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Pine Seed and Seedling Depredations by Short-Tailed Crickets[1]

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ABSTRACT

Anurogryllus muticus De Geer forage pine seeds and newly germinated seedlings, but they prefer succulent grasses and forbs when available. Populations high enough to cause serious losses are rare, and control measures are not justified.

For reforestation, southern pine seeds are often sown directly on the ground in lieu of planting seedlings from a nursery. Losses of seeds and newly germinated seedlings to predators are major problems, however, and much research has been done to reduce these losses. Seeds and seedling fragments were found in the burrows of short-tailed crickets, *Anurogryllus muticus* De Geer, by Russell (1958), and he attributed to the insect heavy losses of seedlings of slash pine, *Pinus elliottii* Engelm. But Russell did not fully evaluate the probable impact of crickets on direct-seeding success. The present paper reports the results of 7 studies made between 1964 and 1968 to determine the extent of damage by short-tailed crickets on direct-seeded areas.

This burrowing insect is found in the United States along the Atlantic and Gulf Coasts from New Jersey to Texas (Blatchley 1920, p. 690–2). Caudell (1904) reported damage to agricultural crops in Louisiana as early as 1852. He suggested also that the insect probably lives in colonies, but little was known about the life cycle and habits in Louisiana until Weaver and Sommers (1969) reported on their studies.

A. muticus constructs an elaborate underground burrow with major cavities and storage tunnels (Fig. 1). A small mound of pelletized soil around the surface opening marks a newly constructed or recently enlarged burrow (Fig. 2). Since these mounds are readily eroded by rain, they are inconspicous unless soil has been recently excavated.

The highest population found by Weaver and Sommers (1969) was 9000 active burrows/acre, but this aggregation covered only 1.5 acres. Finding concentrations of 3000 or more/acre and covering up to 3 acres required diligent searches. Populations on preferred habitats averaged 1000–2000 crickets/acre. The short-tailed cricket in central Louisiana seemed to prefer open areas with a grass rough less than 3 years old—heavily grazed, recently burned, or lightly cultivated—where tender vegetation emerged in early spring. The largest populations were found on Ruston soils with good internal drainage, although some occupied wet, heavy soils with poor drainage.

PROCEDURES, OBJECTIVES, AND RESULTS.—Since procedures varied by study, methods and results of each of the 7 studies are reported separately.

Study 1.—Field observations had indicated repellent coating applied to seeds for protection against birds, rodents, and insects was lethal to short-tailed crickets. Three laboratory tests were made to determine how many treated seeds could be handled by the insect before it was affected and how long it took for death to occur. The tests were made with crickets confined

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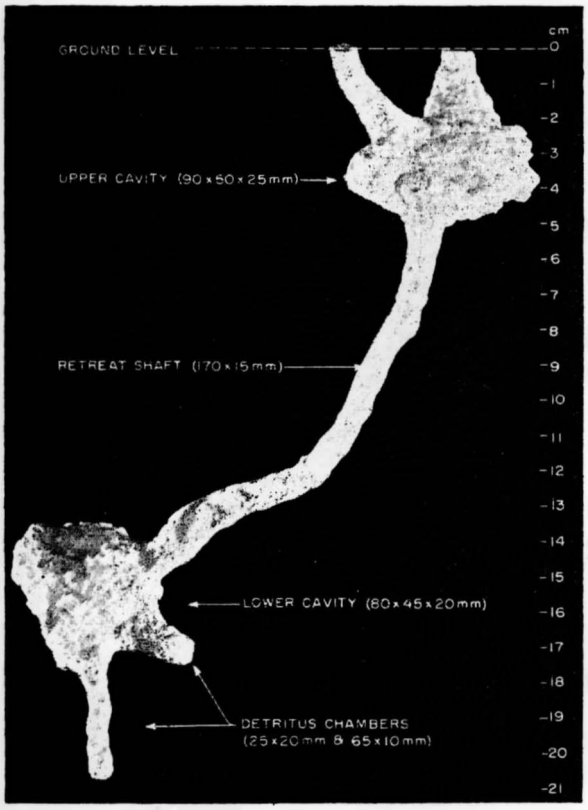

FIG. 1.—Bioplastic casting of a typical field burrow excavated by a mature cricket.

individually in plastic containers filled with soil. After small burrows had been constructed by the insects, 25 treated slash pine seeds were placed on top of the soil. Seeds were coated with a formulation of 2 gal thiram[4] (Arasan 42-S), 2 lb endrin 50 WP, and 11 fluid oz latex sticker per 100 lb dry, unstratified seed (Derr 1963).

Crickets were observed carrying seeds in their mandibles, and handling 2 or more was lethal in 24–48 hr. But each of the 38 crickets carried 2–15 seeds to its burrow before dying. Therefore, a relatively small cricket population has the potential of removing in a short time a large proportion of the seeds sown on an area.

Study 2.—Seed losses were measured for 100 days around 150 cricket burrows in the field. Surface vegetation was scraped away from ½ the burrows, and entrance holes were covered individually with wire cages. The cages measured 45×32×20 cm and were made of 4-mesh hardware cloth. They excluded birds and rodents but not insects. The other ½ of the burrows were not scraped or caged. Fifteen repellent-treated seeds of loblolly pine, *P. taeda* L., were placed around each of the 150 burrow entrances on Feb. 27, 1964. Crickets were presumed responsible for all seeds that disappeared from within the enclosures. Their depredations around open burrows were estimated by carefully excavating 7 burrows every 2 weeks and retrieving the contents.

An average of 4.88 seeds/caged burrow (32.5%) were taken in the 1st 18 days after sowing. Losses declined rapidly after that because of cricket mortality from endrin in the seed coating. In 100 days, 40.0% of the ungerminated seeds and another 3.2% in the form of newly germinated seedlings had disappeared.

Excavation of 56 uncaged burrows yielded an average of only 0.9 seeds and 0.7 germinated seedlings/

[4] This paper reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State or Federal agencies before they can be recommended.

FIG. 2.—Each mound of freshly excavated soil is over an entrance into the upper cavity of a common burrow. Note cricket on larger mound.

burrow. Losses would probably have been slightly greater if none of the burrows had been excavated until the end of the study.

Study 3.—This test evaluated losses of repellent-treated seeds around 38 burrows and untreated seeds around 37 burrows. Entrances were scraped and caged as in Study 2. Each burrow had 15 seeds and no alternate food. Losses were recorded for 38 days, from Apr. 9 to May 17, 1965.

Four days after sowing took place, an average of 45.3% of treated seeds (6.8) and 34.7% of untreated seeds (5.2) had disappeared. Ten burrows with heaviest losses of treated seeds were excavated. All 10 crickets were dead, but each had taken from 11 to 15 seeds into its burrow.

Total losses at the end of the test were 79.1% of the treated seeds and 62.7% of the untreated seeds. The remaining burrows were excavated, and nearly all missing treated seeds were recovered; 25 crickets were dead and 3 could not be found. About 8% of the untreated seeds missing from around 37 burrows could not be accounted for and probably had been eaten by the crickets. But from 8 to 13 seeds were recovered from each burrow. No mortality was noted among crickets foraging untreated seeds.

Study 4.—This test was similar to the 3rd one, 38 burrows with treated seeds and 37 with untreated seeds, except entrances were not caged, and vegetation was left in place to provide an alternate food. The pattern of seed losses was about the same as in Study 3, but overall depredations were slightly higher. About 83% (12.5) treated and 74% (11.1) untreated seeds disappeared. Here too most losses occurred in the 1st 3 days. Most of the missing treated seeds were recovered from cricket burrows, but only about ½ the missing untreated seeds were recovered. Predators other than crickets probably acounted for some of the losses. Thirty of the 38 crickets foraging treated seed were found dead, 1 was alive, and 7 were missing. Only 1 cricket taking untreated seeds was dead. Although a few were missing, most were still living in their burrows.

Study 5.—This study measured the impact of a large population of short-tailed crickets on slash pine seedling establishment by direct seeding. Ten 0.1-acre plots were situated so that each had at least 300 active burrows. Populations ranged from 312 to 897 per plot. The overall average was 589, or 5890 burrows/acre; untreated plots averaged 550 each. Plots were then paired by proximity (they were not contiguous), and crickets were eradicated from 1 plot of each pair by spraying a formulation of 5 oz heptachlor (25% EC) in 5 gal of water on the plot surface. A followup treatment, one week later, was 10 tbsp of carbaryl (50 WP) in 5 gal of water. This method killed the target species, but it also killed other insect predators of seeds and seedlings, possibly influencing results. Plots were seeded Mar. 17, 1966, at a rate of 1¼ lb (about 18,000) of repellent-treated seeds/acre. Seed losses and seedling establishment were estimated from sixteen 1-milacre subplots on each plot.

Approximately 55% of the seeds, or 11.8/milacre, had disappeared by the time germination was complete. Losses on unsprayed plots were slightly higher than on sprayed plots (14.0 vs. 9.7), but the difference was not statistically significant at the 0.05 level. Since no burrows were excavated, the exact total taken by crickets is not known.

Established seedlings were inventoried late in June, after cricket damage normally has stopped. Stocking was significantly higher (0.05 level) on treated than on untreated plots, 9060 as compared with 6710 seedlings/acre. Clipping and disappearance of seedlings accounted for 82% of the difference. While 1200 seedlings/acre were clipped and another 720 disappeared on untreated plots, only 137 were clipped and 275 were missing on treated plots. Some seedlings were undoubtedly destroyed by nontarget insect species, but most of the damage was attributed to crickets. These results show that 5500 crickets/acre are detrimental to seedling establishment.

Study 6.—Seedling establishment on areas with and without crickets was compared, much as in the previous study, but instead of spraying the entire plot, crickets were eradicated by injecting an insecticide directly into the burrows. Presumably the treatment did not affect most other insects on the plot. In addition, a poisoned-bait method of cricket control was tested, and a higher sowing rate was tried to determine if it would offset losses to cricket. The study area had an average of 5000 crickets/acre. The 4 treatments were:

1. Check—crickets undisturbed.
2. Crickets killed—about 5 ml of a heptachlor-water solution was injected into every burrow on treated plots.
3. Toxic bait—a chlordane-albran bait was mixed with treated seed on a 6:1 ratio by weight; the mixture was broadcast uniformly over each treated plot.
4. Increased sowing rate—crickets were undisturbed, and the sowing rate was increased by 25%.

The 4 treatments were installed on 0.1-acre plots in a randomized complete block with 5 replications. Plots in treatments 1, 2, and 3 were sown at a rate of 14,000 repellent-treated slash seed/acre; those for treatment 4 were sown at 18,000/acre. Results were estimated from 16 circular milacre subplots on each treatment plot. Milacres were adjusted to 14 seeds each for treatments 1, 2, and 3, and to 18 for treatment 4.

Seed losses ranged from 3.0/milacre on injected plots to 5.6 on those receiving the high sowing rate. Losses on plots sown with toxic baits as well as seeds averaged 3.7, while those on the control plots averaged 4.5 seeds/milacre. Depredations from plots sown at the high rate differed significantly (0.05 level) only from those on cricket-killed plots.

Initial stocking in seedlings per acre averaged 2900 on plots without crickets, 2790 where the toxic bait was used, 2370 on control plots, and 2140 where sowing rates were increased. Since differences between stocking levels were not statistically significant, none of the treatments seemed justified. Seedling stocking did not reflect the differential in seeds available to germinate. For example, it is difficult to explain why the high sowing rate with 12,400 seeds/acre after losses did not produce more trees than the check with 9500 seeds/acre after losses. Both treatments had about the same number of crickets on the plots.

Study 7.—The final study made a 3rd comparison of seedling establishment on plots with and without crickets. However, instead of searching out an extremely high population as in earlier studies, a site was selected with a typical population of about 1000 crickets/acre. There were 5 randomized blocks with 3 plots each. One plot/block was rid of crickets

by individual burrow treatment, 1 was untreated and used as a check, and 1 was untreated and used for periodic burrow excavation. Repellent-coated slash pine seeds were broadcast at a rate of 15,000/acre in late February 1968.

Seed losses on all plots averaged about 17% (2.5 seeds/milacre), and most were listed as missing. Check plots lost 425 more seeds/acre than treated plots, but the difference was not statistically significant. A total of 3 seeds was recovered from 91 excavated burrows.

More important than seed losses were germination failures. About 25% of the seeds sown either failed to initiate germination or started to germinate and aborted before the process was completed.

Seedling losses were due to disappearance, clipping, and mortality, in that order of magnitude. The number that disappeared was greatest on check plots. Crickets may have been responsible—whole seedlings have been found in their burrows—yet in this study only 7 seedlings were recovered from 91 burrows. Losses from clipping were relatively light, but the number for treated plots (329/acre) was more than twice that for untreated plots. This result suggests a predator other than crickets. Less than 1% of the germinated seedlings died.

Seedling establishment was almost identical for the 2 treatments. Check plots averaged 7410 seedlings/acre, and treated plots averaged 7440. This study indicated that 1000 crickets/acre are not detrimental to direct seeding slash pine.

DISCUSSION.—It was established that short-tailed crickets carried pine seeds and seedlings to underground burrows, presumably for food. The repellent coating did not deter them from taking seeds, but carrying only a few was lethal. While a single cricket took as many as 15 seeds in laboratory tests before dying, the average was about 2 seeds/cricket in field tests in which alternate food was available.

Some foraging occurred in January and February in central Louisiana during warm periods, but heavy depredations did not start until late March when minimum daily temperatures were consistently above 50°F. By that time, pine germination was too advanced for intensive seed depredations, but young seedlings were vulnerable to heavy foraging if other foods were scarce. Fortunately, tender grasses and legumes, which constituted the bulk of food found in burrows, had emerged by then. Apparently, crickets preferred these materials to pine seedlings.

In the 3 field studies comparing seedling establishment on plots with and without crickets, the average reduction was 188 seedlings/acre per 1000 crickets. But there was wide variation between studies. On 1 area with 5500 crickets/acre losses were 2350 seedlings; on another with 5000 crickets the stand was reduced by only 530 seedlings/acre.

Cricket populations as high as 9000/acre were found by diligent searching, but these were rare and occurred as small isolated colonies that covered only an acre or two. Gross populations on a favorable habitat averaged 1000 to 2000/acre. Depredations by numbers of this magnitude are not severe enough to warrant control measures.

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