objective.

*The Forestry Commission began distribution of Improved Seedlings in 1964.*


*Georgia landowners have planted the first trees resulting from the Commission's Tree Improvement Program. Improved trees possess many of the desirable characteristics of parent trees from which they were obtained.*

*It is the ultimate objective to be able to produce trees that may be ordered for definite uses such as high gum yielders or lumber having specific wood qualities.*

TABLE 1

## CLONES BY SPECIES IN PROGRAM

| Number | |
|---|---|
| 167 | Slash Pine |
| 133 | Loblolly Pine |
| 15 | White Pine |
| 25 | Virginia Pine |
| 27 | Shortleaf Pine |
| 16 | Slash Pine High Gum Yield; Olustee Slash Pine Selections |
| 12 | Slash Pine High Gum Yield; Multi-purpose Georgia Forestry Commission Selections |
| 64 | Slash Pine Union Camp Corporation-Georgia Forestry Commission Selections |

TABLE 2

## NUMBER CLONES IN SEED ORCHARD BY SPECIES

| Species | Horseshoe | Arrowhead | Sondy Run | Hightower |
|---|---|---|---|---|
| Slash Pine | 67 | 147[1] | 56 | |
| Lablolly Pine | 61 | 111 | 28 | |
| Slash Pine High Gum Yielders | | 16 | | |
| Union Camp Carparation— | | | | |
| Georgia Forestry Cammission | | | | |
| Slash Pine | 64 | | | |
| Tennessee Valley Authority— | | | | |
| Geargia Forestry Cammission | | | | |
| Shortleaf Pine | | 27 | | |
| Virgina Pine | | | | 25 |
| White Pine | | | | 15 |
| TOTAL | 192 | 301 | 84 | 40 |

[1]Same clones used in more than ane archard.

TABLE 3

## NUMBER LIVING RAMETS, NOVEMBER, 1966, IN GEORGIA FORESTRY COMMISSION SEED ORCHARDS BY SPECIES

| Species | ORCHARD | | | | |
|---|---|---|---|---|---|
| | Horseshoe | Arrowhead | Davisboro | Hightower | Total |
| Slash | | | | | |
| Georgia Forestry Commission | 5,041 | 10,628 | 1,554 | | 17,223 |
| Georgia Forestry Commission— Union Camp Corporation | 5,145 | | | | 5,145 |
| Georgia Forestry Commission— Naval Stores | | 1,475 | | | 1,475 |
| Loblolly | 5,091 | 5,773 | 839 | | 11,703 |
| Eastern White Pine | | | | 370 | 370 |
| Shortleaf Pine | | 368 | | | 368 |
| Virginia Pine | | | | 247 | 247 |
| TOTAL | 15,277 | 18,244 | 2,393 | 617 | 36,531 |

TABLE 4

## SEED YIELD RECORD

| Year | Species | Total Pounds Seed |
|---|---|---|
| 1966 | Slash | 131 |
| | Loblolly | 393 |
| 1965 | Slash | 458 |
| | Loblolly | 427 |
| 1964 | Slash | 408 |
| | Loblolly | 264 |

[1]Decrease due to damage caused by ice storm

TABLE 5

## LIVING GRAFTS ESTABLISHED BY YEAR

| Year | Slash | Loblolly | Shortleaf | White Pine | Virginia Pine | Total |
|---|---|---|---|---|---|---|
| 1955 | 281 | 302 | | | | 583 |
| 1956 | 718 | 175 | | | | 893 |
| 1957 | 2,484 | 1,192 | | | | 3,676 |
| 1958 | 618 | 157 | | | | 775 |
| 1959 | 1,613 | 1,024 | | | | 2,637 |
| 1960 | 2,359 | 1,453 | | | | 3,812 |
| 1961 | 2,598 | 910 | | | | 3,508 |
| 1962 | 2,612 | 2,002 | | | | 4,614 |
| 1963 | 4,752 | 2,453 | | 163 | | 7,368 |
| 1964 | 4,242 | 1,426 | | 144 | | 5,812 |
| 1965 | 1,566 | 609 | 368 | 63 | 247 | 2,853 |

TABLE 6

## IMPROVED SEEDLING PRODUCTION BY YEAR

| Planting Season | Species | | |
|---|---|---|---|
| | Slash Pine | Loblolly Pine | Total |
| 1964-65 | 257,000 | 321,000 | 578,000 |
| 1965-66 | 1,781,000 | 1,114,000 | 2,895,000 |
| 1966-67 | 3,288,000 | 3,506,000 | 6,794,000 |
| | | | 10,267,000 |

# Glossary

*Breeding*—The science of systematic genetic improvement of a species.

*Clone*—A group of plants derived from a single individual (ortet) by vegetative propagation.

*Controlled Pollinating*—Transferring pollen of a known source to receptive female flowers to the exclusion of all other pollen.

*Cutting*—Detached portion of stem, root, or other plant part used for producing a whole new plant by vegetative propagation.

*Elite*—Verified, by appropriate progeny testing, as a desirable or superior clone.

*Genetics*—The basic science dealing with the causes of variations among plants or animals related by descent.

*Grafting*—Uniting parts of plants by matching their cambial tissue so that union and growth can occur.

*Improved*—A non-technical term referring to forest tree seedlings grown from open pollinated seed from selected trees.

*Graft Incompatibility*—A failure or partial failure in the graft union leading to malfunction of vital processes necessary for normal plant growth.

*Isolation*—The prevention of breeding among populations or individuals occurring in a population.

*Pollination*—The transfer of pollen to the receptive part of the female flower.

*Progeny Test*—Evaluation of the breeding value of parents by suitable comparisons among their offspring.

*Ramet*—An individual member of a clone.

*Resistance*—Relative ability to survive pests or other damaging influences.

*Roguing*—Systematic removal of undesired individuals from a population.

*Rootstock*—The root-bearing plant or plant part, usually stem or root, onto which another plant is grafted.

*Scion*—Any aerial plant part, often a branchlet, that is grafted onto the root-bearing part of another plant.

*Seed Orchard*—A plantation consisting of clones or seedlings from selected trees, isolated to prevent pollination from outside sources, and cultured for early and abundant production of seed for reforestation.

*Selection*—The choosing of specific desirable plants in a given population. They are propagated by man to produce improved strains.

*Superior*—A non-technical term referring to selections which appear or have been proved outstanding.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