

THE EFFECTIVENESS OF CERTAIN CHLORINATED HYDROCARBONS
AS TOXICANTS IN BAITS AND SPRAYS FOR THE CONTROL
OF GRASSHOPPERS IN KANSAS

by

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INTRODUCTION

Kansas has been called the "Grasshopper State" for many years even though other states have consistently more grasshoppers. Dean and Kelly (1920) believed that Kansas should not be called the "Grasshopper State" because of the widespread damage caused by the grasshopper in other states. The grasshopper problem is more acute in Kansas because a great portion of land is planted in crops.

Because of the acute grasshopper problem in Kansas, early attempts at its control were carried out in this state. One of the most significant advances in grasshopper control originated in Kansas in the early 1900's. This event was the introduction of a grasshopper poison called the Kansas bait. This mixture consisted of bran, a toxicant such as white arsenic, London purple or Paris green, a sweetener such as syrup or molasses, and an attractant such as oranges or lemons and water.

In 1917, it was demonstrated in Kansas that grasshoppers could be controlled on a large scale by the use of the Kansas bait. Furthermore, the organization of large scale grasshopper poisoning campaigns in various counties in Kansas proved so effective that the farmers accepted the Kansas bait readily.

The Kansas bait, however, was not the panacea for grasshopper control. Its kill was not always dependable because of factors such as temperature, type of vegetation in the treated area, etc. However, the Kansas bait remained the best grasshopper control measure for many years.

Further work proved sawdust could be mixed with the bran in poison baits with no subsequent reduction of its attractiveness to the grasshoppers. The addition of sawdust in the bran bait formula extended the supply of available bran and was more economical. Likewise, fruit and molasses were eliminated when it was found that they did not appreciably add to the attractiveness of the bait formula.

Because of the sporadic success of the poison bran baits against the grasshopper, there was considerable work done in search for better control methods. Dusting various toxicants on vegetation proved unsuccessful, as did spraying with sodium arsenite. Meanwhile, the Kansas bait continued to be the standard recommendation.

During World War II, entomologists in the Bureau of Entomology and Plant Quarantine, searching for new insecticides to control insects that affected our food reserve and the health of our fighting men, learned that a Swiss chemist had prepared a chlorinated hydrocarbon, DDT, which proved to be very toxic to insects. As a result, it received much publicity and acclaim, and soon became widely used.

The economic entomologists tested samples of DDT as sprays against grasshoppers, but the results were not spectacular. Other chlorinated hydrocarbons followed DDT, of which chlordane and toxaphene proved very successful in grasshopper control on succulent foliage.

This experiment was chosen because:

1. There has been no investigations on the use of aldrin,

chlordane, or toxaphene in baits in Kansas.

2. Additional experiments on the effectiveness of some of the newer chlorinated hydrocarbons when used as sprays against grasshoppers in eastern Kansas were desirable.

3. It seemed desirable to note the effects of temperature and time of application on the effectiveness of the chlorinated hydrocarbon baits against the grasshoppers.

Some of the objectives of this work were:

1. To study the effectiveness of certain chlorinated hydrocarbons as toxicants in baits.

2. To substitute some of the newer insecticides used as sprays in baits against the grasshoppers, Melanoplus mexicanus and M. bivittatus.

3. To attempt the control of the grasshopper in alfalfa by means of chlorinated hydrocarbon sprays and to note any obvious effects of these materials against other insects.

The work was undertaken as a part of the Kansas Agricultural Experiment Station Projects, Bankhead-Jones 211 and Commercial No. 56.

REVIEW OF LITERATURE

Since early times, the grasshopper or locust has been the bane of mankind. In Biblical times there are descriptions of times when locusts ate all the herbs of the land and all the fruit on the ground, causing great famines. References to this are found in Psalms cv:34-35 and Exodus 11:14-15.

Ancient China too had its locust problem which was so in-

tense that the army as well as the populace fought them. Seatchkow (1883) refers to an early attempt by the people to control this menace. He asserts that the ancient Chinese believed that at sunrise locusts, upon creeping up the long stems of corn and other strong grasses and sipping dew until they could neither fly nor jump, could be driven easily into containers and from them burned by fire or scalded by hot water.

Along with the destruction of adult and nymphal stages of the locust, much emphasis was placed on the destruction of eggs as a means of control. In Europe, entire villages turned out to dig locust eggs. Our neighbor, Missouri, has paid as much as 50 cents for each bushel of grasshopper eggs gathered (Rept. U. S. Ent. Comm., 1878). Several other states, including Kansas, have also paid bounties for grasshopper eggs.

The destruction of locust eggs by a chemical was reported by Mochuskit (1858). This was accomplished by watering heavy egg beds with a solution of water and lye.

The United States Entomological Commission in 1878 stated, "We have never had much faith in the application to any plant or insect of any chemical mixtures, fluids, powders as means of destroying grasshoppers."

LeConte (1876) foresaw some sort of spraying apparatus with several nozzles connected to large tanks of fluid and powered by steam, horse, or man power. It is known that this type of apparatus was eventually used for grasshopper control, but its first and main use until comparatively recently has been the spraying of orchards.

Criddle, according to Gibson (1915), in 1901 upon noticing that grasshoppers feeding upon lush vegetation in a field and leaving this succulent food to feast on fresh horse droppings, devised an early poison bait by adding some poison such as white arsenic or Paris green to horse manure.

Horse manure as a bait constituent was soon dropped, but the bait idea had proved to be the most practical and efficient control for grasshoppers at that time. Milliken (1916) recommended a mixture of white arsenic or Paris green and wheat bran to be mixed with water and placed in small piles or balls around the areas of the field where the grasshoppers were doing the most damage. This pile or ball method of making the bait available to grasshoppers was abandoned when it was found that birds, poultry, or other domestic animals were poisoned by the bait. Instead, the bait was broadcast in order to minimize the danger to animal life. The quantities of ingredients in the poison bait referred to by Milliken (1911), known as the "Kansas mixture," were as follows for five to ten acres:

Bran	20 lb.
Paris green or white arsenic	1 lb.
Syrup	$\frac{1}{2}$ gal.
Lemons or oranges	3 gal.
Water	$3\frac{1}{2}$ gal.

The above formula, with white arsenic or sodium fluosilicate as the toxic agent, has been the recommended chemical control for grasshoppers until the development of the chlorinated hydrocarbons. The only modifications have been in the substitution of

sawdust for some of the bran and the elimination of the fruits and syrup.

There were several experiments with the use of sodium arsenite spray for grasshopper control, but the results in Kansas were not satisfactory.

During World War II, considerable publicity was accorded the use of one of the chlorinated hydrocarbons, DDT, because of its phenomenal success in the destruction of insects. In the years immediately following the war, much work was done on the development of other chlorinated hydrocarbons as insecticides. Kearns (1945), Brett and Rhoades (1947), and Weinman and Decker (1947) found that some of the newer chlorinated hydrocarbons were effective against grasshoppers. Weinman and Decker (1949) reported that insecticidal sprays for grasshopper control are not only practical but give much more satisfactory results than poison baits in Illinois. They also state that sprays are superior to dust both in initial kill and in the persistence of effectiveness.

Parker and Wakeland (1948, 1949, 1950) stated that on dense succulent vegetation two chlorinated hydrocarbons, chlordane and toxaphene, are very effective when applied as sprays. Under these conditions the results initially are better and they continue to kill longer than the formerly popular sodium fluosilicate bait. These workers later state that, in sparse short green vegetation and grain stubble, baits are as effective as sprays and more economical.

Butcher, Wilbur, and Dahm (1950) working in Kansas indicated that four of the chlorinated hydrocarbons--chlordane, toxaphene,

parathion, and aldrin--killed grasshoppers better and over a longer period of time than did the standard sodium fluosilicate wet-bait.

MATERIALS

Experimental Plots

Four miles east of Manhattan, Kansas on Highway U. S. 24-40, at the ManKan Airport, a large population of grasshoppers was discovered in newly-cut alfalfa. These grasshoppers were predominately Melanoplus mexicanus DeG. The west portion of the ManKan Airport, Plate I, was divided into 16 plots of 2.5 acres each. Two adjacent fields were located south of Manhattan in Geary County on R.F.D. 2 at the farm of A. E. Hickman. The alfalfa in these fields was not able to grow because of a heavy population of M. bivittatus Say.

The alfalfa fields in Geary County were very irregular in shape and comprised approximately 10 acres. Because these fields were so remote, no marking of the plots was done.

Insecticides

Toxicants Used in Sprays. The toxicants used were toxaphene, aldrin, and chlordane. The toxaphene was Coopertox 65 per cent emulsifiable concentrate obtained from the Wm. Cooper & Nephews Inc., chlordane was 74 per cent emulsifiable concentrate obtained from the Julius Hyman Co., and the aldrin was an experimental quantity of 25 per cent emulsifiable concentrate which was obtained

EXPLANATION OF PLATE I

West portion, ManKan Airport, divided into plots of 2.5 acres. The plots, designated by numbers or letters, and the material applied to them are shown below.

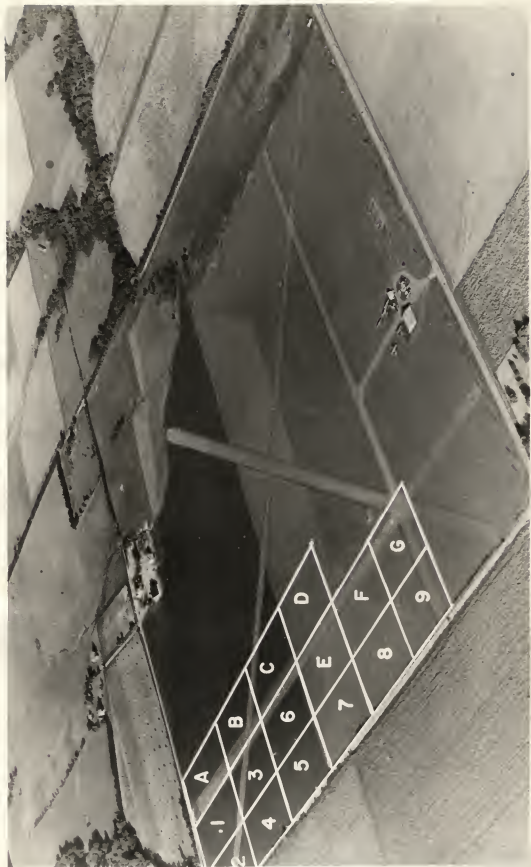
Sprayed Plots

- A. Chlordane
- B. Toxaphene
- C. Aldrin
- D. Toxaphene
- E. Aldrin
- F. Chlordane
- G. Check

Baited plots

- 1. Toxaphene
- 2. Chlordane
- 3. White arsenic
- 4. Aldrin
- 5. Toxaphene
- 6. Check
- 7. Chlordane
- 8. Aldrin
- 9. White arsenic

PLATE I



from the Julius Hyman Co.

The materials used, their formulation, and the amount of actual insecticide used per acre of alfalfa at the ManKan Airport for the control of grasshoppers are shown in Table 1.

Table 1. The materials used in sprays, pounds of actual insecticide per acre of alfalfa, and their formulation, at the ManKan Airport for the control of grasshoppers.

Material :	:Pounds of actual: :insecticide per : : acre :	Formulation
Toxaphene	1.76	65% emulsifiable concentrate, containing 6.8 lbs. of toxaphene per gallon.
Chlordane	1.0	74% emulsifiable concentrate, containing 8 lbs. of chlordane per gallon.
Aldrin	0.25	25% emulsifiable concentrate, containing 2 lbs. of aldrin per gallon.

Toxicants Used in Baits. The toxicants used in baits were chlordane, 74 per cent emulsifiable concentrate containing 8 pounds of technical material to the gallon at the rate of 0.05 pounds of technical material per acre of alfalfa; toxaphene, 65 per cent emulsifiable concentrate containing 6.8 pounds of technical material to the gallon at the rate of 0.1 pounds of technical material per acre; aldrin, 25 per cent emulsifiable concentrate containing 2 pounds of technical material to the gallon at the rate of 0.0124 pounds of technical material per acre; and white arsenic powder, 6.4 ounces per acre.

Mixing the Baits. The baits were composed of bran, a toxicant, and approximately 3 gallons of water or enough water to properly wet the bran. The insecticides, toxaphene, chlordane, and aldrin, were added to water and sprayed from a three-gallon, hand, air-compressed sprayer to their respective 25 pounds of bran that was spread on a concrete slab. The white arsenic was dusted uniformly over the bran that was spread on the concrete slab and dry-mixed thoroughly with the bran before the water was added. A shovel was used for the mixing of these materials.

Bait Formula. The formula for each portion of the poison bait consisted of the following ingredients which were used on one acre:

Bran	10 lb.
Insecticides, either	
Toxaphene*	0.1 lb.
Chlordane*	0.05 lb.
Aldrin*	0.0124 lb.
White arsenic	.40 lb.
Water	1-2 gal.

*Actual insecticide.

Spray Equipment

The sprays were applied with a John Bean model 4-E two-wheeled sprayer, with a spray boom 16 feet in length, containing 13 nozzles, producing a fan-shaped spray and operating at 30 pounds pressure per square inch. Approximately 12 gallons of solu-

tion were sprayed per acre while the sprayer was pulled by an automobile at the rate of three miles per hour.

METHODS

Evaluation of the Grasshopper Population

Separate adjacent plots of 2.5 acres were used in this experiment. Grasshopper counts were taken by sweeping the alfalfa plants with cloth sweeping nets which measured approximately 13 inches in diameter and from 20 to 28 inches deep. The counts were taken from three strips in each of the plots--the two outer strips were at least 60 feet inward from each side and end of the plot, while the center strip was mid-way between the two outer strips. Each strip was divided into five stations. From each station, 12 unit counts were taken which consisted of three sweeps per unit or 36 sweeps per station. This made a total of 180 sweeps per strip or 540 sweeps per plot. It was believed that this method of determining the relative grasshopper population was more accurate than attempting to estimate the numbers of grasshoppers per square yard.

Figure 1 shows the scheme of the sweeps made in the plots.

Counts were made immediately before treatment and were repeated at 24 hours, 72 hours, and 7 days after treatment.

Each of the plots used for the spraying and baiting tests had one replicate not immediately adjacent. Separate check plots were used for each of the spraying and baiting series.

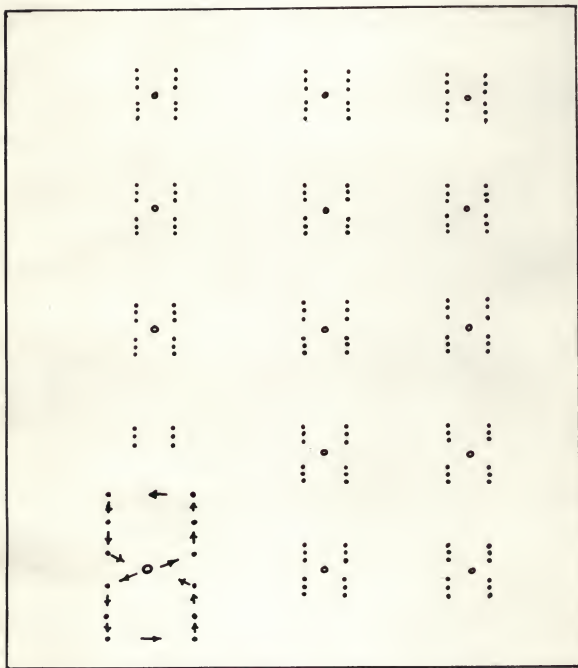


Fig. 1. Positions in a 2.5 acre plot to show where sweep net samples were made to evaluate the grasshopper population. Small circles in the center of the rows of dots indicate the starting point. Dots represent points from which three sweeps of the net were made. Enlarged section in lower left-hand corner indicates the direction taken by two persons with nets during the sweeping process.

Application of Baits

The baits for the tests at ManKan Airport were mixed the night before their application and placed in burlap bags overnight to assure that a good saturation of the toxic materials and water into the bran occurred. The poisoned bait was removed the following morning and taken to the field for application.

The bran bait was poured into a small wash tub which rested on the right front fender of a 1946 model Ford automobile. Since the baits were applied by hand, the person who applied them sat astride the front of the hood of this automobile with his feet resting on the front bumper. With his left hand he steadied himself as the automobile moved slowly through the field, and with his right hand the bait was broadcast.

The method of broadcasting the bran was as follows. The right hand was put into the tub containing the material and brought out again with as much of the material as it could hold. The hand containing the material was moved sharply to the left in a wide sweeping motion, and at the same time the relaxing of the thumb and the first finger occurred to release a stream of the bait. When the end of the sweep came, the right hand was reversed in the same sweeping motion, but this time the 3rd, 4th, and 5th fingers were relaxed to permit the bran to stream out. This was repeated throughout the field, and, as the car was traveling between two and three miles per hour, the broadcaster had ample time to see that the material was spread evenly throughout the field.

No flags or men were used to guide the driver of the automo-

bile because the cut alfalfa was thick enough to show the tracks of the automobile and to serve as a guide.

The plan of distributing the bait was as follows: As the bait was distributed, the automobile at approximately 12 feet from one side moved parallel to that side from one of the adjoining sides to the opposite side. When this side was reached, the bait broadcasting was stopped while the driver drove into the adjoining field to turn around. When the automobile returned to the field being treated, it began at a point approximately 24 feet from the first tracks in the alfalfa and moved toward the opposite side parallel to its initial tracks. This procedure was followed until a plot was baited completely.

Spraying

Calibration of Spraying Equipment. Before the actual spraying was begun, it was necessary to calibrate the spraying equipment so that a known amount of spray could be dispensed in a known area. The preliminary step in the calibration consisted of putting a small amount of water in the tank of the sprayer, starting the pump engine, and opening the valve that controlled the flow of the material from the tank, through the pump, and finally through the nozzles to the ground. This operation was necessary in order to see that all of the nozzles were open and that the liquid was being dispensed freely from them. For the actual calibration, the following formula obtained from Dr. Paul Dahm was used:

$$\frac{66 \times \text{gallons used in 40 rods}}{\text{width of the boom}} = \text{gallons sprayed per acre}$$

The sprayer tank was filled with water, and the sprayer was drawn by the automobile at a certain speed for 40 rods with the main valve open and the sprayer dispensing the water at a set pressure. At the end of 40 rods, the main valve was closed. In order to measure the number of gallons used in 40 rods, water carefully measured was added to the tank until the water sprayed during the 40 rods was replaced. This amount of water was substituted in the above formula and divided by the width of the boom. The resulting figure multiplied by 66 indicates the amount of water sprayed per acre by the sprayer, provided the pressure and rate of travel by the sprayer remained the same as when the test was run. If a higher or lower speed or an increase or reduction in pressure is desired, then a test run using the above formula must be performed again.

Application of Spray. In the spraying of a plot, the equipment and personnel consisted of a sprayer, an automobile to draw the sprayer, one driver for the automobile, and four men to act as guides for the driver. These guides were necessary to keep the sprayer in straight lines and to eliminate the possibility of missing strips or treating other strips more than once.

The procedure during the spraying operation was as follows:

The four guides took initial positions at points approximately 9 feet from the two sides of each of the four corners of a 2.5 acre plot. Although the boom of the sprayer measured 16 feet in length, the flat, fan-shaped spray from it covered an extra length of one foot on either end of the boom to make the total swath 18 feet wide. With the guides standing at 9 feet, which was exactly

one-half of the swath length, the driver of the automobile could drive directly from one guide to a distant guide on the same side of the plot and the sprayer would be on the line between the two guides, and a swath could be sprayed evenly along the outer 18 feet of the 2.5 acre plot. The automobile and the sprayer, which made up the spray rig, were put on an imaginary line between two guides at a point close to one of the guides on one side of the field. The motor of the sprayer was started, and the main valve of the sprayer was opened as the automobile began to move at three miles per hour toward the distant guide.

As the spray rig left the starting point, the guide who was at that point faced to his left and took four steps, which measured approximately nine feet, before he stopped. The second guide, referred to before as the distant guide, as soon as the spray rig had passed him, took four steps in the same direction as the spray rig had been going, stopped, faced to his left, took four more steps in the new direction, and stopped again. This same procedure was followed by the third and fourth guides. After the spray rig had passed the first guide again, this man followed it for four steps, stopped, faced to his left, took two additional steps, and stopped. The method of proceeding to new positions was repeated by every guide until the entire field was sprayed. Figure 2 shows the direction of travel by the spray rig through a plot being treated and the positions of the guides.

Formula for the Evaluation of Effectiveness of Insecticides

For the evaluation of the effectiveness of the insecticides

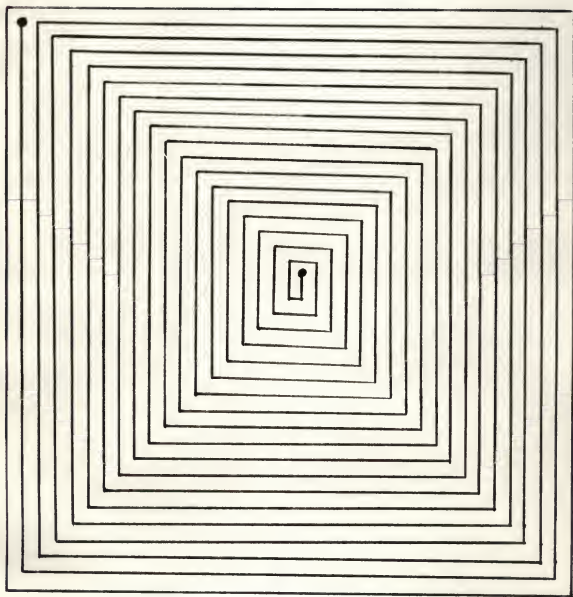


Fig. 2. Path taken by the spray rig during the spraying of a 2.5 acre alfalfa field at the ManKan Airport. Dot in upper left-hand corner indicates starting point, and dot in center indicates stopping point.

used as baits and sprays at the ManKan Airport, the following formula was used:

$$100 \times \frac{X-Y}{X} = \% \text{ Reduction}$$

Where X = No. insects living in the check plot.

Where Y = No. insects living in treated plot.

Evaluation of the Effectiveness of the Sprays in Reducing Webworm Damage

Thirteen days after spraying the materials toxaphene, chlordane, and aldrin on alfalfa, an infestation of the garden webworm, Loxostege similalis Guen, was noted throughout these plots. This insect pest defoliates the alfalfa plants, thus reducing the vigor and occasionally killing the stand.

In order to evaluate the degree of infestation in the six fields, each field was traversed by the observer following a diamond-shaped route. The observer starts from the center of one side of a field and walks to the center of an adjoining side; continues to the center of the side opposite from the starting point; and then back to the starting point. The observer inspected 50 alfalfa plants along this route at random and evaluated them numerically as follows:

0. No infestation.
1. Worms present but no injury noted.
2. Slight injury.
3. Somewhat more injury.

4. Severe injury.
5. Foliage destroyed.

EXPERIMENTAL RESULTS

Baiting - ManKan Airport

When poison bran grasshopper baits with the toxicants--toxaphene emulsifiable concentrate at 0.1 pounds per acre, chlordane emulsifiable concentrate at 0.05 pounds per acre, aldrin at 0.0124 pounds per acre, and white arsenic powder at 6.4 oz. per acre--were applied to the test plots, the following detailed results were secured. Tables 2 through 5 give the relative grasshopper abundance as determined by the sweep net method immediately before baiting, 24 hours after baiting, 72 hours after baiting, and 7 days after baiting.

Table 2. Grasshopper populations on baited plots immediately before treatment with four toxicants at the Mankan Airport as determined by the sweep net method.

Plot no.:	Grasshoppers caught in net after 30 uniform sweeps for each station					:Total	
	: Station 1	: Station 2	: Station 3	: Station 4	: Station 5		
Toxaphene							
1	E. to W. 4 5 5 8 10 11	1 3 3 4 5 2 17 4 6 2 3 5	4 5 10 8 5 8 5 5 9	5 4 8 3 9 8 5 4 6	4 7 3 8 5 3 1 6 2 4 6	3 10 4 11 6 6 5 3 6 7	
	W. to E. 7 5 7 9 10 8 11 10 6	3 2 6 8 4 5 3 8 3	1 2 2 4 4 10 9 5 5	2 8 7 1 4 4 10 9 5	6 5 3 1 4 1 3 6 2	7 3 2 3 5 6 4 4 4 6	
	E. to W. 8 1 5 4 7 10	4 2 4 5 3 8 7 3 4	3 1 5 8 9 3 6 5 4	5 4 6 5 8 5 3 2 4	6 8 5 5 8 5 3 2 4	6 4 8 11 5 5 6 2 9	966
Chlordane							
2	W. to E. 10 3 4 11 7 5	5 6 4 20 10 19 2 3 9	8 5 5 4 7 11 8 8 5	7 4 4 6 8 6 4 6 4	6 4 5 8 3 3 3 8	1 8 4 5 7 1 2 2 4	
	E. to W. 9 9 8 6 5 10 12 9 1 5	7 11 8 14 7 1 4 3 3	4 1 4 1 3 0 3 6 3	4 3 3 2 1 1 3 2 5	1 0 4 3 7 5 3	8	
	W. to E. 8 8 5 12 19 13 5 4 2	5 1 1 7 3 2 2 7 4	2 4 1 5 2 2 3 0 4	3 1 1 1 1 0 3 3 0	3 1 3 2 7 4 3	4 1 0 5 6 1 3	689
White arsenic							
3	E. to W. 13 6 1 13 3 3	3 2 4 2 5 3 4 9 2	3 4 1 3 5 0 2 2 3	1 3 3 6 1 5 3 1 5	3 1 1 5 3 1 5	4 4 3 10	
	W. to E. 1 1 3 2 1 3 4 3 1	1 3 2 1 1 2 0 2 4	4 1 2 0 0 1 5 4 0	4 3 0 2 2 0 4 1 3	2 2 0 4 1 3 2 2 2	2 5 4 5 0 5	606

Table 2. Cont.

Plot no.:	Grasshoppers caught in net after 36 uniform sweeps for each station					Total	
	Station 1	Station 2	Station 3	Station 4	Station 5		
4	White arsenic (cont.)						
	E. to W.	1 0 2 0 1 2	1 0 0 1 0 2	3 0 2 4 5 3	4 4 2 3 2 0	4 4 2 3 2 0	422
	5 4 3 0	1 4	1 1 0 1 1 4	1 1 6 0 3 2	0 2 3 0 1 4	2 3 2 1 2 0	
	4 5 3 5	0 4					
	Aldrin						
E. to E.	1 2 4 1 4 2	0 0 1 5 1 5	2 0 0 3 4 1	1 1 3 1 0 5	1 1 3 1 0 5		
7 0 5 4	4 3	4 0 3 5 2 1	1 2 1 5 2 1	2 1 1 1 2 2	1 1 3 1 0 5		
1 6 0 3	5 3						
E. to W.	1 2 0 0 2 0	0 3 2 3 1 1	1 0 0 0 2 4	1 1 0 1 1 4	1 1 0 1 1 4		
3 2 3 0	1 2	3 2 3 4 0 3	0 4 3 3 2 1	2 0 4 2 2 4	4 1 1 1 2 1		
1 5 3 5	1 1						
E. to E.	4 0 1 5 1 0	0 0 0 4 0 2	2 1 1 1 2 2	4 2 2 4 0 0	4 2 2 4 0 0		
4 3 0 4	2 0	4 0 1 5 1 0	0 0 2 0 1 4	4 3 0 2 1 1	1 3 7 0 1 0	344	
0 1 2 2	2 7	0 2 1 1 3 0	0 0 2 0 1 4	4 3 0 2 1 1			
5 (The count on this plot was inadvertently missed.)							
Check							
E. to W.	1 3 2 0 5 6	9 4 5 4 9 7	10 8 7 4 3 3	2 8 6 1 1 0	2 8 6 1 1 0		
5 2 4 4	3 11	4 15 15 9 3 10	11 10 17 2 5 10	6 12 14 7 1 4			
3 4 2 2	1 11	0 7 5 2 4 5					
E. to E.	6 9 10 18 9 11	3 2 2 10 16 1	5 1 0 5 4 7	4 12 1 0 3 7	4 12 1 0 3 7		
0 3 1 11	5 12	8 8 8 1 17 21	2 5 12 5 8 13	6 6 4 1 7 8	15 2 25 1 0 4		
1 6 3 3	3 17						
E. to W.	1 2 7 10 2 2	1 3 4 2 2 1	7 4 2 9 6 4	3 2 1 7 1 7	3 2 1 7 1 7		
1 3 12 2 11 16	2 2	1 6 6 0 9 8	4 0 2 1 2 5	2 14 13 2 8 9	2 8 15 8 5 13	621	
Chlordane							
E. to W.	1 1 0 0 0 1	3 1 0 0 6 0	4 2 6 0 0 1	1 3 0 1 0 4	1 3 0 1 0 4		
4 2 1 0	0 0	1 0 1 1 2 1	3 3 4 1 1 6	3 2 1 0 0 1	0 4 7 2 0 6		
1 5 2 0	1 0						

Table 2. Concl.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Chlordane (cont.)						
W. to E.	0 2 1 0 3 8	0 0 3 3 2 4	2 0 4 7 3 0	5 2 1 4 3 0	3 6 3 2 2 0	
2 2 4 4 5 3	2 1 4 6 3 6	1 3 1 2 3 4	1 5 3 6 4 3			
E. to W.	5 4 10 1 2 1	6 4 2 2 2 3	3 4 3 5 2 4	6 4 1 3 10 3	3 7 9 2 5 4	465
7 4 5 0 1 2	6 2 1 4 0 3	5 4 2 3 1 2	1 5 8 4 2 3			
3 4 1 1 6 5						
Aldrin						
E. to W.	3 3 1 1 0 1	3 2 1 0 1 6	3 3 4 2 2 6	2 5 0 2 2 7	6 6 10 4 8 7	
1 0 4 1 0 0	1 1 6 1 3 5	1 1 0 0 2 4	4 2 2 0 2 3			
0 3 6 1 5 1						
W. to E.	4 1 3 7 0 2	8 6 3 4 3 4	2 3 3 3 3 2	5 2 0 0 3 2	6 1 5 1 3 0	
1 1 5 5 0 1	2 3 4 0 4 3	1 1 2 3 3 5				
3 3 1 1 2 3						
E. to W.	6 3 2 1 4 4	1 5 1 2 0 3	4 2 3 3 1 0	2 1 5 2 2 0	2 3 5 3 2 6	385
5 1 4 1 0 0	5 6 7 0 0 1	1 3 5 2 0 4	5 3 2 0 1 1			
3 4 4 1 1 4						
White arsenic						
E. to W.	7 0 4 5 3 3	3 5 0 5 3 1	4 4 4 1 1 3	6 4 6 8 5 3	9 7 4 2 10 0	
10 5 5 2 1 2	5 3 10 5 9 2	3 4 8 4 2 7	12 8 10 5 5 8			
12 6 5 3 7 3						
W. to E.	0 3 0 0 2 1	5 1 0 0 5 7	3 3 3 2 3 0	8 2 4 8 6 2	3 6 7 2 6 8	
3 4 4 7 6 5	1 3 6 5 4 4	1 5 0 0 2 8	3 1 0 2 2 2			
E. to W.	6 1 1 7 3 4	4 1 1 5 7 5	4 2 5 11 7 2	14 6 1 4 3 3	6 8 10 12 8 7	795
4 2 1 0 4 2	4 0 6 3 1 2	8 3 4 4 9 7	5 7 12 7 7 7			
0 3 5 5 7 6						

Table 3. Grasshopper populations on baited plots 24 hours after treatment with four toxicants at the Mankan Airport as determined by the sweep net method.

Plot no.:	Grasshoppers caught in net after 26 uniform sweeps for each station						Total
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 5	
1	Toxaphene						
	W. to E.						
	4 76	3 10	2 4	2 9	2 3	3 3	2 2
	3 20	2 0	1 1	1 1	1 1	2 3	1 1
	E. to W.						
	2 12	4 1	4 1	0 3	2 1	1 0	4 3
	1 0	5 1	1 0	1 0	1 1	1 2	1 3
	W. to E.						
	2 2	5 5	4 4	0 0	0 0	2 0	3 0
	2 4	4 5	6 2	0 3	1 0	0 0	1 0
2	Chlordane						
	W. to E.						
	4 3	8 2	1 1	0 0	1 0	2 0	3 2
	5 5	4 3	1 1	0 1	0 0	1 1	1 1
	E. to W.						
	4 2	7 1	4 5	1 2	2 0	1 2	3 6
	4 4	4 8	0 0	2 1	5 3	0 1	0 1
	W. to E.						
	3 2	2 2	2 1	0 0	1 0	2 0	3 2
	5 5	4 3	1 1	0 1	0 0	1 1	1 1
3	White arsenic						
	W. to E.						
	3 2	2 9	10 5	19 2	2 9	3 2	10 2
	0 3	5 1	1 6	5 3	6 1	1 3	2 8
	W. to E.						
	3 4	10 5	1 3	3 2	6 2	7 9	10 2
	2 1	3 1	0 0	1 2	3 4	4 7	6 0
	E. to W.						
	4 1	6 3	2 1	2 0	2 6	4 1	5 5
	4 5	0 7	1 6	1 0	1 3	3 4	4 5

Table 3. Cont.

Plot:		Grasshoppers caught in net after 16 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
	White arsenic (cont.)					
	W. to E.	2 0 2 0 2 5	4 3 5 0 0 1	0 1 1 3 1 0	0 1 0 1 2 7	6 1 5
	2 5 4 5 2 1 4	0 3 2 0 0 3	0 2 10 2 0 1	3 0 0 3 5 1	1 2 2 0 1 2	
	6 3 1 2 1 2		Aldrin			
4	W. to E.	0 0 0 0 0 0	0 2 1 0 0 0	0 0 1 0 0 0	0 0 0 0 1 0	
	1 4 2 1 0 2	0 0 1 0 0 0	0 0 1 0 0 0	0 0 2 1 0 2	0 2 1 0 0 0	
	0 1 2 1 0 0		Toxaphene			
	E. to W.	1 0 0 1 0 0	1 0 1 0 0 0	0 0 2 0 0 10	1 0 1 5 0 2	
	1 0 0 0 0 1	0 0 0 1 2 1	2 0 0 0 1 0	0 3 0 1 0 1	1 0 0 0 0 1	
	W. to E.	0 0 0 0 0 0	2 2 0 1 1 1	0 0 0 0 1 0	0 2 1 0 0 0	1 0 7
	3 1 0 0 0 0	0 0 1 0 0 0	0 0 1 2 1 0	0 0 3 1 1 1	1 1 0 0 1 1	
	2 0 0 0 0 1		Toxaphene			
5	W. to E.	0 1 1 0 0 1	0 0 5 0 2 4	1 0 1 3 1 1	1 1 2 0 0 0	
	0 0 2 2 2 0	0 1 1 0 2 0	1 3 0 0 0 2	0 0 0 2 3 2	3 1 1 1 1 0	
	0 0 0 0 2 0		Toxaphene			
	E. to W.	0 1 0 2 2 0	0 0 0 1 0 0	1 1 1 2 1 1	1 0 0 2 2 3	
	2 1 0 0 0 1	0 0 5 1 0 1	1 0 0 1 5 1	1 0 0 0 2 2	0 0 0 2 3 3	
	3 2 0 2 2 0		Check			
	W. to E.	10 8 11 6 6 7	9 8 18 7 5 1	4 4 1 0 4 0	3 0 1 0 0 0	3 1 1
	2 3 1 1 4 6	8 7 8 1 0 0	2 3 0 0 0 3	0 0 0 1 1 0	0 1 0 0 1 4	
	0 1 2 0 1 2		(run way)			
	0 1 3 0 1 1	4 6 3 6 4 1	2 2 2 10 9 9	4 0 3 8 7 3	1 2 1 10 24 26	
		6 3 7 6 6 5	1 2 1 6 20 11 7	8 7 2 4 3 10	1 1 4 8 14 14 30	

Table 3. Cont.

Plot: Grasshoppers caught in net after 36 uniform sweeps for each station						
No.	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Check (cont.)						
Chlordane						
7	W. to E. 16 10 7 3 6 2 12 15 2 4 2 1	3 6 1 2 0 2 3 0 0 2 1 1	1 5 2 1 2 1 1 3 2 1 1 4	2 4 1 2 0 0 0 1 2 0 0 1	1 0 0 1 3 0 2 3 0 1 1 2	665
	E. to W. 6 0 1 1 3 3 2 0 0 0 1 3 1 0	5 2 4 4 1 0 0 1 3 1 2 4	0 1 2 6 2 1 0 3 0 4 1 6	0 1 0 0 1 1 0 4 0 3 3 1	0 1 1 6 2 0 0 1 1 1 2 1 1	
Aldrin						
	E. to W. 0 0 0 2 0 1 1 0 2 2 2 0	0 1 2 0 2 1 0 1 0 4 3 4	0 0 0 3 1 0 0 0 4 4 1 0	0 1 1 0 1 0 0 0 0 1 0 0	0 0 0 0 0 1 0 0 0 0 2 0	
	W. to E. 0 1 1 1 0 0 1 1 0 0 0 0	0 1 2 4 1 0 0 2 2 1 0 0	2 2 3 0 0 1 0 0 1 4 0 1	1 4 1 2 2 0 0 1 1 1 2 0	2 3 1 2 0 2 0 1 5 0 1 2	172
8	W. to W. 0 0 0 2 4 1 2 1 0 0 1 1	1 0 0 3 0 1 0 2 3 0 0 1	1 2 1 2 0 1 0 2 0 0 0 0	1 0 0 1 0 1 0 3 3 0 0 2	0 1 2 0 0 1 0 0 0 1 0 0	
	W. to E. 3 1 0 0 0 3 0 2 1 5 4 1	3 1 3 2 0 0 0 0 1 2 0 2	2 1 0 0 1 0 0 0 1 1 1 0	0 1 1 0 0 0 1 0 1 0 2 1	1 0 1 3 1 1 0 1 1 2 2 1	
	E. to W. 2 0 0 1 0 1 0 0 0 0 0 1	2 0 1 1 2 0 1 1 0 2 3 2	1 1 0 2 0 4 2 4 2 0 1 2	0 1 0 0 3 0 2 2 0 1 0 3	0 1 2 4 2 1 0 1 0 1 1 2	
	W. to E. 1 2 0 2 2 0 0 0 0 1 2 3	0 1 0 4 2 1 1 0 1 1 0 1	0 1 2 3 1 1 1 0 0 1 0 0	0 0 1 2 4 0 0 0 0 0 1 0	0 0 1 3 3 0 0 0 1 2 2 0	185

Table 3. Concl.

Plot:		Grasshoppers caught in net after 26 uniform sweeps for each station				
No.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
White arsenic						
9	E. to W.					
	2 23043	501130	112300	601613	584436	
	521232	432101	406101	030124	231133	
	W. to E.					
	212320	101431	023013	246250	242113	
	048226	115110	111150	233125	541111	
	E. to W.					
	000512	100410	111445	103323	3571438	
	021000	325203	420361	111301	123961	431

Table 4. Grasshopper populations on baited plots 72 hours after treatment with four toxicants at the ManKan Airport as determined by the sweep net method.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Toxaphene						
1	W. to E. 211011 033030	011110 000010	140450 100110	354022 010221	004623 320141	
	E. to W. 120100 111102	010210 001000	001010 003001	200010 000003	510022 000003	
	W. to E. 422102 041122	311111 114063	300000 200000	000002 010010	010000 021000	195
Chlordane						
2	E. to W. 200101 100010	011320 011201	001000 000100	201201 012000	000032 000153	
	W. to E. 300000 402100	110020 000000	412221 110211	435220 000111	537234 362230	
	E. to W. 311250 013310	112200 411000	132204 321311	321003 415312	321123 030332	239
White arsenic						
3	E. to W. 010424 201443	214333 133533	412041 751353	010303 211162	010201 121110	
	W. to E. 210211 431331	402244 109434	243041 113134	231322 319122	113102 014311	

Table 4. Cont.

Grasshoppers caught in net after 36 uniform sweeps for each station						
Plot no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
White arsenic (cont.)						
E. to W.						
3 2 1 4 2 3	0 1 0 2 3 1	0 0 0 0 1 2	1 2 2 5 1 0	1 0 0 1 0 1	1 0 0 1 0 1	3 3 8
0 2 1 5 3 3	0 2 0 0 0 0	0 0 1 1 0 3	2 1 0 3 2 0	1 5 0 1 1 0	1 5 0 1 1 0	
Aldrin						
4	W. to E.					
	3 0 0 0 1 1	0 0 1 0 1 0	0 0 0 0 0 1	1 0 0 1 1 0	0 0 0 1 0 0	0 0 1 0 0 0
	0 0 1 1 1 1	2 2 0 0 0 2	0 0 0 0 0 0	0 3 0 0 0 0	0 1 0 2 1 2	0 0 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 1 0 0	1 1 6 1 1 0	0 2 0 2 0 0	
	W. to E.					
	1 0 3 0 0 0	0 1 0 0 0 0	0 0 0 1 0 1	0 1 0 0 0 0	0 1 1 0 0 2	8 6
	3 1 2 1 1 2	0 0 0 0 0 0	1 1 1 0 0 0	1 1 0 3 1 0	3 0 0 0 0 0	
Toxaphene						
5	E. to W.					
	0 2 1 0 0 1	0 0 1 0 1 0	1 1 1 0 0 1	1 2 1 0 1 1	1 0 1 0 0 1	
	0 1 1 1 1 0	1 2 1 0 0 0	2 1 2 0 0 1	1 2 1 0 0 1	1 1 0 1 0 0	
	W. to E.					
	0 2 0 1 1 0	1 1 1 1 0 0	1 0 1 1 0 0	0 0 2 0 0 1	0 1 0 0 2 0	
	1 1 0 0 0 0	0 0 0 2 1 0	0 2 0 1 2 0	0 0 0 0 2 1	0 1 0 1 0 0	
	E. to W.					
	0 1 1 1 0 3	2 0 0 2 1 0	0 0 0 2 1 1	2 0 0 0 0 0	3 0 0 0 2 1	1 2 1
	1 1 1 0 1 1	1 0 1 0 0 2	1 0 1 0 4 1	1 0 1 0 0 2	0 1 3 0 0 0	
Check						
6	W. to E.					
	6 2 9 4 2 4	8 7 4 6 10 5	8 13 4 5 7 6	1 0 9 3 5 4	2 2 3 4 1 1	
	8 0 2 6 6 6	8 6 7 2 2 3	4 4 5 8 5 6	6 2 7 2 4 1	2 1 2 2 2 1	

Table 4. Cont.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station					Station 5	Station 4	Station 3	Station 2	Station 1	Total
no.:		Station 1	Station 2	Station 3	Station 4	Station 5						
Check (cont.)												
Chlordane												
E. to W.		131210	202440	110981	032532							
321101		212223	111222	110125	235637							
241112												
W. to E.		220101	002422	220654	375052						480	
203210		014100	100221	522103	375052							
113102												
Aldrin												
7	W. to E.	134111	000110	100000	101013							
	110200	020100	100010	212001	100001							
	000000											
E. to W.		101201	000210	001210	010201							
402201		305210	012402	001023	000110							
320010												
W. to E.		000000	030000	001000	011010						115	
001000		100000	000012	102000	010010							
001000												
8	E. to W.	000001	000101	010110	201100							
	001201	100000	000001	001010	211031							
	000110											
W. to E.		101000	100002	102200	013001							
000210		100100	000001	002100	010001							
012000												
E. to W.		300200	000220	101100	011002							
000100		200010	100010	101100	011002						90	
002120												

Table 4. Concl.

Plot:		Grashoppers caught in net after 36 uniform sweeps for each station					
no.:		Station 1	Station 2	Station 3	Station 4	Station 5	Total
White arsenic							
9	W. to E.		211124	003101	002001	000101	
		330100	332110	121120	100230	000015	
	020312						
	E. to W.		332110	121120	100230	000115	
		020312	112010	000131	201031	231143	
	010310						
	W. to E.		510310	001002	001010	013020	
		211022	101100	123002	301101	021002	187
	010303						

Table 5. Grasshopper populations on baited plots 7 days after treatment with four toxicants at the Mankan Airport as determined by the sweep net method.

Plot no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Toxaphene						
1	W. to E. 3 1 1 1 1 0 0 1 0 0 0 0	1 0 1 1 0 1 0 1 0 2 0 3	2 2 1 1 1 0 1 1 2 1 0 0	0 1 0 0 0 0 0 0 0 0 0 0	0 0 0 1 1 0 0 0 0 0 0 0	0 0 0 1 1 0 0 0 0 0 0 0
	E. to W. 1 0 0 0 0 0 1 0 0 0 0 1	0 0 0 0 0 0 0 0 0 0 0 1	0 0 0 0 0 0 1 3 0 0 0 0	0 1 1 1 1 0 0 0 0 0 0 0	4 1 3 2 0 1 1 1 1 0 1 0 2	
	W. to E. 6 1 4 1 3 0 1 2 5 4 3 2	1 0 0 1 0 1 0 0 0 2 2 2	0 0 0 0 0 0 1 0 3 0 0 1	4 2 0 2 1 0 3 1 2 0 0 0	2 0 0 0 0 1 2 0 3 5 4 3	155
Chlordane						
2	W. to E. 2 2 1 2 2 3 1 1 1 0 1 1	0 0 0 2 0 2 0 1 1 1 1 1	0 0 0 1 0 0 0 0 0 1 0 0	1 2 1 0 2 3 0 0 0 2 1 1	2 2 2 3 0 0 1 4 1 0 0 0	
	E. to W. 0 0 1 0 0 0 0 2 0 0 0 1	0 5 2 1 0 0 0 0 0 0 0 0	0 0 1 0 0 0 0 2 3 0 0 1	0 0 0 0 0 1 0 0 0 2 0 1	1 2 0 0 0 2 1 0 0 1 1 2	
	W. to E. 3 3 1 0 0 1 2 4 0 0 1 1	0 0 0 0 1 0 2 0 0 0 0 1	0 1 0 0 1 0 5 3 1 0 0 0	1 0 0 1 1 0 1 0 0 0 0 0	4 1 1 0 0 0 5 1 0 3 1 0	140
White arsenic						
3	W. to E. 2 2 2 3 2 1 5 1 2 0 1 0	2 1 0 1 1 0 0 0 0 0 0 5	0 2 1 2 1 2 0 1 4 4 3 3	0 3 1 3 1 2 1 2 0 1 0 2	0 2 0 1 0 1 0 0 0 3 1 2	
	E. to W. 2 0 0 1 1 2 0 0 0 1 2 1	4 5 8 3 3 0 2 7 3 1 2 0	1 0 0 5 2 4 2 1 1 3 1 6	3 2 3 3 4 3 2 2 1 0 1 3	3 5 7 1 4 1 1 0 9 8 0 1 1	

Table 5. Cont.

Plot:		Grasshoppers caught in net after 26 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
White arsenic (cont.)						
4						
	W. to E.	0 1 1 4 0 1	0 0 1 0 0 0	8 5 5 0 0 0	2 2 1 2 4 1	331
	2 3 1 5 2 6	2 0 0 0 0 2	5 3 0 0 0 0	0 1 0 0 1 2	0 0 4 2 0 3	
	1 0 3 2 4 6		Aldrin			
	W. to E.	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 0 2 0	0 0 0 0 0 0	0 0 0 0 1 0	
	0 1 0 0 0 1					
E. to W.						
	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 2 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 0 0 1	0 0 0 0 0 0	
	0 0 0 0 0 0					
W. to E.						
	0 1 1 0 0 1	1 0 0 0 0 0	0 0 0 0 1 0	1 0 0 0 0 1	0 0 0 1 0 1	40
	6 1 3 0 0 0	0 1 0 0 0 1	0 0 1 0 0 0	1 1 1 1 0 0	0 0 0 0 1 0	
5						
	E. to W.	1 0 2 2 2 2	3 1 2 1 0 2	1 1 3 3 5 3	1 1 2 1 2 1	
	0 0 1 0 0 1	0 0 0 0 0 1	0 1 2 2 2 2	4 2 2 1 0 4	0 3 3 4 2 2	
	0 0 1 2 2 0		Toxaphene			
	W. to E.	1 0 1 2 3 0	0 0 3 1 0 0	0 1 0 1 1 2	4 1 1 0 0 2	
	0 0 1 0 0 1	1 0 1 0 0 3	2 0 1 1 1 1	1 0 1 3 1 0	1 2 1 0 1 3	
	0 0 1 0 1 0					
6						
	E. to W.	2 1 1 0 1 1	1 0 3 4 0 1	0 0 2 0 1 0	0 1 0 2 1 0	195
	2 1 0 1 1 1	2 0 1 0 1 2	0 1 0 1 0 0	0 1 1 2 1 0	0 0 0 0 2 2	
	0 1 0 3 0 3		Check			
	W. to E.	2 5 5 12 128	6 5 8 10 7 8	5 5 3 10 3 6	0 5 2 3 2 4	
	2 2 3 10 10 5	6 3 3 4 5 3	5 9 10 7 5 11	2 2 3 4 4 8	2 2 3 2 1 11	
	3 4 13 1 3 5					

Table 5. Cont.

Plot no.	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Grasshoppers caught in net after 16 uniform sweeps for each station						
Check (cont.)						
E. to W.	0 0 1 1 0 0	0 0 0 2 0 3	3 1 2 1 2 1	1 1 4 4 1 1		
0 0 0 1 0 0	1 3 2 0 1 3	1 0 2 2 0 0	0 0 0 0 2 1	0 1 1 2 0 0		
W. to E.	0 3 1 1 0 0	2 2 3 1 2 0	1 1 0 3 1 2	0 2 0 0 1 2		480
1 2 1 1 7 5	1 2 3 1 3 7	2 2 3 1 2 0	2 1 5 0 1 2	0 1 1 0 1 1		
Chlordane						
E. to W.	0 2 0 1 1 1	0 0 1 1 0 0	0 0 1 1 0 0	1 0 0 0 0 3		
0 2 0 0 1 1	0 1 1 1 0 1	1 1 0 0 0 0	0 1 0 0 0 0	2 1 0 1 1 0		
0 1 0 0 0 0	1 0 0 0 0 1	0 0 0 1 1 0	1 1 0 1 0 0	1 1 1 1 1 1		
W. to E.	0 0 0 0 0 0	0 0 0 1 0 2	0 0 2 0 0 1	1 0 1 1 1 0		
0 0 0 2 1 1	1 0 0 0 0 0	0 0 0 1 1 0	0 0 2 0 0 1	1 0 1 1 1 0		
E. to W.	0 1 1 0 0 0	0 0 0 3 0 0	0 2 3 1 1 0	0 0 2 1 3 2		122
0 1 1 0 0 2	0 0 0 0 1 1	0 5 0 1 2 2	2 3 3 0 0 1	3 1 2 4 1 2		
Aldrin						
W. to E.	3 0 0 0 2 1	1 0 3 0 1 2	0 1 0 2 0 0	0 0 1 1 1 0		
0 1 0 0 1 0	1 0 0 0 0 0	0 0 0 3 2 2	0 1 0 0 0 0	0 0 0 1 0 0		
0 0 2 2 0	3 0 0 0 0 0	0 0 0 3 2 2	0 1 0 0 0 0	0 0 0 1 0 0		
E. to W.	0 1 1 0 1 1	0 0 3 0 0 0	0 0 0 0 1 0	0 1 0 0 1 0		
0 0 3 0 2 1	0 1 0 1 2 3	0 1 1 2 0 0	0 1 0 0 0 0	0 1 1 0 0 0		
W. to E.	1 0 0 0 0 0	0 1 0 0 0 0	0 1 1 0 0 0	0 0 0 0 1 1		95
1 0 3 2 1 1	0 0 0 0 1 0	0 0 0 0 0 1	0 0 0 0 0 0	1 0 0 2 1 1		
1 1 0 1 1 1	0 0 0 0 1 0	0 0 0 0 0 1	0 0 0 0 0 0	1 0 0 2 1 1		

Table 5. Concl.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station					
No.:		Station 1	Station 2	Station 3	Station 4	Station 5	Total
		White arsenic					
9	E. to W.	0 1 2 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 5 4 1	4 3 2 6 3 5	
	0 0 0 2 1 0	1 1 0 0 1 1	2 1 0 1 0 2	1 0 0 1 1 4	6 5 2 4 7 2		
	W. to E.	2 2 1 3 2 1	0 1 2 0 1 0	2 2 1 2 3 1	0 1 4 3 1 1		
	3 3 1 4 2 4	2 0 3 0 1 0	1 1 2 1 1 3	2 3 3 2 1 1	8 1 0 8 2 1		
	E. to W.	4 2 0 2 2 1	1 3 1 1 1 0	6 6 4 2 2 3	0 3 1 3 4 5		
	1 0 3 2 1 2	1 1 0 1 0 1	1 0 2 0 2 0	1 1 7 1 3 7	5 1 0 3 5 2		331

This experiment was divided into two phases, namely, those plots baited in the early morning and those baited in the early afternoon. Four applications were made in the morning between 5:18 and 6:27 A. M. at temperatures that ranged between 74° F. and 78° F. Four applications were made in the afternoon of the same day between 2:50 and 3:47 P. M. at the temperature of 89° F.

The morning applications included toxaphene at 0.1 pounds, chlordane at 0.05 pounds, aldrin at 0.0124 pounds, and white arsenic at 6.4 ounces per acre. The afternoon applications were replicates of the morning applications.

The following results were obtained when the materials were applied in the morning (Figure 3 and Table 6). Toxaphene at 0.1 pounds per acre showed a 46 per cent reduction of grasshoppers at 24 hours, a 59 per cent reduction at 72 hours, and a reduction of 67 per cent seven days after application. Chlordane at 0.05 pounds per acre showed a 21 per cent reduction in grasshoppers 24 hours after application, a 50 per cent reduction at 72 hours, and a 70 per cent reduction at seven days. White arsenic at 6.4 ounces per acre showed at 24 hours after application a 7 per cent reduction, at 72 hours a 29 per cent reduction, and at seven days a 31 per cent reduction in population. Aldrin at 0.0124 per acre showed an 83 per cent reduction in population at 24 hours after treatment, 82 per cent reduction at 72 hours after treatment, and a 90 per cent reduction at seven days.

The afternoon treatments were replicates of the morning applications, and the results were: toxaphene at 24 hours, 54.7 per cent reduction in population, at 72 hours a 74.7 per cent reduc-

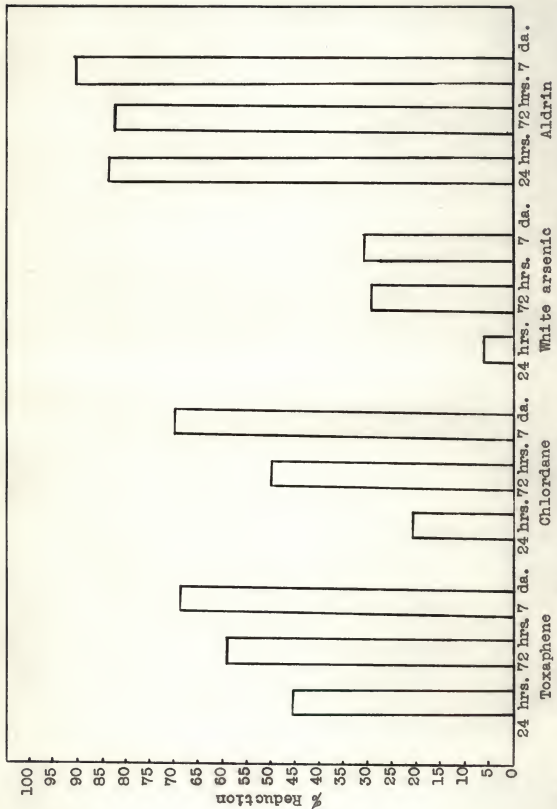


Fig. 3. The percentage and comparative rate of reduction of grasshoppers in alfalfa at 24 hours, 72 hours, and 7 days, of four poison bran baits applied in the morning between 5:18 and 6:45 a.m. at temperatures from 74° F. to 78° F.

Table 6. Effectiveness of four toxicants when used in baits against grasshoppers in alfalfa at ManKan Airport, Pettawatomie County, Kansas, from June 24 to July 2, 1949.

Material	:Lbs. of ac- :tual toxicant per : acre	:Temper- :ature : when	: applied:	Time	% Reduction of grasshoppers		
					: 24 hrs.:	: 72 hrs.:	: 7 days
Morning applications							
Toxaphene	0.1	74° F	5:18-5:30	46	59	67	
Chlordane	.05	77° F	5:50-6:09	21	50	70	
White ar- senic	.40	78° F	6:27-6:45	7	29	31	
Aldrin	.0124	77° F	6:09-6:27	83	82	90	
Afternoon applications							
Toxaphene	0.1	89° F	3:47	54.7	74.7	59	
Chlordane	.05	89° F	3:34	75	76	74	
White ar- senic	.40	89° F	2:50	35	61	31	
Aldrin	.0124	89° F	3:15	72	81	80	

tion in population, and at 7 days a 59 per cent reduction was noted. Chlordane at 24 hours showed a 75 per cent reduction in grasshopper population, at 72 hours a 76 per cent reduction, and at 7 days a 74 per cent reduction. White arsenic at 24 hours after application showed a 35 per cent reduction, at 72 hours a 61 per cent reduction, and at 7 days a 31 per cent reduction. Aldrin in 24 hours showed a 72 per cent reduction in population, at 72 hours an 81 per cent reduction, and at 7 days an 80 per cent reduction (Figure 4 and Table 6).

Baiting - Geary County

A check was made at the end of one week after the application of the material to the alfalfa. It was found that the alfalfa in the treated portion of the fields showed very good growth while that alfalfa in the untreated plots showed no new growth because of the feeding of the grasshoppers. At two weeks after application, the treated portions of the field showed a very lush growth of alfalfa. The untreated portions were still in the condition of little or no vegetation as they were before the treated areas of the other portions.

A narrow lane separated the two fields, which are hereafter referred to as the north and south fields.

Figure 5 shows the approximate shape of the fields treated. Plates II through VIII show the progress of the baiting experiment.

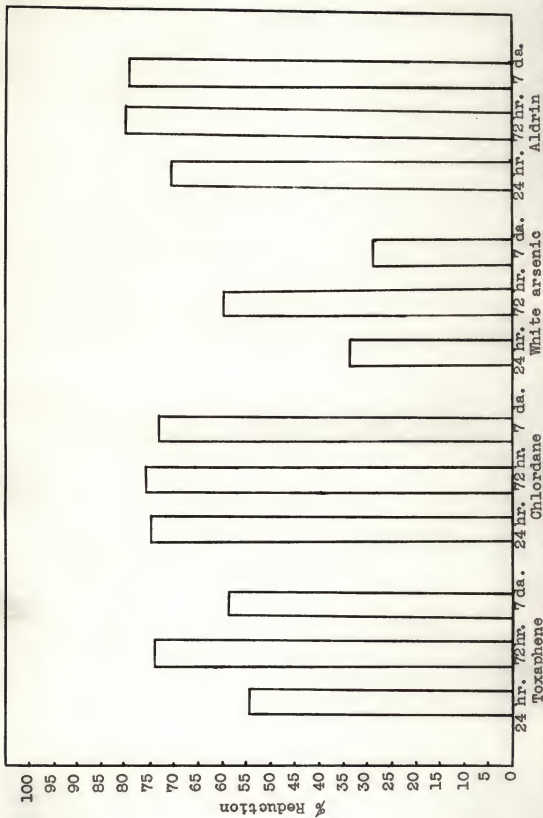


Fig. 4. The percentage and comparative rate of reduction of grasshoppers in alfalfa at 24 hours, 72 hours, and 7 days, of four poison bran baits applied in the afternoon between 2:50 and 3:47 P.M. at a temperature of 89° F.

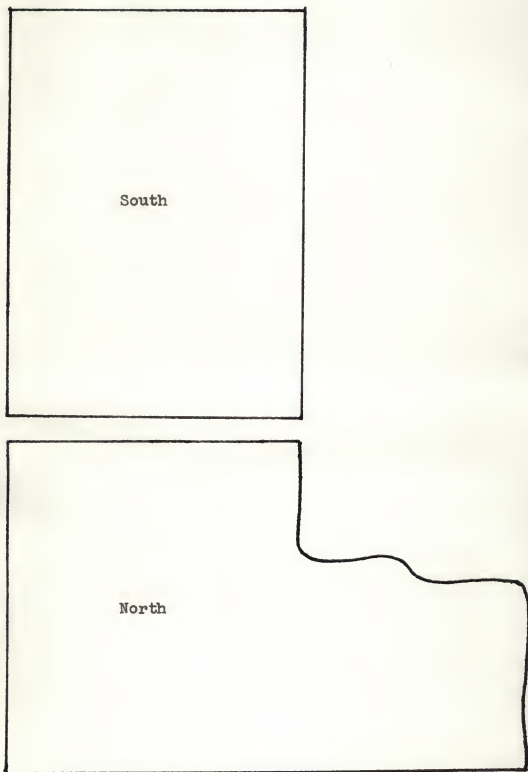


Fig. 5. Approximate shape of alfalfa fields treated with poison bran at the Hickman Farm to control M. bivittatus Say.

EXPLANATION OF PLATE II

Fig. 6. The trailer bed in which the aldrin and bran were mixed. The handle of the shovel used for mixing the bait, the jar containing the aldrin, the measuring cup, and the top of the sprayer are shown in the foreground with the bran being in the background.

Fig. 7. Close-up of defoliated alfalfa plants at the Hickman farm showing a grasshopper on a bare alfalfa stem.

PLATE II



Fig. 6



Fig. 7

EXPLANATION OF PLATE III

Fig. 8. Section of check plot in the south field on the Hickman farm, Geary County, before application of aldrin baits.

Fig. 9. Another section of the check plot described in Figure 8.

Fig. 10. The north field of the Hickman farm before treating.

PLATE III



Fig. 8



Fig. 9

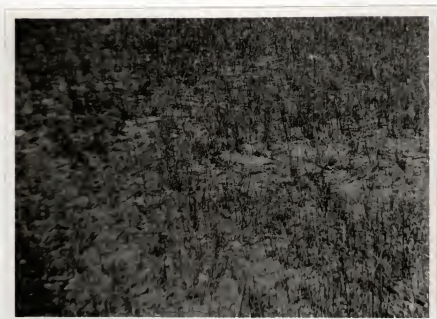


Fig. 10

EXPLANATION OF PLATE IV

Fig. 11. Alfalfa in the check plot in the north field of the Hickman farm before treatment showing severe grasshopper damage.

Fig. 12. Alfalfa in the north plot of the Hickman farm one week after treatment.

PLATE IV



Fig. 11



Fig. 12

EXPLANATION OF PLATE V

Fig. 13. The south field at the Hickman Farm one week after treatment showing slight recovery from grasshopper attack.

Fig. 14. The alfalfa in the immediate foreground serves as a check portion of the south field at the Hickman Farm one week after treatment of the rest of the field.

PLATE V



Fig. 13



Fig. 14

EXPLANATION OF PLATE VI

Fig. 15. The south field at the Hickman Farm, two weeks after treatment, showing continued damage to the alfalfa by the grasshoppers.

Fig. 16. The check plot at the south field at the Hickman Farm, two weeks after treatment, showing continued damage to the alfalfa by grasshoppers.

PLATE VI



Fig. 15



Fig. 16

EXPLANATION OF PLATE VII



Fig. 17. The check of the north field at the Hickman Farm, two weeks after treatment of the rest of the field, showing continued damage to the alfalfa by grasshoppers.

Fig. 18. Treated and untreated portions of the north field two weeks after application. The darker portion at the right of photograph is the treated portion, while the lighter area on the left is the check.

PLATE VII



Fig. 17



Fig. 18

EXPLANATION OF PLATE VIII

Fig. 19. Portion of north field of the Hickman Farm, two weeks after applications of baits, showing alfalfa recovery.

Fig. 20. Portion of north field of the Hickman Farm, two weeks after applications of baits, showing alfalfa recovery.

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PLATE VIII



Fig. 19



Fig. 20

Spraying - ManKan Airport

Grasshoppers. After the insecticides--chlordane, toxaphene, and aldrin--were sprayed, each plot was checked for grasshoppers just before spraying at 24 hours, 72 hours, and 7 days, respectively.

The unit grasshopper counts obtained by the sweep net method are shown in Tables 7 through 10.

Table 7. Grasshopper populations on sprayed plots immediately before treatment with three toxicants at the Mankan Airport as determined by the sweep net method.

Plot no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Chlordane						
1	294263	653423	512373	220111	450355	
	652323	664132	155463	151333	322413	
	111112	158122	340221	012211	002123	
	110333	485312	022100	012202	010114	
	101121	011001	400331	7106130	581532	463
	101300	000200	432011	321220	998558	
Toxaphene						
2	343067	542301	220322	103023	441841	
	1111716	010002	101312	131037	5986114	
	020014	120021	000200	105012	110000	
	110202	100220	012022	052200	2853112	
	130240	121100	111000	000100	000110	312
	104051	001012	005311	001000	001013	
Aldrin						
3	302322	463246	143000	000000	000000	
	2656412	8841053	938321	51012311	2109321	
	836886	400010	000002	000100	000000	
	731405	401321	001023	000003	002121	
	230112	101201	201000	221024	033000	367
	231102	225021	005100	104010	143001	
Toxaphene						
4	230547	310002	122213	000203	000302	
	3215414	353216	010332	053233	000635	

Table 7. Cont.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Toxaphene (cont.)						
5	216433 122834 531412 330120	1212232 618234 142588 5586511	668562 13852052 8918210 554506	20157811 101711315 100874 134101210	2308117 222259 561511 0152523	784
Aldrin						
5	111001 001012 543021 243211 011410 001111	012000 010016 533000 141031 020111 332100	002440 300003 231203 100032 002300 211112	121130 310211 021021 101220 300003 011001	101352 210154 010101 010231 422311 242122	238
Chlordane						
6	6101331 3912628 503536 121021 300002 0232272	332423 335433 215355 200012 110101 438310	132710 221143 431352 525023 001131 012336	140012 321110 641557 1131226 442225 100100	101132 140302 103354 213220 123564 041269	467
Check						
7	531141 032413 834212 5311214	231102 032413 211001 104201	942001 100003 010310 022310	113301 711015 010310 300122	211314 011230 001213 121011	

Table 7. Concl.

Plot: Grasshoppers caught in net after 36 uniform sweeps for each station						
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
			Check (cont.)			
632502	521124	210114	210111	500340	371421	
314215	624025	235314	150243	052635	381	

Table 8. Grasshopper populations on sprayed plots 24 hours after treatment with three toxicants at the MenKan Airport as determined by the sweep net method.

Plot:		Grasshoppers caught in net after 36 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
	Chlordane					
1	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 1 0	0 0 0 1 0 0	0 0 0 1 0 0
	0 0 0 0 0 0	0 0 0 0 1 0	0 0 1 0 0 0	0 0 1 0 0 1	1 0 0 0 0 0	1 0 0 0 0 0
	0 0 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 3 0 0 0 1	0 1 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 1	0 0 0 0 1 0	0 0 0 0 1 0
	0 0 0 0 0 1	1 0 1 0 0 1	0 0 0 0 0 1	0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 0 0 1
	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 0	0 0 0 0 1 1	0 0 1 0 0 0	0 0 1 0 0 0
	Toxaphene					27
2	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 2 1	0 0 0 0 1 0	0 0 1 0 0 0	0 0 1 0 0 0
	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 1	0 2 1 0 0 0	0 2 1 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 1	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 1 0 1	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Aldrin					22
3	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	0 1 0 0 0 0	0 1 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	1 0 0 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 0 0 0	1 0 0 0 0 0	1 0 0 0 0 0
	Toxaphene					8
4	0 0 4 0 1 0	0 0 1 0 1 1	1 0 0 1 2 1	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	0 0 1 0 4 2	1 0 1 0 0 1	0 0 1 0 1 1	0 1 0 1 2 2	0 1 2 0 0 1	0 1 2 0 0 1
	1 1 0 0 1 0	0 0 0 0 0 0	0 2 0 0 0 0	1 0 0 0 0 0	0 0 1 1 1 0	0 0 1 1 1 0
	1 0 1 0 0 0	0 1 3 0 0 0	0 0 1 1 0 0	2 1 1 1 0 0	2 2 0 0 0 2	2 2 0 0 0 2

Table 8. Concl.

Plot no.:	Grashoppers caught in net after 36 uniform sweeps for each station					
	Station 1	Station 2	Station 3	Station 4	Station 5	Total
5	013231	230123	100000	000110	010200	118
	132011	002011	111100	101001	000143	
Toxaphene (cont.)						
5	000001	000000	000000	000000	000000	7
	000000	000000	000000	000000	001000	
Aldrin						
5	000000	000000	000000	000000	000000	7
	000000	000000	000000	000000	100000	
Chlordane						
6	130010	101111	101110	000010	000000	43
	110000	000300	000001	000000	000000	
6	000100	200000	100000	000000	000010	43
	100000	101000	000000	000000	000010	
6	000000	010001	111001	101200	011010	43
	000100	000000	000000	000000	000010	
Check						
7	020322	204203	200342	130401	120411	283
	581032	225224	113133	333121	111121	
7	111003	412030	220113	121030	501201	283
	100011	201026	011240	101100	000111	
7	251200	120302	121000	222042	000522	283
	240132	201004	111113	120122	210754	

Table 9. Grasshopper populations on sprayed plots 72 hours after treatment with three toxicants at the ManKan Airport as determined by the sweep net method.

Plot no.:	Grasshoppers caught in net after 36 uniform sweeps for each station					Total
	Station 1	Station 2	Station 3	Station 4	Station 5	
1	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	1 1 0 0 1 0	0 1 1 1 0 0	21
	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 1 0 0	0 0 1 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	1 0 0 0 0 0	3 0 0 2 0 1	0 0 1 0 0 0	0 0 0 0 1 0	
2	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	6
	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 1	1 0 0 0 0 0	
3	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	7
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 2 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0	
4	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	7
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 1 0 0	
	1 1 0 1 0 0	0 0 0 0 0 0	1 1 0 1 1 0	0 0 0 0 0 1	0 0 0 0 0 0	
	0 1 0 0 0 1	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 1 0 0	1 1 0 0 0 0	
5	0 0 0 0 0 0	0 1 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	6
	0 0 0 0 0 0	0 1 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 1 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 1 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
6	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	7
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
7	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	7
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 2 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0	
8	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	7
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
9	1 1 0 1 0 0	0 0 0 0 0 0	1 1 0 1 1 0	0 0 0 0 0 1	0 0 0 0 0 0	6
	0 1 0 0 0 1	0 0 0 1 0 0	0 0 0 0 0 0	0 0 0 1 0 0	1 1 0 0 0 0	
	0 0 0 0 0 0	0 1 1 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 1	0 0 0 0 0 0	0 0 0 0 0 0	

Table 9. Concl.

Plot no.:	Grasshoppers caught in net after 36 uniform sweeps for each station						Total
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 5	
	Toxaphene (cont.)						
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	18
	Aldrin						
5	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	2
	Chlordane						
6	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 1 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	0 1 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	1 1 0 0 0 0	0 0 0 0 0 0	0 0 0 1 0 1	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 0 1 0	
	0 0 0 0 1 0	0 0 0 0 0 0	1 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 1 1 0	21
	0 0 0 0 1 0	1 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	
	Check						
7	3 4 3 2 3 2	4 0 2 3 2 2	5 4 1 7 3 3	2 4 0 2 2 2	2 4 0 2 2 2	9 3 4 2 4 9	
	2 3 3 4 3 2	2 4 5 1 0 1	5 2 2 1 3 3	3 0 6 2 4 2	3 0 6 2 4 2	3 3 2 5 4 1	
	1 0 3 4 4 3	1 3 3 0 1 0	1 4 0 1 1 3	6 3 2 4 1 1	6 3 2 4 1 1	0 1 1 5 1 1	
	3 5 2 4 4 3	5 3 1 3 2 1	1 3 0 1 4 3	2 1 3 2 2 3	2 1 3 2 2 3	1 3 4 0 5 1	
	10 4 2 9 4 5	5 2 2 8 6 7	7 4 1 2 8 5	4 8 2 5 0 2	4 8 2 5 0 2	6 5 3 3 9 5	649
	5 6 10 11 6 7	5 4 8 11 4 7	4 2 7 8 5 1 5	6 4 11 6 4 2	6 4 11 6 4 2	4 6 4 3 3 5	

Table 10. Grasshopper populations on sprayed plots 7 days after treatment with three toxicants at the ManKan Airport as determined by the sweep net method.

Plot no.:	Grasshoppers caught in net after 36 uniform sweeps for each station					Total
	Station 1	Station 2	Station 3	Station 4	Station 5	
1	001000	000000	104010	010000	110000	110000
	100001	100000	030100	000011	100100	100100
	100000	000020	011101	010101	100100	100100
	100000	120010	010100	010000	101000	101000
	011000	000000	000000	000000	000000	000000
001000	000111	001010	010101	110000	56	
2	000100	000000	010000	110000	000000	000000
	000010	000100	000100	000000	000000	000000
	110100	000011	233100	000102	000010	000010
	000000	210101	000111	001012	110110	110110
	000001	010000	000000	010020	110200	110200
020001	000000	201001	001000	000100	000100	59
3	000000	001000	100001	000000	100000	100000
	010100	001101	100000	020000	000001	000001
	200000	101000	000000	011000	000000	000000
	112110	100001	000000	000000	000010	000010
	010000	010001	001000	003000	000000	000000
010000	100000	000003	000000	000000	000000	40
4	100000	000000	000010	000000	001000	001000
	100000	000000	011000	000000	000000	000000
	011020	010000	000000	000021	100100	100100
	010101	000000	000100	000100	100111	100111

Table 10. Conol.

Plot:		Grasshoppers caught in net after 16 uniform sweeps for each station				
no.:	Station 1	Station 2	Station 3	Station 4	Station 5	Total
	0 0 0 0 0	1 0 0 0 0 2	2 0 0 2 0 0	0 2 2 2 1 1	1 0 0 0 2 1	65
	1 0 1 0 0 0	0 1 0 0 0 0	0 1 1 1 0 1	3 0 1 2 1 1	1 0 3 2 0 0	
		Toxaphene (cont.)				
5	1 0 0 0 2 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	
	0 0 0 0 1 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 2	0 0 0 0 0 0	
		Aldrin				
	0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 0 1 0	1 0 0 0 1 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 1 0 0	0 0 0 2 0 0	0 0 0 0 0 0	0 0 0 0 1 0	20
	0 1 1 0 0 0	0 0 0 0 1 3	0 0 0 0 0 0	1 0 1 0 0 0	0 0 0 1 0 0	
		Chlordane				
6	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0	
	0 0 1 0 0 0	0 0 0 0 0 0	0 0 1 0 0 0	0 0 0 1 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	2 0 0 1 0 0	0 0 0 0 0 0	0 0 0 0 0 0	
	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 0 0 0	2 2 1 0 1 0	0 1 0 0 0 0	
	0 0 1 0 0 0	0 0 1 1 0 0	1 0 0 0 0 0	0 0 0 0 0 1	0 0 2 0 1 0	32
	0 0 1 1 0 1	1 0 0 0 0 0	0 1 0 0 1 0	0 0 1 0 0 1	0 1 0 0 0 0	
		Check				
7	0 0 0 0 0 0	1 0 1 2 2 0	2 0 0 1 1 0	2 0 1 0 3 0	2 1 0 1 2 1	
	0 0 0 1 1 1	2 2 2 0 0 0	0 0 0 2 1 1	3 1 0 0 1 0	3 3 3 0 1 1	
	6 1 3 5 4 3	2 0 1 1 1 0	0 1 4 0 3 1	0 6 2 2 2 1	0 1 3 1 0 1	
	3 2 1 3 4 1	1 2 3 4 2 4	0 1 4 0 3 1	1 5 6 1 2 1	2 4 4 1 0 0	
	3 2 3 1 2 2	0 2 1 3 0 0	2 1 0 3 0 1	2 1 1 0 0 1	2 1 3 2 0 2	273
	5 1 4 0 1 0	1 0 1 1 0 3	2 2 2 3 4 7	1 4 2 1 5 1	1 0 2 1 6 1	

Table 11 shows that chlordane at one pound per acre effected 87 per cent reduction in population 24 hours after application; at 72 hours, 96 per cent; and at 7 days, an 83 per cent reduction was found.

Toxaphene at 1.76 pounds per acre showed a 70 per cent reduction 24 hours after application; at 72 hours, a 98 per cent reduction; and 7 days, a 72 per cent reduction was effected.

Aldrin at 0.25 pounds per acre effected at 24 hours a 97.5 per cent reduction; at 72 hours, a 98.5 per cent reduction; and at 7 days after application, an 88.5 per cent reduction.

Figure 21 shows the comparative rate of reduction of grasshoppers by the sprays over a seven-day period.

Table 11. Effectiveness of three insecticides used in sprays against grasshoppers in alfalfa at ManKan Airport, Pottawatomie County, Kansas, from June 30 to July 7, 1949.

Materials	: Lbs. of actual: insecticide : per acre	Per cent reduction of grasshoppers*		
		24 hours	72 hours	7 days
Chlordane	1.0	87	96	83
Toxaphene	1.76	70	98	72
Aldrin	0.25	97.5	98.5	88.5

*Based in comparison with the check plot.

Extent of Webworm Damage Observed on Plots Sprayed for Grasshoppers. The average degree of infestation is shown as follows:

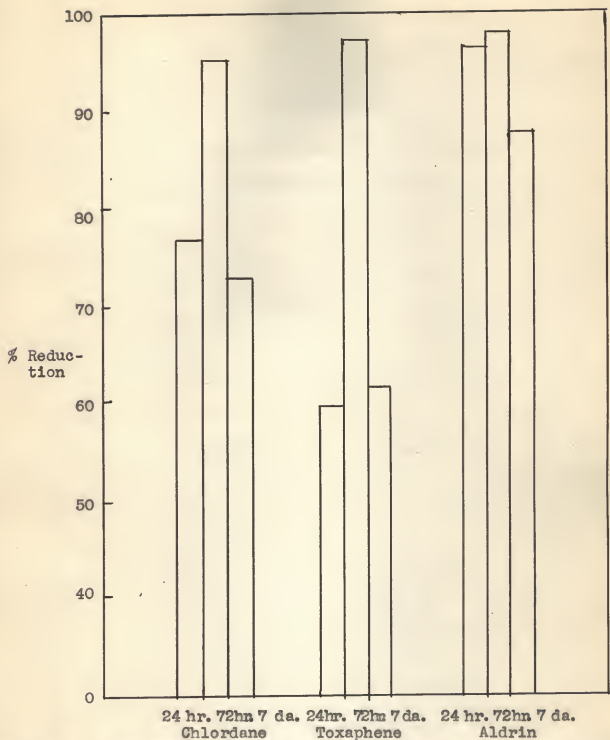


Fig. 21. Percentage and comparative rate of reduction of grasshoppers in alfalfa at 24 hours, 72 hours, and 7 days by toxaphene, chlordane, and aldrin used as sprays.

<u>Material used</u>	<u>Lbs. actual toxicant per acre</u>	<u>Type injury</u>	<u>Av. degree of inf.</u>
Chlordane	1.0	Severe	3.7
Toxaphene	1.76	Little	.82
Aldrin	0.25	Severe	3.5
Check	—	Severe	3.8

SUMMARY AND CONCLUSIONS

Baiting - ManKan Airport

Aldrin, at the rate of 0.0124 pounds per acre in bran baits, showed a consistently higher rate of grasshopper reduction than any of the other materials tested. When applied to alfalfa in the early morning at a temperature of 77° F., aldrin at the same dosage as applied to alfalfa in the afternoon at a temperature of 89° F., showed a high reduction of grasshopper population but not as high as that of the material applied in the morning.

White arsenic, in bran baits, applied to alfalfa at the rate of 6.4 ounces per acre in the morning at a temperature of 78° F., showed a 7 per cent reduction of the population at 24 hours but, at 72 hours after application, only a slight increase in reduction was evident, and in 7 days a 31 per cent reduction was determined. White arsenic in poison bran baits applied to alfalfa in the same dosage as above, in the afternoon, at a temperature of 89° F. gave similar poor results.

Chlordane at the rate of 0.05 pounds per acre applied to alfalfa in the morning at a temperature of 77° F. showed a poor reduction in grasshopper population at 24 hours. The number of

grasshoppers on this plot decreased at 72 hours and 7 days. Chlordane made a poor showing at the dosage applied in the morning. Chlordane, applied in the afternoon at a temperature of 89° F. at the same dosage as the morning treatment, showed better results. The reduction in grasshopper population was consistent during the three samplings of this plot.

Toxaphene, applied to alfalfa in bran baits at the rate of 0.1 pounds per acre and in the morning at the temperature of 74° F., was partially effective against grasshoppers at this dosage, the highest reduction being 67 per cent at 7 days. Toxaphene, at the above dosage applied to alfalfa in the afternoon at a temperature of 89° F., showed a higher reduction in grasshoppers at 72 hours after treatment.

The four materials used in baits, applied both in the morning and in the afternoon, are rated as follows in their average effectiveness against grasshoppers for one week:

<u>Material</u>	<u>When applied</u>	<u>Temperature, °F.</u>
Aldrin	A. M.	77°
Aldrin	P. M.	89°
Chlordane	P. M.	89°
Toxaphene	P. M.	89°
Toxaphene	A. M.	74°
Chlordane	A. M.	74°
White arsenic	P. M.	89°
White arsenic	A. M.	78°

Baiting - Geary County

Aldrin at 0.012 pounds per acre showed very good results in the control of the two-lined grasshopper, Melanoplus bivittatus Say.

Spraying - ManKan Airport

Grasshoppers. Aldrin at the rate of 0.25 pounds per acre showed a higher initial and more consistent reduction of the grasshopper population than any of the materials used. Chlordane at the rate of 1.0 pounds per acre was next best of the materials. At this dosage, chlordane effected a reduction as high as 96 per cent. Toxaphene performed very well at 72 hours after application, but still was not as effective as the other materials against grasshoppers.

Webworms. Of the three materials, chlordane at 1.0 pounds per acre, toxaphene at 1.76 pounds per acre, and aldrin at 0.25 pounds per acre, applied to alfalfa for the control of grasshoppers, toxaphene showed the most promising results.

Role of Poison Baits in Modern Grasshopper Control

With the advent of the chlorinated hydrocarbon sprays, it has appeared to certain investigators that poisoned bran baits for grasshopper control have become obsolete. This reasoning is not absolutely correct, as has been shown in these experiments. Poison bran baits still have their place. It has been demonstrated that poison baits have a good effectiveness against grasshoppers

in newly cut alfalfa fields.

For the smaller farmer who has little capital to invest in expensive spraying equipment, poison bran baits using some of the recommended new insecticides are his answer to the grasshopper control problem.

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