SHOULD SLASH PINE SEED ORCHARDS BE MOVED SOUTH FOR EARLY FLOWERING?

Charles R. Gansel[1/]

Abstract. --In two slash pine seed source study plantations, trees from northern sources produced cones earlier than those from southern sources. As the plantations increased in age, more southerly sources started cone production. Conelet production 11 years after planting was considerably greater in the south Florida plantation than in the north Florida plantation (20.4 versus 0.5 conelets per tree) even though the trees in the former were on the average 8 feet shorter. Multi-whorl conelets were common in south Florida but not in the north. Significant differences in number of conelets occurred both among seed sources and families within seed sources. Tenth-year heights and 1973 conelet production in the south Florida plantation were significantly correlated ($r = 0.38$). Within plantings, taller trees generally produced more cones.

Additional keywords: Pinus elliottii Engelm., site effects, conelet production, racial variation.

Seed orchard managers are wondering why some of their orchards are producing heavy cone crops while others of the same age are not. Racial variation studies may provide a partial answer to this question. The objective of this study was to determine what effect planting site and seed source have on early cone production of slash pine (Pinus elliottii Engelm.).

Information in the literature on this subject is very limited. Boyer and Evans (1967) reported that early flowering in longleaf pine (P. palustris Mill.) may be influenced by seed source. Wells and Wakeley (1970) found well-defined patterns of variation in degree of early cone production in shortleaf pine (P. echinata Mill.). The large seed source study of slash pine described by Squillace (1966) provided an excellent opportunity for studying the effects of planting site and seed source on early flowering.

PROCEDURE

Seed Sources and Planting Sites

Progeny from 53 slash pine seed sources are represented in the racial variation study (fig. 1). It samples the entire natural range of slash pine from Georgetown, South Carolina to the tip of the Florida peninsula and westward to New Orleans, Louisiana. At each source, seed were collected from 5 trees and kept separate by mother tree. Seedlings were grown at Olustee and established in four plantations in 1962. The plantations are located in Bleckley County, Georgia; Baker and Collier Counties, Florida; and Harrison

[1/] Associate Plant Geneticist, USDA, Forest Service, Southeastern Forest Experiment Station, Olustee, Florida, 32072.

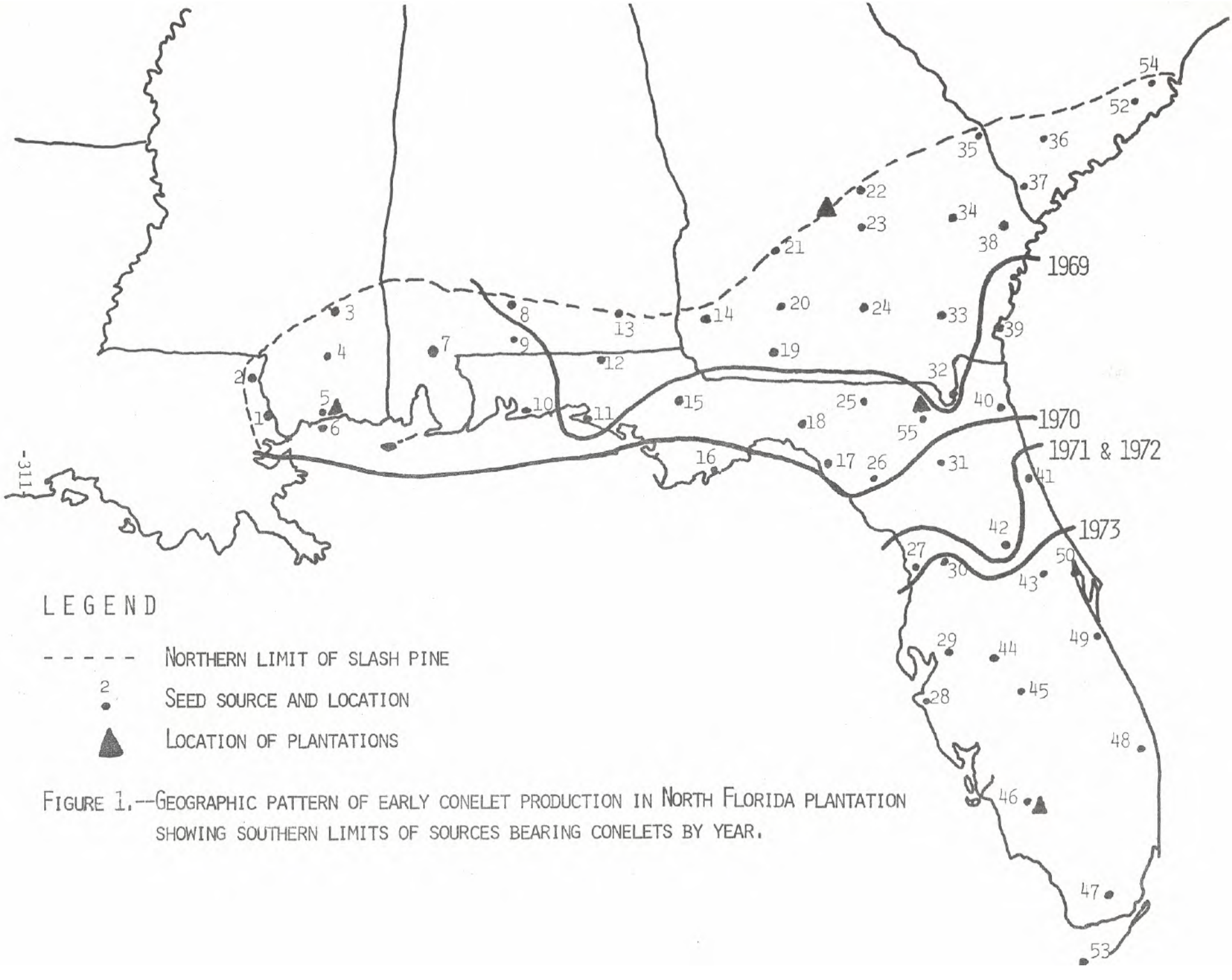


FIGURE 1.--GEOGRAPHIC PATTERN OF EARLY CONELET PRODUCTION IN NORTH FLORIDA PLANTATION SHOWING SOUTHERN LIMITS OF SOURCES BEARING CONELETS BY YEAR.

County, Mississippi. A complete description of the study was presented by Squillace (1966). Information on early flowering reported here was obtained from the two Florida plantations.

Measurements and Analysis

Conelet counts were first made in the Baker County plantation in 1969, 7 years after outplanting when the trees first started flowering. Counts were made in the spring after the new shoots had elongated but before the new needles obscured the conelets. The conelets were highly visible at this time. Subsequent counts were made annually for 5 years. A total of 2,131 trees were observed in the Baker County plantation. Conelet counts were made in the Collier County plantation in the spring of 1972 and 1973. A total of 1,875 trees were observed in this plantation.

The data were analyzed using an analysis of variance for a hierarchial design with unequal numbers of trees per family and families per source (Snedecor 1956, p. 271). A correlation analysis using family means was used to determine if early cone production and height were correlated.

RESULTS

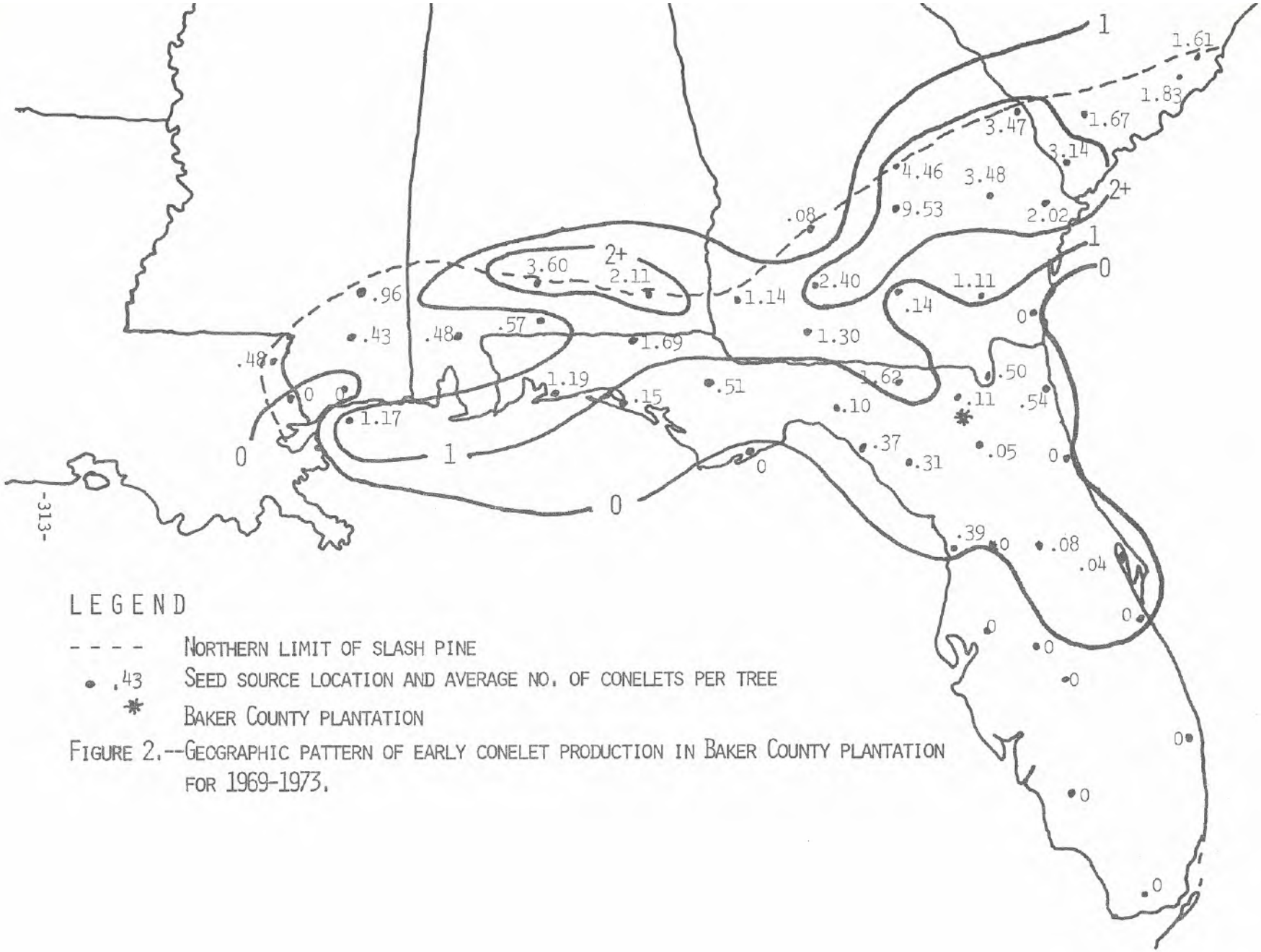
Genetic variation in early cone production in the 11-year-old slash pine seed source study was very evident. In the north Florida plantation, trees from the more northerly sources were the first to produce cones. As the trees grew older, more southerly sources started cone production (fig. 1). After 5 years, the most southerly source flowering was Citrus County. Average numbers of conelets per tree by source for the first 5 years of production are presented in Figure 2. The geographic pattern for conelet production was similar to that found for height growth (Gansel et al. 1971).

Conelet production in the south Florida plantation for 1972 and 1973 is presented in Figure 3. Geographic patterns are not the same as that found in the north Florida plantation. A coastal effect was evident, with production being generally lower for sources near the coast and increasing inland. Conelet production per tree by source and distance from the coast were correlated ($r = .50$). Even the more southerly sources are producing conelets at a younger age.

The average number of conelets produced by year for both plantations is presented in Table 1.

The 1973 conelet production and 10th year heights by family in Collier and Baker Counties were correlated ($r = .38$ and $r = .18$, respectively). Even though the correlation is not very strong, the taller trees generally produced the most cones. Double whorls of conelets were common in the south Florida plantation but absent in the Baker County plantation.

An analysis of variance was run on the Collier County plantation data and is presented in Table 2.



LEGEND

- - - - NORTHERN LIMIT OF SLASH PINE

• .43 SEED SOURCE LOCATION AND AVERAGE NO. OF CONELETS PER TREE

* BAKER COUNTY PLANTATION

FIGURE 2.--GEOGRAPHIC PATTERN OF EARLY CONELET PRODUCTION IN BAKER COUNTY PLANTATION FOR 1969-1973.

Table 1.--Average conelet production per tree for the Florida plantations

Year	Baker County plantation	Collier County plantation
	Conelets per tree (number)	
1969	.03	not counted
1970	.22	"
1971	.08	"
1972	.37	3.58
1973	.47	10.38

Table 2.--Analysis of variance for conelet production in the Collier County plantation in 1973.

Source of variance	df	MS[a/]	Components
Seed source	49	585.76*	$\sigma_w^2 + n_o A\sigma^2_m + (nb)_o\sigma^2_s$
Mother tree/source	171	393.90**	$\sigma_w^2 + n_o B\sigma^2_m$
Trees/mother/source	1654	213.12	σ_w^2

/ * Significant at 0.05 level
** Significant at 0.01 level

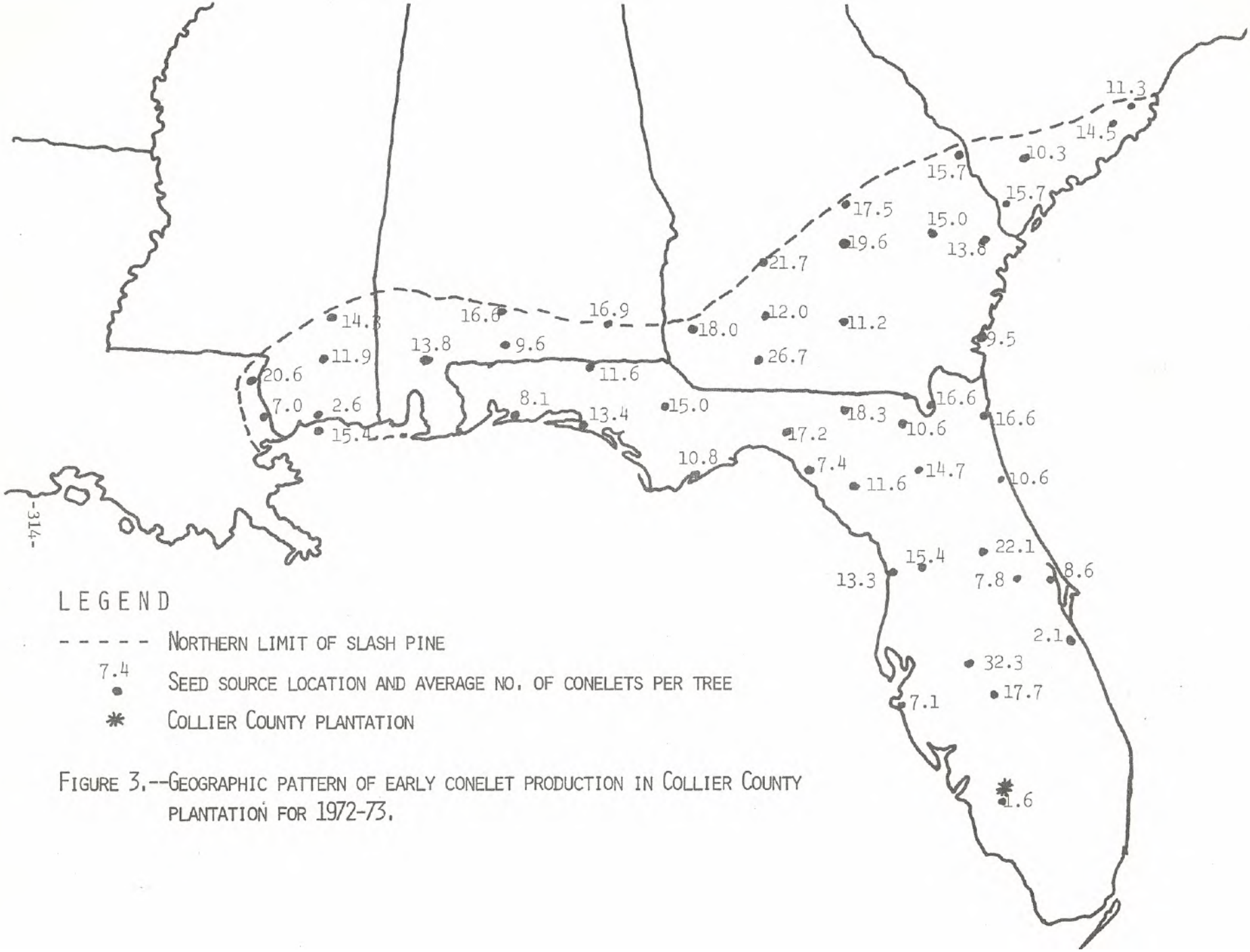
$\sigma_m^2 = 21.41$ $\sigma_s^2 = 5.02$ $\sigma_w^2 = 213.12$

Seed sources were significantly different at the 0.05 level while family differences were significant at the 0.01 level. The component of variance iue to family was 4 times greater than that for source.

In addition to the genetic effects, we also have a large site effect. The site effect is largely responsible for the much greater overall production of the south Florida plantation, which produced 10.4 versus 0.5 conelets per tree in 1973. The trees were approximately 30% shorter in the Collier County plantation (19 versus 27 feet) at the time of the 10th year measurements in 1972.

Application of Results

The first thing one may conclude from the results is that slash pine seedling seed orchards planted in the southern part of the species range will produce more conelets earlier on smaller trees than those planted in the



LEGEND

- - - - - NORTHERN LIMIT OF SLASH PINE

7.4 • SEED SOURCE LOCATION AND AVERAGE NO. OF CONELETS PER TREE

* COLLIER COUNTY PLANTATION

FIGURE 3.--GEOGRAPHIC PATTERN OF EARLY CONELET PRODUCTION IN COLLIER COUNTY PLANTATION FOR 1972-73.

northern part of the range. However, before moving all our seed orchards south, remember that in this study conelets were counted, not mature cones full of seed. Also, we must remember that seedlings rather than grafts were used in this study. Orchards composed of vegetative propagules may or may not show the strong planting site effect reported here. A large percentage of conelets never develop into mature cones. There are numerous pitfalls in cone and seed development. Some pertinent questions to be considered are: How does seed set in the northern seed orchards compare with that in the south? What happens to flowering synchronization when trees are moved long distances to adverse sites? Is strobili receptivity still synchronized with pollen shedding? Will cone production in the northern plantation overtake production of the southern plantation in time? These questions should raise the caution sign.

What advantages are possible by moving seed orchards southward?

1. Potential for heavier and earlier cone production.

2. Elimination of damage from snow and ice storms.

3. Tender conelets and pollen less likely to be damaged by late hard frosts.

4. Reduced fusiform rust damage in the seed orchards.

5. Possibility of less outside pollen contamination in the orchard because flowering is not synchronized with the native population.

With all these potential advantages the possibility of moving seed orchards southward should not be overlooked.

LITERATURE CITED

Boyer, W. D. and Evans, S. R. 1967. Early flowering in longleaf pine related to seed source. Jour. of Forest. 65: 806.

Gansel, Charles R., Brendemuehl, R. H., Jones, Earle P., Jr., and McMinn, James W. 1970. Seed source effects in 5- and 10-year-old test plantings of slash pine in Georgia and Florida. Forest Sci. 17: 23-30.

Snedecor, George W. 1956. Statistical Methods. 534 p. The Iowa State Univ. Press.

Squillace, A. E. 1966. Geographic variation in slash pine. Forest Sci. Mongr. 10, 56 p.

Wells, Osborn O. and Wakeley, Philip C. 1970. Variation in shortleaf pine from several geographic sources. Forest **Sci.** 16: 415-423.