The Rate of Recovery of Insect Populations in the Sand-Sage Grasslands of Northwestern Oklahoma

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In northwestern Oklahoma there is an extensive rangeland area known as the sand-sage grassland type. The vegetation is dominated by sage, several grass species and a few forbs. The dominant insect groups associated with this plant aggregation are leafhoppers and grasshoppers. Each of these groups is represented by several species which reach peak abundance near the beginning of August each year.

As a consequence of research on the control of range insects at the Southern Plains Experimental Range near Supply, Oklahoma, we became interested in the rate at which insect populations of the dominant groups could re-enter an area, such as that described above, from which the previous inhabitants had been eradicated or significantly reduced. Therefore, a contrived catastrophe was created, from which there were few survivors, with the intent of measuring the rate of recovery of the population equilibrium.

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METHODS AND MATERIALS

An experimental area was laid out as precisely as could be done with surveyor's transit and rod so as to provide five concentric squares each fifty feet deep around a centrally-located 50′ X 50′ plot (Figure 1). Thus the whole experimental area appeared as a large square, each side measuring 450 feet in length.

FIG. I

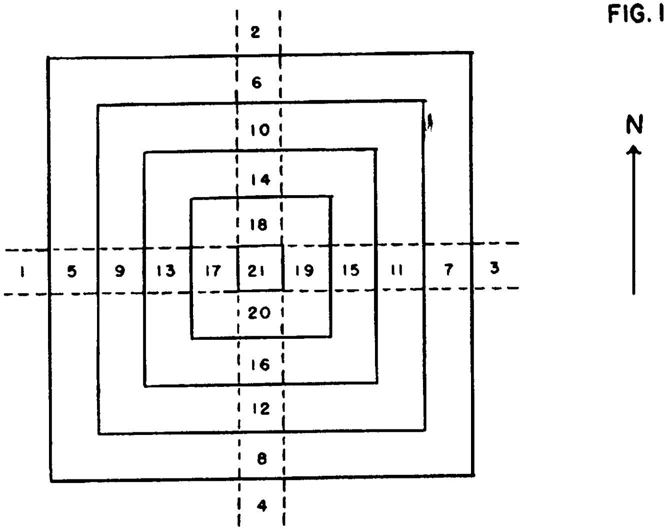


Figure 1. Diagram of insecticidally treated (within solid lines) and untreated areas showing location of twenty-one 50′ X 50′ population sampling plots (within dotted lines).

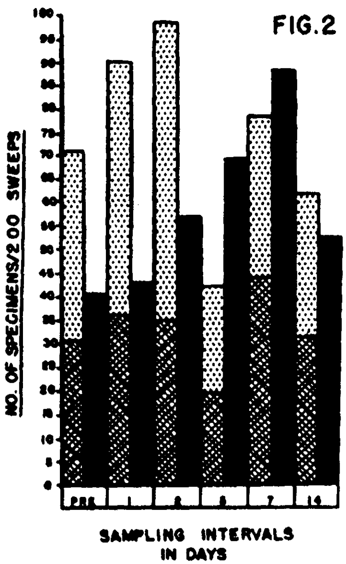
This area was treated with a mixture of two insecticides calculated to be lethal to leafhoppers and grasshoppers, respectively. The insecticidal application was made by means of a power-driven sprayer equipped with a 25 foot boom which gave thorough coverage of the treated area.

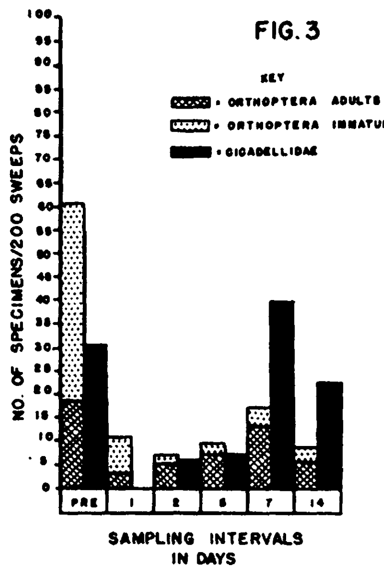
Since the smallest square measured 50 feet on each side, similar sampling areas were marked off in the center of each of the sides of each square (Figure 1). In each of the 21 areas so delimited, insect populations were sampled by taking 50 sweeps with an insect net. The sweeps were made in three traverses equally spaced between the opposite boundaries of each sampling area while progressing directly across the whole experimental area.

As each 50-sweep sample of insects mixed with vegetation was taken it was placed in a separate one-half gallon, liquid-tight, cardboard container numbered to coincide with the sampling plot number. The samples were then transported to a nearby laboratory where the insects were separated from the accumulated debris by means of Berlese funnels and preserved in 70 per cent ethyl alcohol. Subsequently the leafhoppers and grasshoppers were counted and recorded from each sample.

The original or pre-treatment counts were made from samples taken from all plots immediately before application of the insecticides. Thereafter, counts were made at 1, 2, 5, 7, and 14 days after treatment. As checks on the untreated population, counts were made from samples taken simultaneously from the areas immediately adjacent to each side of the treated area and in the previously described manner.

On the first day after treatment the peripheral or untreated population which was to supply the "reinvaders" (sampling areas 1-4 inclusive, Figure 2) was somewhat higher than that noted prior to the application of insecticide. In the counts from the untreated area one can see the upward trend of the leafhopper population over a period of about 7 days (Figure 2). This phenomenon has been noted in similar studies conducted by the authors and is apparently due to emergence of newly-hatched nymphs from sites of oviposition within the experimental area.



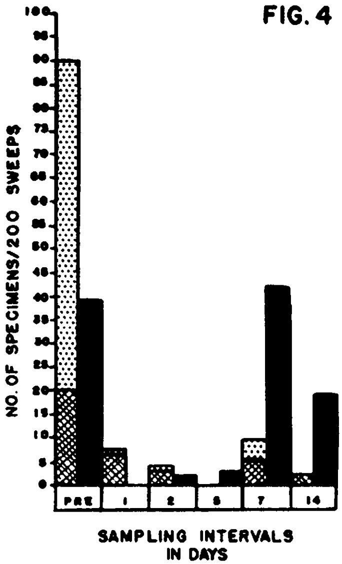


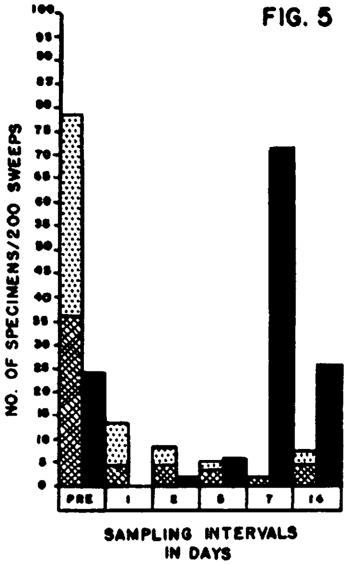
Figures 2 and 3. Representation of grasshopper and leafhopper populations in untreated plots 1-4 (Figure 2) and insecticidally treated plots 5-8 (Figure 3) for six sampling dates.

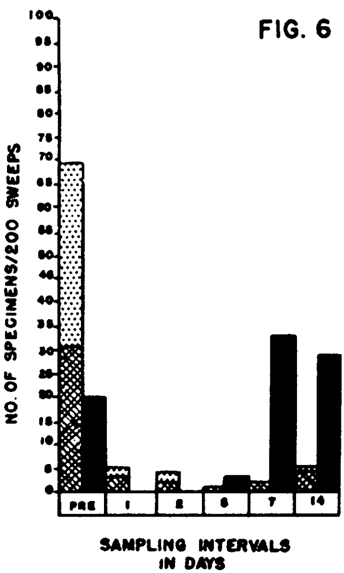
For purposes of illustration all four counts from each square have been totalled so as to give a composite figure for each of the concentric squares. In each case the counts for the innermost area have been adjusted to compare in sample size with the rest of the areas since only 50 sweeps were taken there against 200 elsewhere.

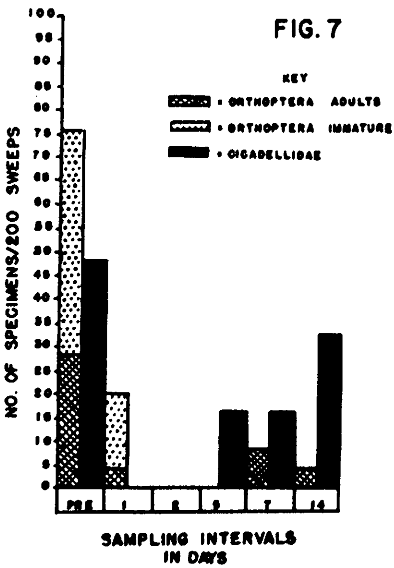
RESULTS

The pretreatment counts, representing the population samples taken immediately before application of the insecticide, are indicated by the letters "PRE" in the accompanying bar diagrams (Figures 2-7 inclusive). Each bar represents all of the samples taken on each sampling date from one of the concentric squares or the stations external to the treated area which served as a check upon the untreated population. From these data it appears that the pretreatment populations of grasshopper adults and nymphs and leafhoppers in each of the sampling areas were reasonably similar in size.









Figures 4-7. Representatión of grasshopper and leafhopper populations in insecticidally treated plots 9-12 (Figure 4), plots 13-16 (Figure 5), plots 17-20 (Figure 6) and plot 21 (Figure 7) for six sampling dates.

Apparently the insecticidal treatment did not disturb the population equilibrium beyond the boundaries of the treated area. This was not unexpected because the insecticide was applied under optimum conditions to confine it to the treated area.

By the fifth day after treatment the counts in the plots adjacent to the untreated area began to show the recovery of both grasshopper and leafhopper populations (Figure 3). Grasshopper counts in the rest of the treated area declined while the leafhopper numbers increased (Figures 4-7).

On the seventh day there was a spectacular increase in leafhopper numbers, so that in all squares except the center one the populations exceeded those found in the pretreatment counts (Figures 3-6). This sudden rise, appearing simultaneously in all treated areas, must be attributed to emergence of nymphal leafhoppers as well as to reinvasion. Apparently the major portion of each increase was due to emergence. However, the populations in each case had been restored at least to their original sizes by the end of the week following treatment. In the meanwhile, however, the untreated or "check" populations had doubled. The leafhopper counts in the innermost square do not conform to the pattern seen elsewhere (Figure 7). It is believed that this may be due to the fact that the 50 sweeps per sampling date taken in this area constituted an inadequate sample to accurately measure the population.

In spite of the fact that the adult and nymphal orthopteran populations generally had increased in the untreated areas by the end of the week following treatment, the counts in all treated areas continued to decline (Figures 4, 5, 6) except in the outermost and innermost squares (Figures 3, 7). The increase noted in the outer square apparently was due to reinvasion while that of the inner square was probably due to experimental error in sampling.

By the fourteenth day counts in the outermost treated areas (Figures 3, 4, 5) showed leafhopper populations to be declining in approximately the same ratio as that identified with the untreated areas.

At this time the orthopteran adult and nymphal counts in the untreated area were nearly equal to the pretreatment counts (Figure 2). This would indicate that the numbers of these insects were nearly static during this period. Reinvasion in this group took place only in the outermost square (Figure 3). After the initial population reduction in the rest of the treated area, the numbers of orthopterans remained roughly the same throughout the fourteen days of sampling.

In summary, under the conditions of this experiment, recovery of the leafhopper populations at least to their original numbers was noted within seven days after eradication. Some of this reestablishment was due to reinvasion while the major portion was attributable to emergence of immatures within the treated area. On the other hand, the orthopteran populations had no such internal means of recovery and their numbers remained at approximately the levels noted on the first day after treatment except on the periphery of the treated area where reinvasion was accomplished by the end of the seventh day.

The rate of recovery was apparently due more to internal factors than to reinvasion. Reinvasion would appear to be far slower than one would expect in two groups of insects with capabilities of movement in excess of the distances involved in this experiment.