Life History and Habits of the Short-Tailed Cricket, *Anurogryllus muticus*,[1] in Central Louisiana[2]

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ABSTRACT

Adult female *Anurogryllus muticus* (De Geer) were present in burrows from mid-April to early July; adult males lived in burrows for about 1 week in the latter part of April. Eggs were in the burrow for 4 weeks from early May to early June. Most of the nymphs remained in the parent burrow until the female died; dispersal occurred soon thereafter. The external genitalia of both sexes are illustrated.

The short-tailed cricket, *Anurogryllus muticus* (De Geer), is widely distributed throughout the eastern part of the Americas from New Jersey to Bahia Blanca, Argentina (Hebard 1928). Apparently native to the United States, it occurrs mainly along the Atlantic coast from New Jersey to Florida and west into Louisiana and southeastern Texas.

Over much of the South the cricket is at times a serious threat to regeneration of pines by direct seeding (Mann and Derr 1961). Heavy populations may virtually destroy a seeding by foraging seed and clipping needles of newly germinated seedlings. A thiram-endrin-latex seed coating, which is the standard repellent for major bird, mammal, and insect predators of pine seed, is not fully effective against the pest. The insect is killed by the endrin component, but it may carry several seeds into the burrow before it dies.

While Scudder (1894) recorded certain habits of *A. muticus*, a more complete knowledge of its life history and habits is essential for development of practical controls. This paper describes the findings of a 16-month study in central Louisiana, where the cricket is usually abundant.

METHODS

Seasonal development of *A. muticus* was observed from March 1966 to July 1967. Weekly observations were made during spring, summer, and fall, with biweekly observations during winter. In 1967, stages of development were determined and additional data obtained by excavating 10 or more burrows for each observation period with collection of at least 10 perfect specimens of late-stage nymphs or adults. Some nymphs collected in late October 1966 were held indi-

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vidually in 6-dr plastic vials for further study. By comparing development of laboratory specimens with those from field collections, approximate duration of the last 2 instars was determined. Observations from April through June 1967 were made to confirm dates of 1st appearance of adults, eggs, and nymphs, and dispersal of the new brood from data obtained the previous year. Hundreds of burrows were excavated during the study, to ascertain their size and contents. Bioplastic castings were used also to determine extent of burrows (cf. Fig. 4).

LIFE STAGES

EGG.—Eggs are oblong, glabrous, and off-white. They average 2.48±0.18 mm long and 0.97±0.13 mm wide, and range from 1.76 to 2.79 mm long, and 0.59 to 1.18 mm wide.

NYMPH.—The number of nymphal stages was not determined in our study. According to Liebermann (1955) there are 6 instars during the life cycle in Argentina. Major morphological differences between instars are size and development of wingpads. Observations in our study indicate that general body coloration is light brown in all stages. Wingpads were well developed in the last instar. Large specimens in the final instar may attain a body length of 16 mm.

ADULT.—The adult is similar in appearance to the field cricket *Acheta assimilis* F., except that general body coloration is light brown and wings are shorter. Sex ratio is 1:1. The sexes are about equal in size, but wings of the male measure nearly 3 mm longer than those of the female. The fully developed wings are nearly black. Body length ranges from 14 to 17 mm. Absence of the long ovipositor common to other female members of Gryllidae separates this species from other similar appearing forms (Fig. 1). Walker (1928) illustrated what appears to be an adult female with a long ovipositor. The ovipositor of *A. muticus* is scarcely visible and extends only 1 or 2 mm beyond the distal edge of the 9th sternite. Male external genitalia are hidden by the greatly enlarged 9th sternite. Fig. 2 shows ventral aspects of the posterior abdomen and exposed genitalia of both sexes. Hindwings in both sexes do not fully develop. When the cricket first transforms into the adult stage, the wrinkled, whitish hindwings extend for some distance beyond the posterior edge of the forewings (Fig. 1). Usually within 24 hr the hindwings are broken off at the base and eaten.

LIFE HISTORY

The adult female appears in April and the adult male 1 week later (Fig. 3); mating occurs soon afterward. Longevity of adult males in the field was not determined; they occupy the parent burrow for only about 1 week, and are seldom found in burrows after the first of May. In Florida, marked males are known to live up to several weeks in the field after leaving their burrows (T. J. Walker, personal communication). Female adults live 8–10 weeks and can be found in burrows with the new brood up to the 1st part of July. However, most are dead by the end of June.

Only 1 brood is produced per year. Oviposition begins in early May and continues for about 3 weeks. Hatching usually starts during the 3rd week of May, and for a brief time both eggs and nymphs may be found in the burrow. Eggs may be found in a few burrows as late as the 1st week of June.

Nymphs overwinter in the next-to-last instar. The

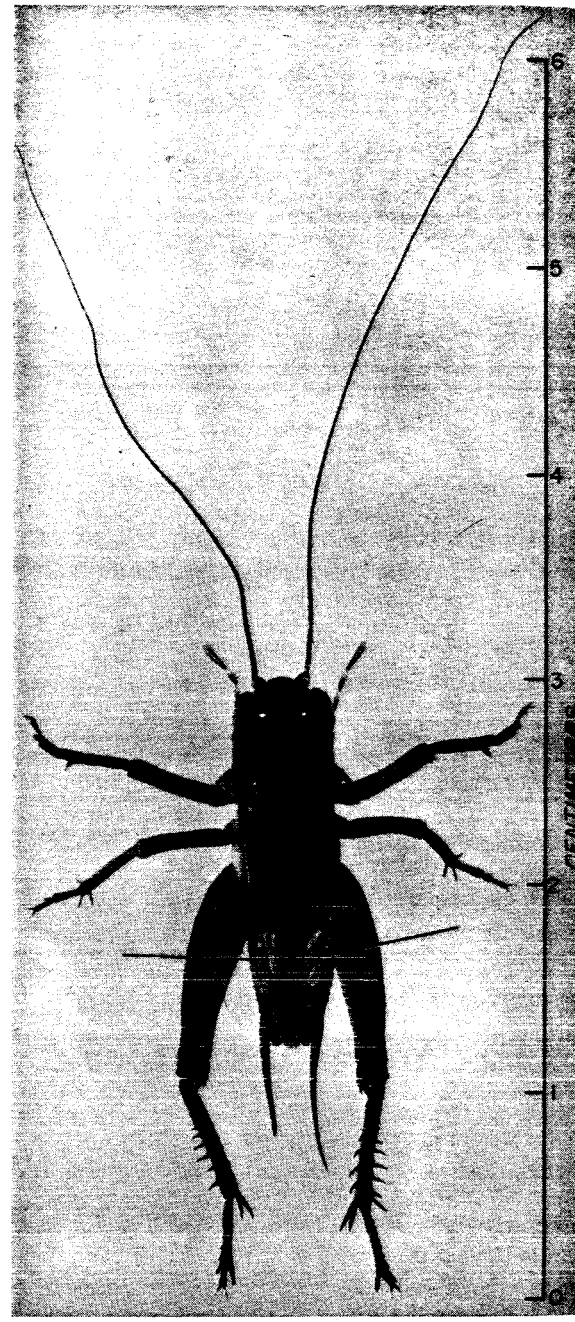

FIG. 1.—Adult female *A. muticus* 12 hr old. Arrows denote whitish, wrinkled hindwings that are later broken off at the base.

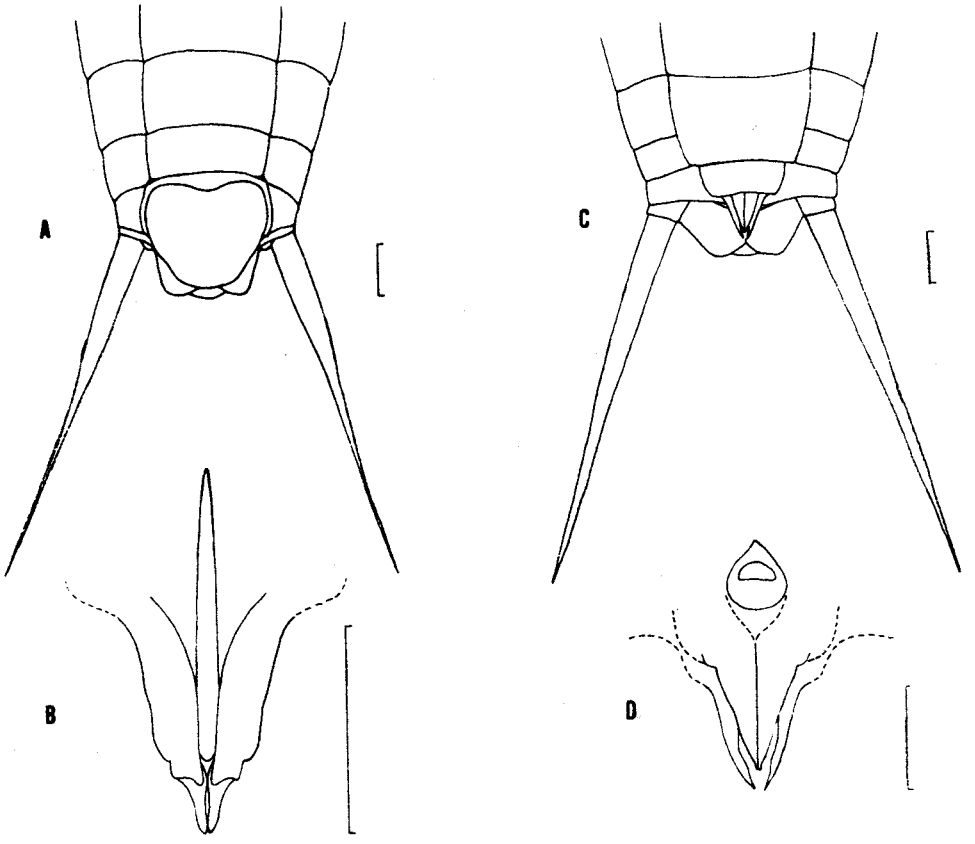

FIG. 2.—Ventral aspect of the posterior abdomen and external genitalia of adult *A. muticus*. A, Male abdomen; B, male genitalia; C, female abdomen; D, female genitalia. Scale = 1.0 mm.

last instar, of short duration, appears about mid-March. Only 1 instance of recent molting was observed in the field, during early October. The newly transformed nymph was comparable in size and appearance to nymphs later determined to be in the next-to-last instar. All nymphs collected from late October 1966 to late February 1967 molted once before transforming into adults.

HABITS

The short-tailed cricket is the only species of Gryllidae that constructs a multichambered burrow (Fig. 4). It does not venture above ground in daylight. Therefore, its present is rarely noticed except when it causes extensive damage to crops or when it excavates and enlarges the burrow. Mounds of the burrows are evident when freshly excavated.

Some heavily infested areas in Rapides Parish, La., have averaged nearly 9000 crickets/acre. The largest populations observed have been in Ruston soils, which have good internal drainage. However, the cricket is found also on wet, heavy soils with poor internal drainage. The cricket is most prevalent on areas with succulent forage. Numerous burrows have been observed in small openings of heavily forested areas grazed by range cattle. A few crickets can be found in almost any type of soil and ground cover in central Louisiana.

Burrows observed were somewhat different from those described by Manee (1908) in Florida, and Liebermann (1955) in Argentina. Liebermann described the burrow as consisting of 1 cavity, up to 20 cm deep, at the end of an angular retreat shaft, and with no secondary tunnels. Manee found a different type of burrow from those in Louisiana, although it did have an upper cavity and secondary tunnels. Under laboratory conditions, late-stage nymphs do not construct burrows as elaborate as those found in the field. The laboratory burrow is much like that illustrated by West and Alexander (1963), consisting of an enlarged cavity at the end of a single retreat shaft and 1 or more defecation chambers.

The typical field burrow in this study initially consisted of a shallow upper cavity 2–3 cm diam with a single vertical shaft 3–4 in. deep extending from 1 edge. As the cricket grows, it enlarges the burrow and makes it more elaborate. In addition to the vertical shaft, a retreat shaft is constructed at an angle, often in a half spiral, to a much lower depth. A 2nd exit from the upper cavity may be opened after 1 or 2 months. Frequently, another short shaft extending from the retreat shaft will be excavated about midway down the burrow. This shaft and others of short length are excavated as needed for disposal of fecal pellets, discarded food material, and other debris (Fig. 4 A). Once filled, the refuse chambers are

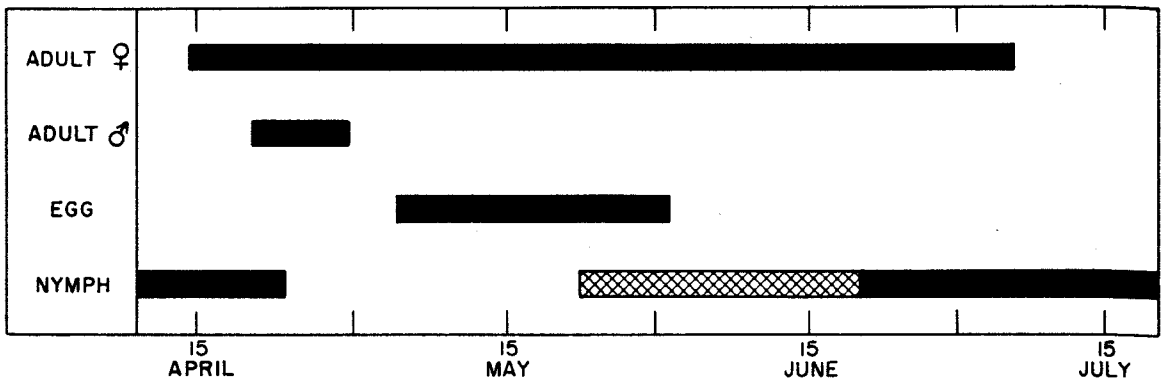

FIG. 3.—Seasonal occurrence of the life stages of the short-tailed cricket in central Louisiana. Hatched area at beginning of nymphal stage indicates period of life cycle spent in parent burrow. (The 1-week period shown for the adult male is the time spent in the parent burrow; longevity of adult males in the field was not determined.)

difficult to recognize unless the surrounding soil is of light color. In older burrows the upper and lower cavities are quite large and irregular in shape; frequently there will be a 3rd, well-defined, but smaller intermediate cavity (Fig. 4 B). Most burrows are less than 12 in. deep, but in sandy soils they may extend down to 20 in. There is no apparent difference in burrows constructed by the male and female.

The cricket enlarges the burrow only when the soil is moist and pliable. Usually there is a flurry of excavating activity in a warm period after a rain or prolonged cold weather. Little excavation occurs during cool weather, even when the soil is moist. However, Liebermann (1955) was able to induce the cricket to excavate by simulating rain over areas in which the insects appeared dormant.

Except for the brief period after the brood has hatched, only a single cricket occupies the burrow. Molting takes place within the burrow; the exuviae, except for harder portions such as the tips of mandibles, are consumed by the crickets, as are the detached hindwings of the adult.

Above-ground evidence of the burrow is a mound of small soil pellets (Fig. 5). Mounds of older bur-

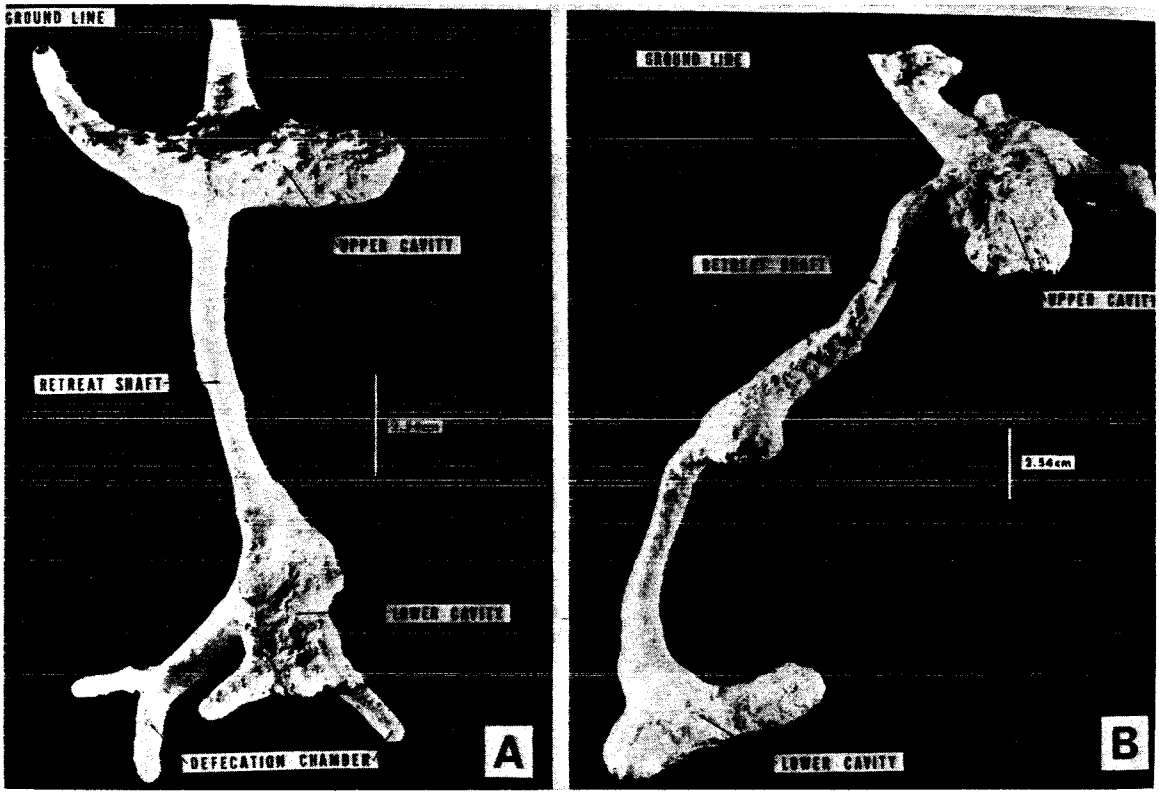

FIG. 4.—Plastic castings of typical field burrows. A, 12 weeks after nymph dispersal; B, near end of the life cycle.

rows may be as much as 5 cm high and 7 cm diam. Excavated soil is thrown out on all sides of the burrow exit. When there are 2 exits from the upper cavity, 2 distinct mounds will be present; one is usually smaller than the other. When mounds have been washed down by rain, the cricket may plug the entrance with a small amount of soil or vegetation. Not all crickets are active at the same time. It may taken 1–3 weeks, depending on weather conditions, to determine the number of burrows in a given area.

We did not ascertain if more than 1 burrow was constructed during the life cycle. Many burrows tagged early in the cycle became inactive, but the fate of the crickets could not be determined. It is probably not normal, at least in the latter part of the cycle, for the cricket to make a new burrow.

Underground chambers afford protection from the evironment and natural enemies, especially during early stages of the life cycle. Eggs are laid and young nymphs hatch within the burrow. Most of the eggs are deposited in the upper cavity, but a few may be found in 1 of the lower cavities.

The number of eggs found in burrows varied considerably. On May 10, 1966, 4 burrows yielded 33, 66, 104, and 129 eggs. On May 16, 1967, during the peak of the oviposition period, 10 burrows yielded from 5 to 88 eggs for an average of 49/burrow. The number of eggs remaining in the ovaries of 5 crickets examined on the latter date averaged 25/female (range 18–30). Ovaries of 5 ♀ examined May 23 contained an average of 12 eggs (range 4–28). Of 5 crickets examined June 6, ovaries of 2 were void and the others contained 2, 2, and 4 eggs each.

FIG. 5.—Mounds of freshly excavated soil; each mound is situated over an entrance into the upper cavity of the common burrow.

After hatching, young nymphs remain in the parent burrow for about 1 month. According to Liebermann (1955), the cricket passes the 1st 3 instars in the parent burrow. West and Alexander (1963) have given the most complete report on behavior of the female during oviposition, care of eggs, feeding and protection of the new brood, and housekeeping chores in the burrow.

We determined the number of nymphs in the parent burrow before and during dispersal by fumigation with methyl bromide and careful excavation. On May 23, 1967, when the 1st nymphs were observed, 10 burrows were excavated; 6 contained both eggs and nymphs, 3 contained eggs only, and 1 had nymphs only. Six burrows were excavated 2 weeks later and an average of 46 nymphs was found (range 30–56); no eggs were present. One week later, 9 burrows yielded an average of 33 nymphs (range 7–72). The last excavations were made June 22, at which time an average of 8 nymphs/burrow was found (range 1–20). In 1966, 1 excavated burrow contained 89 nymphs.

Most of the new brood begin to disperse when the female dies; some may leave earlier. Dispersal occurs about 3–4 weeks after eggs are hatched and appears to be limited in range. In 1 instance where the parent burrow was isolated, new burrows were most numerous within a radius of 6–10 ft.

Food and foraging habits were studied in the laboratory. Individual late-instar crickets were caged in 6-qt plastic containers filled with soil at room temperature. Introduced crickets constructed burrows in the containers and foraged blades of fresh grass placed on the soil surface. Observations over a 3-month period indicated that the cricket will forage nearly every night.

Weather conditions undoubtedly influence foraging activity. However, observations in the field indicated inactivity for extended periods even under ideal conditions. During cool weather the insect lives on stored food; some food is nearly always present in the upper cavity.

Food varied with the season. During spring and summer, crickets fed on forbs, grasses, and pine seedlings. In fall and winter they foraged seeds of these plants. In October 1966, practically all burrows investigated contained the axillary fruit of poor-joe, *Diodia teres* Walt. Many burrows near pine trees also contained portions of brown pine needles from the surrounding leaf litter.

PARASITES, PREDATORS, AND INQUILINES

Several species of parasites, possible predators, and inquilines were collected. Four different species of spiders were found in recently active burrows from which crickets were missing. Included were 2 immature females of the genus *Myrmeciophila,* and adult and immature stages of *Lycosa baltimoriana* Keyserling, *L. carolinensis* Walchenaer, and *L. antelucana* Montgomery.[4] The *Myrmeciophila* sp. did not

[4] Identified by W. J. Gertsch, The American Museum of Natural History, New York.

attack large nymphs in laboratory tests, but *L. baltimoriana* quickly subdued and devoured the cricket. Reactions of the remaining species were not tested. However, all these spiders are capable of feeding on crickets (W. J. Gertsch, personal communication).

A newly described species of mite, *Hypoaspis (Laelaspis) moseri* Hunter, was often found in defecation chambers and attached to various body regions of the cricket.[5] The mite is apparently an inquiline.

There were at least 2, possibly 3 tachinid parasites of the cricket. One definitely belongs to the genus *Exoristoides;* the other is tentatively placed in the tribe Theresiini.[6] Status of the 3rd group, dipterous larvae and puparia, remains questionable; none appears to belong to either of the just-mentioned taxa. Another dipteran, *Sciara* sp. (Sciaridae),[7] was collected in burrows; it probably inhabits the feculent material of the defecation chambers, as do other organisms yet to be identified.

Chlorion aerarium Patton, a large metallic blue wasp, has been captured in burrows. This species is known to prey on *A. assimilis.*

[5] Identified by J. C. Moser, Forest Service, USDA, Alexandria, La.
[6] Identified by C. W. Sabrosky, Entomology Research Division, ARS, USDA, Washington, D. C.
[7] Identified by R. J. Gagné, Entomology Research Division, ARS, USDA, Washington, D. C.

Other insects and related forms invade burrows, especially older, abandoned burrows. These invaders include other species of crickets, small spiders, millipedes, snails, slugs, assassin bugs, dung beetles, and elaterids.

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Successful Laboratory Mating of *Apanteles congregatus*,[1] a Parasite of the Tobacco Hornworm, *Manduca sexta*[2,3]

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ABSTRACT

Although males attempted courtship of females, *Apanteles congregatus* (Say) failed to copulate in laboratory cages, probably because of crowding and milling by the aggregation of insects and the positive phototactic response of the adults that drew them to the top of the cage. When 3×5-inch cards were placed horizontally in the cage to provide more surface area for copulation, and a 3-inch-wide opaque band was placed at the perimeter of the glass top to keep the wasps away from the sides of the cages, mating was achieved.

The braconid wasp *Apanteles congregatus* (Say) is probably the most important parasite of the tobacco hornworm, *Manduca sexta* (Johannson), in the eastern United States and might be used in the biological control of this important pest of tobacco. However, lack of knowledge about the mating habits and concomitant inability to produce female progeny in the laboratory have prevented the mass production of *A. congregatus* that is necessary before it can be used as a biological-control agent. Like most other braconids, *A. congregatus* is capable of arrhenotokous reproduction: if a female does not mate, she will produce all male progeny; if she does, she produces both males and females.

This paper describes the mating behavior of *A. congregatus* and techniques used to induce mating in the laboratory.

METHODS AND MATERIALS

In August 1967, parasitized 4th- and 5th-stage larvae of the tobacco hornworm were collected from several tobacco fields in the vicinity of Oxford, N. C. (Hornworm larvae parasitized by *A. congregatus* can easily be recognized once the parasite larvae emerge and spin their white cocoons characteristically attached to the host larva (Fulton 1940)). In the laboratory, I stripped the cocoons from hornworm larvae and placed them in small plastic containers for several days until they darkened somewhat and it was possible to see on 1 end, the outline of the cap through which the adult wasps would later emerge. The cocoons were placed in 2×2×2-ft laboratory

[1] Hymenoptera: Braconidae.
[2] Lepidoptera: Sphingidae.
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