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ResearchNote

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Strobili and Conelet Losses In Four Species Of Southern Pines

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SUMMARY

In a central Louisiana seed orchard, 27,677 female strobili were tagged on selected clones of 4 pine species (lobloiiy, slash, shortleaf, and longleaf) over 4 years. Only 41 percent developed into cones. Losses were tallied by date and, when possible, by cause.

For lobloiiy, differences in losses were significant between years but not among clones. For slash there were significant differences both among clones and between years. Shortleaf showed no significant differences among clones or between years, but there were consistently higher losses for both shortleaf and iongieaf than for iobioiiy and slash.

Insects were the largest single identifiable cause of mortality. Losses were greatest in early spring. Damage from birds, mechanical breakage, or weather was minimal. The only weather that caused any large loss was a hailstorm that caused a 20-percent loss of shortleaf coneiets and strobiii in 1974. If losses in the missing, unknown, and aborted stage-l categories are included with known insect depredations, over 98 percent of ail losses can be attributed to insects.

Additional keywords: cone insects, *Pinus palustris, Pinus taeda, pinus elliottii, Pinus echinata.*

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THE PROBLEM

The loss of female strobili, conelets, and cones[1] from southern pines is an important problem for seed orchard managers charged with producing genetically improved seed. This study was initiated in 1971 to learn what agents are responsible for the losses, when the losses occur, and how losses differ among species.

METHODS

Grated trees, established at 15 x 30 foot spacing, in the Stuart Seed Orchard near Pollock, La., were used in the study. The trees were 6 years old in 1971. Loblolly (*Pinus taeda* L.) and slash (*P. elliottii* Engelm. var. *elliottii*) trees were about 20 feet tall, and shortleaf (*P. echinata* Mill.) and longleaf trees (f? *palustris* Mill.) were 10 to 15 feet tall. Loblolly trees had been producing female strobili for 2 or 3 years, but the slash had produced few strobili. Shortleaf and longleaf did not produce sufficient strbbili for inclusion in the study until 1973. The orchard consisted of 50 clones each of Texas and Louisiana loblolly, Louisiana slash, Texas and Louisiana shortleaf, and Texas and Louisiana longleaf.

All female strobili were counted and observed on two loblolly trees from each of 10 clones that were high, medium, and low producers of female strobili in January 1971. A tally of all female strobili was repeated on the same trees in 1972. In 1973, however, strobili were tagged on only one tree in each clone because of increased production and inclusion of other species.

Only three slash clones had enough strobili for study purposes in 1971, and all female strobili on two ramets of each clone were tagged in early February. In January 1972 and 1973, two ramets from each of seven additional clones were added to the study.

In March 1973 and 1974, all female strobili on a single tree from each of 10 Texas shortleaf clones were counted and tagged.

All strobili were tagged on two trees from each of 10 Texas longleaf clones in March 1973, and repeated on the same trees in late February 1974.

Observations of strobili and conelet mortality were made from January 1971 until October 1975. All female strobili were tagged and counted each year. For all species each year, inspections were made at 1- to 3-week intervals during spring and early summer, and every 1 to 3 months during the rest of the year. Conelets were picked as they died and examined in detail to determine cause of death. Losses were tallied by date and, when possible, by cause? In some instances death could be attributed to a specific insect because of the type of damage done or presence of the insect. Many times, however, strobili suffered feeding damage or punctures that could not be attributed to a specific insect. In these cases, losses were tallied as "caused by unknown insects." Cones were harvested and counted in the fall of each year. Healthy and some insect-damaged strobili and conelets were picked from trees not in the study for microscopic examination from 1971-75.

RESULTS

Of 27,677 strobili tagged over the 4 years, only 11,303 (41 percent) developed into apparently sound cones. Losses varied widely among species and years. Losses in 1973-74 were significantly higher for loblolly, slash, and longleaf than for any other year in which observations were made.

Insects were a major cause of mortality. Species identified in the orchard that are known predators (Ebel, et al., 1975) were thrips (*Gnophothrips fuscus*), tip moth (*Rhyacionia frustrana*), looper (*Nepytia semiclusaria*), May beetles (*Phyllophaga* spp.), coneworms (*Dioryctria* spp.), cone borers (*Eucosma* spp.), midges (family Cecidomyiidae), seedworms (*Laspeyresia* spp.), and seedbugs (*Leptoglossus corculus* and *Tetyra bipunctata*). Microscopic examination of healthy conelets also revealed the presence of large numbers of mites in many instances, of which the most prevalent were Tyediids and some Tarsonemus.

Losses were usually greatest in early spring, immediately before, during, and shortly after pollination (fig. 1). Typically, at that time, strobili became discolored at their distal end, usually died within 2 or 3 days, and were promptly shed.

[1] In this paper, female strobilus applies to the reproductive bud from the time it becomes visible until pollination. Conelet refers to this structure from pollination until it starts enlarging in the second year; thereafter, the term cone is used.

[2] Assistance in identification of insects was obtained from D. R. Kucera and N. A. Overgaard of the Southeastern Area of State and Private Forestry.

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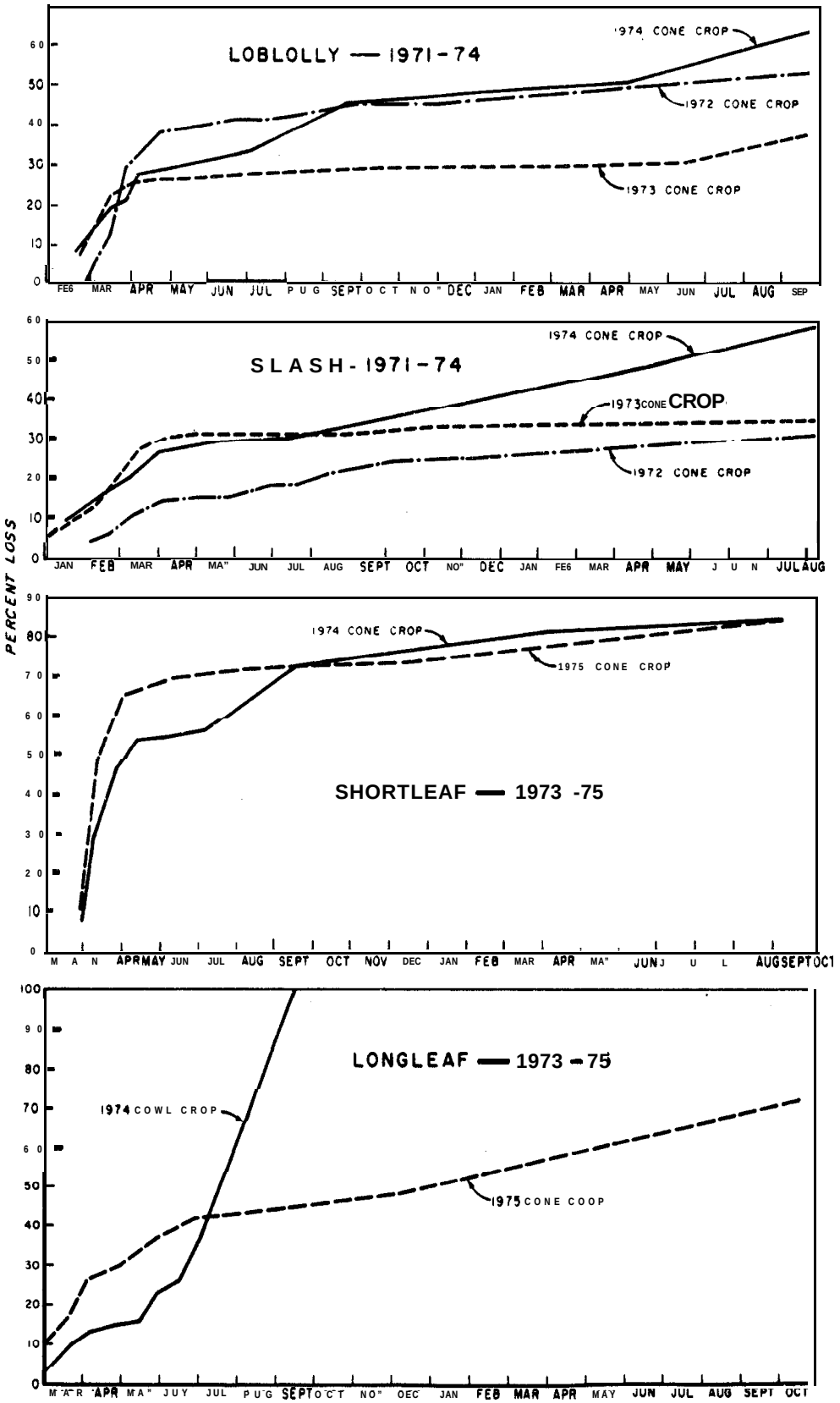

Figure 1. *-Losses of lob/o//y, slash, short/eat, and* ***longleaf strobili*** *and* ***conelets*** *by month.*

Figure ***P.-Puncture mark on scale of loblolly strobilus. White dots are pollen grains.***

When larvae were not present, it was not always possible to ascertain which insect was responsible. Microscopic examination often showed puncture marks in the scales of living strobili (fig. 2), but marks were not detectable after strobili had withered and died.

Loblolly

Insects were the most common cause of death, with known mortality rates of at least 30 percent. Estimates of mortality attributed to insects are conservative since strobili and conelets were picked from trees and brought into the laboratory for microscopic examination as soon as they died. The conelets often contained larvae that may have killed other strobili had they remained on the trees. Mortality in the "presumed insects" category ranged from 12 to 30 percent. In such cases, it was impossible to determine the predator, since it was not present, but tip moths, Dioryctria, loopers, and midges were suspects.

Stage-l buds are often no larger than the point of a pencil and are difficult to see, so the 2-percent loss for loblolly in 1971 tallied as aborted stage-l is probably low. Not as many were tagged in 1.971 as in subsequent years, because of inexperience. Losses of 9 percent in 1972 and 13 percent in 1973 were recorded.

Destruction of conelets by birds perching on young, succulent leaders bearing female strobili was negligible (table 1). Other mechanical losses resulted from branches breaking during mowing or inspection.

No consistent pattern in conelet mortality existed among the 10 loblolly clones, that is. individual clones did not have high losses or low losses in consecutive years, and regression analyses did not indicate correlations between years. An analysis of variance showed no significant differences among clones, although differences between years were significant.

Slash

Losses of slash strobili and conelets ranged from 31 percent in 1971-72 to 59 percent in 1973-74 (table 1). Percentages in 1971-72 would have been higher, because although stage-l abortions occurred, they were not tallied. Insects were a major cause of losses. *Dioryctria* was the most destructive of the known insect predators. As with loblolly, however, unidentified insects caused the greatest losses.

There was a tendency for losses to be greater from some slash clones than from others. When clonal data from 1972-73 were compared with 1973-74 data, the r value of 0.649 was significant. An analysis of variance showed significant differences among clones and between years.

Shortleaf

Shortleaf strobili and conelet mortality averaged 84 percent for two successive crops, 1973-74 and 1974-75 (table 1). Missing conelets and unidentified insects accounted for most losses. Of the known insects, *Dioryctria* and *Phyllophaga* were the most damaging and together caused a loss of 4 percent in 1973-74 and 20 percent in 1974-75. The only significant losses attributed to agents other than insects were caused by a hail storm in April 1974. Twenty percent of the shortleaf strobili were lost when hail broke leaders bearing strobili.

Losses did not differ significantly among clones or between years but were significantly higher than for loblolly and slash.

Longleaf

The highest percentage loss (>99 percent) for all species occurred with longleaf in 1973. In that year, only one conelet remained in September of the 1,027 female strobili tagged 7 months earlier.

Table . -Losses *of* strobili *and conelets by species and year*

Cause of loss	Loblolly			Slash			Shortleaf		Longleaf	
	1971-72	1972-73	1973-74	1971-72	1972-73	1973-74	1973-74	1974.75	1973.74	1974.75
	Percent									
Aborted stage-l	2	9	13	--	8	14	a	5	5	5
Dioryetria	*3*	10	*20*	--	*2*	*20*	*3*	*9*	*7*	*33*
Phyllophaga	..	1	2	..	..	..	< 1	11	--	1
Tip moth	..	..	..	..	..	—	3	1	..	..
Presumed insects	30	12	16	15	16	9	39	18	57	16
Unknown	9	< 1	--	4	2	..	—	—	11	--
Missing	8	5	12	9	6	15	28	19	19	10
Mechanical breakage	< 1	< 1	< 1	3	< 1	< 1	1	1	< 1	1
Birds	< 1	< 1	< 1	–	< 1	< 1	< 1	< 1	< 1	–
Hail	..	..	..	..	--	..	..	20	--	6
Total	53	38	64	31	35	59	84	84	> 99	72
(No. strobili observed)	1,876	8,240	5,787	209	1,621	2,330	2,083	4,170	1,029	334

[1] Dash (-) indicates *no* data rather than 0.

Longleaf conelet losses in 1973 were greatest in July and August, but in 1974 most losses occurred in the spring, as was found with the other species. *Dioryctria* was the primary predator in both years. Again, substantial losses occurred in the unknown, missing, and "presumed insect" categories.

Hail killed 6 percent of the longleaf strobili in 1974. Aborted strobili accounted for 5 percent of the losses in both years,

DISCUSSION

Although it is not certain, most losses in the missing, unknown, and aborted stage-l categories were probably caused by insects. If these losses are included with known insect depredations, over 98 percent of the losses incurred can be attributed to insects. DeBarr and Ebel (1974), DeBarr and Barber (1975), and Ebel and Yates (1974) have previously recorded high losses of conelets caused by insects. In view of the major role insects appear to have in conelet losses, periodicity of cone crops may be related to cycles of insect populations.

In earlier years of seed orchard management, weather was often blamed for losses of female strobili and conelets. Although freezes and extended periods of dry or wet weather can be responsible for losses, hail was the only weather condition that caused losses in this study. In 1971, slash strobili withstood a temperature of −6° C shortly after pollination without harm, and receptive loblolly strobili were unharmed by a temperature of −4° C.

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