MOLE CRICKET CONTROL IN SHADE TOBACCO PLANT BEDS

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The Southern mole cricket, Scapteriscus acutus Rehn and Hebard, and the changa, S. vicinus Scudder, have long been recognized as pests in tobacco plant beds in the Quincy, Florida, area, with the Southern mole cricket being the more prevalent species. Chamberlin and Madden (1942) observed that mole crickets were increasing in importance as plant bed pests, causing little damage by actual feeding on plants, but some injury from burrowing in the soil layer subjacent to the soil surface. Tobacco seedlings in the soil layer superjacent to the burrows often died from lack of moisture caused by the disruption of capillarity existing between the water table and the soil surface. Not only did the burrowing cause death of plants, but it caused the soil to become so desiccated that seed failed to germinate. Damage by these pests was counteracted by use of overhead irrigation to return the soil to its original position or by compacting the soil into position by pressing the raised burrows with the foot or some improvised tamping tool. These methods were laborious and unsatisfactory; therefore, insecticidal control measures were indicated.

The first economic mole cricket control developed for shade tobacco consisted of a bait containing a stomach poison of either calcium arsenate or paris green (Chamberlin and Madden, 1942). Although this bait gave satisfactory control at that time, its effectiveness as a stomach poison depended to a large extent upon the actual feeding of the mole crickets upon the bait. Later, sodium fluosilicate proved to be satisfactory as a stomach poison in a bait (Wisecup and Hayslip, 1958). Control with contact poisons became a reality with the advent of organic chlorinated-hydrocarbon and phosphate insecticides in the 1940's. Kelsheimer (1950), working with vegetables and other crop plants, found that chlordane wettable powder or emulsifiable concentrate incorporated into the soil prior to seeding of plant beds gave excellent protection from mole crickets. However, the bait method persisted because it was economical and had the prestige of established grower usage (Reid and Cuthbert, 1955; Kuiter and Tissot, 1956; and Guthrie et al., 1958). Although baits continued to be recommended, the toxic ingredient was changed to chlordane, which also acts as a contact poison if, or when, enough bait is broadcast onto a plant bed. Guthrie et al. (1958) recommended using a drench containing parathion for flue-cured tobacco plant beds. In shade-tobacco plant beds, control of all insects is based upon prevention of damage to insure an adequate supply of healthy insect-free plants of uniform size for transplanting in the field. The prevention of all insect damage is not always obtained, as is often the case in a control program of this type, but shade tobacco growers continually strive for that degree of perfection in order to glean the highest monetary return from their crop.

Observations prior to 1958 indicated that the critical mole cricket control period in plant beds was approximately 40 to 50 days from seeding, de-

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ponding upon weather conditions. After that time the seedling root systems were developed sufficiently to withstand the burrowing effects of mole crickets. In view of Kelheimer's work (1960), it appeared that a chlorinated hydrocarbon insecticide formulation containing a lower and safer concentration of the toxic ingredient would give effective results when incorporated into the plant bed soil. This prompted tests in 1958 and 1959 to ascertain if granular forms of chlordane or heptachlor would provide the necessary protection during the critical control period.

Hayslip (1943) recognized the importance of temperature in the biology of mole crickets, and observed that dissemination flights were heavy following rains in warm weather. It was later reported (Wisecup and Hayslip, 1953) that mole crickets were most active in the surface soil at night, when temperatures were above approximately 70°F, and the soil was wet. Since mole crickets are polikilothermic, their physical activities are influenced by minimum as well as maximum air temperatures. Therefore, studies were made to determine mean nightly air temperatures that prevailed during the critical control periods, and at which points mole cricket activity was most influenced.

PROCEDURES

Preparation of the plant-bed soil for seeding was begun in August of each year preceding 1958 and 1959 as outlined by Kincaid (1947). In addition, Dowfume W-40, at 40 ounces per 100 square yards, was injected broadcast in October for nematode control. A structure, 64 x 32 x 8 feet, covered on the top and four sides with tobacco shade cloth, was constructed over the beds before seed were sown for protection of the beds and seedlings from the elements.

The bed area was divided into plots or beds 5.7 x 27.0 feet in size and separated from each other by alleys 1.8 feet wide. Treated plots and untreated checks were randomized and replicated three times. Two rates of chlordane granules (5%) at 1.32 and 2.64 ounces active ingredient per 100 square yards were applied broadcast by hand on January 15, 1958, and immediately worked into the top four to five inches of soil with a rotary tiller. One rate each of heptachlor and chlordane granules (5%) at 0.66 and 1.32 ounces active ingredient per 100 square yards, respectively, was applied on January 12, 1959, in plots 4.3 x 27.0 feet. Two days later, January 17, 1958, and January 14, 1959, the beds were seeded, and observations of mole cricket activity were made daily thereafter. The amount of activity was determined by measuring the length of burrows in inches. After measurement, the raised burrows were returned to the surface level of the beds by compressing with a blunt tamping tool. This permitted measurement of mole cricket activity in each 24-hour period. Phytotoxicity observations were made concurrently, and air temperatures at 3.5 feet above ground were recorded nightly from 5:30 P.M. to 6:30 A.M. with a hygro-thermograph. The average of the maximum and minimum temperatures during this period was reported as the mean.

RESULTS AND DISCUSSION

Severe cold weather during February, 1958, retarded seedling development and extended the critical control period from 50 to approximately 80 days. Ordinarily plants would have been transplanted in the field around
March 20 or about three weeks before the test was completed. However, the seedlings were not large enough to withstand the drying effect of mole cricket activity until 83 days after seeding. The critical control period in 1959 reverted to a normal 50 days in length because of favorable weather conditions.

Most persistent control of mole cricket activity in 1958 was obtained with the low rate of chlordane, which gave protection for 81 days after treatment (Table 1). The high rate was less effective, which may have been due to poor distribution of the material in the soil. In 1959, the low rate of chlordane gave protection for only 29 days after treatment, but was more effective than the lower rate of heptachlor. Prevailing mean nightly air temperatures were higher during the latter part of January and early February, 1959, as compared to the same period in 1958 (Figures 1 and 2). These higher temperatures enhanced mole cricket activity, which may explain the relatively poor results with the low rate of chlordane in 1959. Nevertheless, serious damage to the germinating tobacco seed from mole cricket activity was prevented by the low rate of chlordane. In addition, chlordane and heptachlor appeared safe for treating plant bed soils, as no noticeable stunting or leaf distortion was observed.

![Graph](image)

Figure 1. Distribution of total mole cricket activity in relation to mean nightly air temperature and number of days after soil treatments with chlordane granules in shade tobacco plant beds, 1958.

Mean air temperature and total mole cricket activity in treated and untreated beds were found to be positively and significantly related through linear correlation. Correlation coefficients in 1958 and 1959 were 0.670 and 0.840, respectively; significant values at the 5% and 1% levels were 0.553
### TABLE 1.—Mole Cricket Activity at Various Intervals after Treatment with Chlordane or Heptachlor Granules in Shade Tobacco Plant Beds.

<table>
<thead>
<tr>
<th>Material</th>
<th>Active Ingredient per 100 Square Yards (c.w.)</th>
<th>Length of Burrows in Inches (Total of three replicates)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1958 Days After Treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 47 50 51 57 58 61 63 69 71 75 81 83</td>
</tr>
<tr>
<td>Chlordane</td>
<td>1.32</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 73</td>
</tr>
<tr>
<td></td>
<td>2.64</td>
<td>0 0 0 0 0 0 0 0 135 22 36 5 18 0</td>
</tr>
<tr>
<td>Check</td>
<td>Untreated</td>
<td>47 58 169 .315 285 59 60 64 52 105 25 287 37</td>
</tr>
</tbody>
</table>

#### 1959

|          |                                             | Days After Treatment                                  |
|          |                                             | 14 17 21 25 28 29 30 33 35 37 38 42 50                |
| Heptachlor| 0.66                                        | 0 0 0 0 114 50 87 17 86 0 0 10                       |
| Chlordane| 1.32                                        | 0 0 0 0 8 15 0 12 5 9 2                                |
| Check    | Untreated                                   | 36 80 53 15 164 168 55 193 30 11 9 19 15              |
and 0.084 for each of the two years. Therefore, total mole cricket activity varied directly with mean nightly air temperature.

Figure 1 shows that in 1958 mole cricket activity was nonexistent during the latter part of January and early February, when mean nightly air temperatures varied above and below 45° F. (broken line). The longest period of temperatures above 45° F. during that time was four nights, six through nine days after treatment. Seldom was the mean air temperature above 45° F. for more than two nights at a time, except seven nights prior to the first observation of cricket activity in the beds 45 days after treatment. This suggested that mean air temperatures must remain above

![Graph showing cricket activity and temperature](image)

**Figure 2.** Distribution of total mole cricket activity in relation to mean nightly air temperature and number of days after soil treatments with chlordane and heptachlor granules in shade tobacco plant beds, 1959.
45°F. for several nights in order to raise the soil temperature sufficiently to stimulate mole cricket activity. A decrease in mole cricket activity occurred 66 days after treatment, when the mean nightly air temperature dropped below 45°F. This tentatively indicated that 45°F. was the critical mean nightly air temperature. Mole cricket activity was distributed in sporadic outbreaks, which may have been influenced by the cricket's feeding habits as well as temperatures. The greatest amounts of activity were recorded 51 and 81 days after treatment, when mean nightly air temperatures were 64°F and 68°F., respectively.

In 1959, (Figure 2) mean air temperature had been above 45°F. (broken line) for one night before the first mole cricket activity was observed 14 days after treatment. This was 31 days sooner than in 1958 (Figures 1 and 2). The soil had acquired some warmth four nights previously, when the mean air temperature had been above 60°F. This acquired warmth was probably not lost entirely, although the mean air temperature dropped below 45°F. for two of the next three nights. Therefore, one night of exposure to mean air temperature above 45°F. was adequate to raise the soil temperature sufficiently to stimulate mole cricket activity in the beds. Mole cricket activity decreased in a similar manner to that in 1958, when mean nightly air temperatures fell below 45°F. 22 and 40 days after treatment. The highest peaks of mole cricket activity occurred 29 and 33 days after treatment, when mean nightly air temperatures were 67°F and 72°F., respectively.

It is difficult to conceive that mole crickets reached their maximum potential of activity at anytime during the tests due to the relatively low prevailing mean nightly air temperatures. For that reason, it is unlikely that mole crickets will ever be serious pests in shade tobacco plant beds during the critical control period. Mole crickets will, however, remain perennial pests and may cause some damage during periods of very mild weather in January and February following seeding of untreated plant beds.

Plans are being made to study mole cricket activity in relation to soil temperatures at varying depths. The critical mean nightly temperature in the soil may possibly be higher than 45°F.

**Summary**

Tests were conducted in 1958 and 1959 to (1) determine whether soil treatments with chlordane and heptachlor granules (5%) would give protection from mole cricket activity 45 to 50 days following seeding of shade tobacco plant beds; and (2) study the relationship of prevailing mean nightly air temperatures with mole cricket activity. Chlordane was applied in 1958 at 1.32 and 2.64 ounces active ingredient per 100 square yards. In 1959, heptachlor and chlordane were applied at 0.66 and 1.32 ounces active ingredient per 100 square yards, respectively.

Chlordane at the low rate gave protection from mole cricket activity for 81 and 29 days after treatment in 1958 and 1959, respectively. The other treatments were less effective.

Linear correlations showed that mole cricket activity was significantly and positively related to mean nightly air temperature. Mole cricket activity decreased sharply when mean air temperature dropped below 45°F. The highest peaks of mole cricket activity occurred when mean air temperature was above 60°F.
LITERATURE CITED


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