Control of Lepidiota vogeli *Brenske. The Brown Pasture Scarab of the Highlands of New Guinea.*

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ABSTRACT.

Insecticidal trials were carried out in the field at Goroka and Aiyura using dieldrin, B.H.C., and aldrin. The results indicate effective control with all materials.

Control methods and rates of application are discussed.

INTRODUCTION.

THE biology and ecology of this insect was treated in another paper by Barrett (1966). Control was first attempted by J. J. H. Szent-Ivany[1] and R. S. Carne[1] who established two insecticide trials in Goroka prior to 1955. Szent-Ivany (1958 and personal communication) reported that populations of larvae decreased naturally and before satisfactory experimental results could be obtained. Barrett (1966) indicates that this fall-off in numbers of young larvae is normal at the time of the year when the trials were carried out and also when Kikuyu Grass *Pennisetum clandestinum* is the host plant.

For a number of years after 1955, *Lepidiota* grubs were scarce and further trials were delayed until 1961.

INSECTICIDAL TRIAL—GOROKA.

Site.

An area of Blue Couch, *Digitaria didactyla* was selected on the lawn in front of the old residence of the Animal Industry Station. The area had been cut regularly ; grub damage was severe in some parts. The grass on some sections was becoming yellowish in colour and in small patches it was loose and dried out as a result of larval activity. A larval count, made as a preliminary to the application of insecticides, revealed a grub population of between five and six per square foot.

Trial Design.

A 7 x 4 randomized block was used, each plot being 3 metres by 4 metres in size ; area—0.003 acres.

Treatments.

A. Dieldrin (15 per cent. emulsion) at 4.25 lb. act. const./per ac.

B. Dieldrin (15 per cent. emulsion) at 10.6 lb. act. const./per ac.

C. No treatment.

D. BHC (10 per cent. dust) at 10.0 lb. act. const./per ac.

E. Aldrin (40 per cent. emulsion) at 1.9 lb. act. const./per ac.

F. Aldrin (40 per cent. emulsion) at 4.75 lb. act. const./per ac.

G. Water only.

Method of Application.

Treatments A, B, E and F were applied in water at the rate of 2 gal. per plot (= 660 gallons per acre) through a garden watering can, and G similarly. Treatment D was applied with a hand duster. For each treatment the plot was marked off into lanes with twine, and approximately half the material applied. Lanes were then laid out at right angles to the first series and the remainder applied. Progressive treatment of narrow strips ensured a relatively even distribution of insecticide on each plot.

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Plate I.—*Lepidiota vogeli* control trial area at Goroka, one and one-half years after the application of insecticides. Central and mid-distant plots have no larvae. Weeds are absent and the grass cover is complete. Strongly developed weeds are seen on the left where one man is standing, and less dense weeds on the right round the second man. Both of these plots have high populations of larvae.

Date of Application.

Treatments were applied on the 3rd February, 1961.

Counting Method.

Areas of 1 sq. ft. were examined at random in each plot; a strip 18 in. wide along the margin being avoided. Examination to a depth of 9 in. was found to be adequate, the soil being dug out with a spade and the numbers of larvae recorded.

Results of Counts.

Treatment.	Larval Count 2.3.1961 (Total in 16 sq. ft.).	Total Count 10.1.1962 (Total in 8 sq. ft.).
B. Dieldrin 10.6 lb./acre	0	0
A. Dieldrin 4.25 lb./acre	2	0
F. Aldrin 4.75 lb./acre	1	0
E. Aldrin 1.9 lb./acre	5	0
D. BHC 10.0 lb./acre	41	3
G. Water (660 gal./ac.) only	63	26
C. No treatment	64	17

The first count was made four weeks after the application of the insecticides. At the date of the second count 11 months had elapsed and larvae were from the generation of beetles laying eggs about eight months after the insecticides were applied.

The figures were not analyzed.

Treatment D (BHC dust) was not effective one month after application, probably due to lack of penetration. The result in the following year was satisfactory. All levels of dieldrin and aldrin gave a good kill within a month of application and grubs were absent in the following year.

Persistence of Effects.

The trial area was observed in October, 1963, two years and nine months after the treatments were applied. Two generations of larvae had developed since the initial infestation. All treated plots were covered with dense grass, mowing of the area having been discontinued. The untreated areas carried a growth of tall weeds.

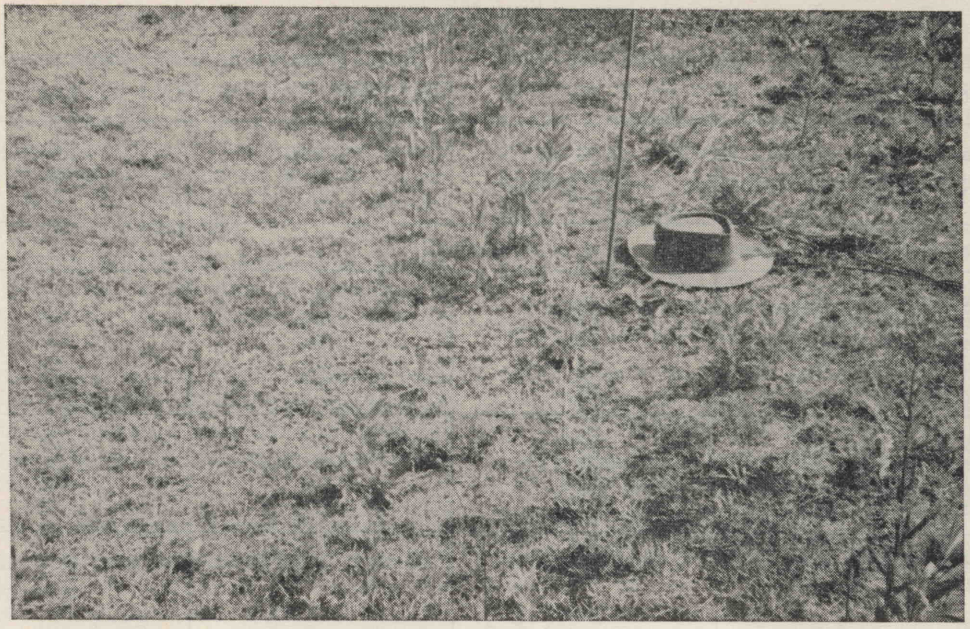

Plate II.—*Lepidiota vogeli* control area at Goroka, one and one-half years after treatment. Grubs have been controlled in the triangular area extending to the left. Weeds (*Erigeron* sp.) and a thin grass cover with some bare soil are visible on the right on both sides of the hat.

Damage to grass by the grubs reduces its vigour and weeds can enter and compete in the sward. This was very clearly seen in the second season of the Goroka trial. Weed growth was so consistently present in untreated plots that the plot plan was marked out in the field. (*Plates* I and II) There was a general correlation between weeds and grub counts. (This point was omitted from the previous paper—Barrett 1966.)

INSECTICIDAL TRIAL—AIYURA.

Trial Design.

The layout was a 5 x 5 Latin square, each plot being 32 sq. yd. in area.

Site.

Restricted areas of infestation made it impossible to use an area of uniform soil and grass cover. The area used was on the lawn of Residence No. 5 at the Highlands Agricultural Experiment Station, Aiyura.

Replication numbers 1 and 2 were on sloping ground with a brown clay soil overlying a lateritic subsoil at 8 to 10 in. The cover was carpet grass, *Axonopus compressus*. Replications 3, 4 and 5 were on a darker clay soil with a clay subsoil. The grass cover was blue couch, *Digitaria didactyla*.

Treatments.

A. Aldrin (40 per cent. emulsion) at 1.2 lb. of active ingredient/ac.

B. Dieldrin (15 per cent. emulsion) at 0.9 lb. of active ingredient/ac.

D. Dieldrin (15 per cent. emulsion) at 2.6 lb. of active ingredient/ac.

E. Aldrin (40 per cent. emulsion) at 2.8 lb. of active ingredient/ac.

C. No insecticide applied.

Method of Application.

All materials were applied in water at the rate of 48 oz. per plot (= 40 gal. per acre) using a 'Fontan' motorized variable volume sprayer. The 7 mm. jet was selected for use on this occasion. To prevent spread of material to adjacent plots, a length of hessian was laid along the outside of the borders of each plot prior to the application of the treatment.

Date of Application.

All treatments were applied on the 14th February, 1962.

Results.

Counts were made in the same manner as in the Goroka trial and details are as follows :—

Date of Count	14.5.1962	17.9.1962	4.3.1963
Total area sampled	100 sq. ft.	50 sq. ft.	75 sq. ft.
Total live insects	144	77	81
Live insects per plot—(mean of log (n + 1) transformation.)			
D. Dieldrin 2.6 lb./ac.	.631	.251	.060
E. Aldrin 2.8 lb./ac.	.620	.260	.396
B. Dieldrin 0.9 lb./ac.	.922	.564	.420
A. Aldrin 1.2 lb./ac.	.827	.715	.797
C. No treatment.	.891	.582	.752
General mean per plot	.778	.474	.485
Variance ratio	3.27 (x)	2.11 (n.s.)	9.19 (xx)
Least sig. diff. 5 per centum	.244	.440	.305
Least sig. diff. 1 per centum	.342	.617	.428
Treatment Differences	B C A D E X X B X X C X X A	A C B E D	A C B E D X X XX A X X XX C X B X E

NOTE.—Counts on the 14.5.1962 and 4.3.1963 were of larvae. Pupae and adults were present on the 17.9.1962.

The above counts were made at periods 3, 7 and 13 months after the application of insecticides. After three months the higher levels of dieldrin and aldrin had significantly reduced the population. At seven months the trend had continued but the sampled area was too small to give significance in the results. In the following year the figures show that dieldrin, at 2.6 lb./ac., under the conditions of this trial, effectively removed the grub population. Aldrin at 2.8 lb. was equal to 1.24 lb. of dieldrin and removed over 50 per cent. of the larvae.

DISCUSSION.

Factors producing some inconsistency in the results of the two trials may be (1) soil, (2) grass cover, (3) volume of solution applied.

The soil variation at Aiyura resulted in differences between replications but the trend of results was towards a reduced effect on the darker clay soil. This soil is most nearly akin to the soil at Goroka.

The grass in both cases was cut a few days before the insecticides were applied, and the amount of material remaining would have been similar in each case.

The volume of water per acre was markedly different in the two trials and this factor is considered responsible for the reduced effects of insecticides in the Aiyura trial. At Aiyura 2.8 lb. of aldrin in 40 gal. of water per acre gave a similar control to 1.9 lb. of aldrin in 660 gal. of water per acre in the trial at Goroka. It is considered that relatively high volumes of water are necessary to ensure that the insecticides are carried through the grass and close to, or on to the surface of the soil. The delayed effect of BHC when applied as a dust may also be due to poor initial penetration of the insecticide.

The relative effectiveness of aldrin and dieldrin is indicated in the second trial where 0.9 lb. of dieldrin gave a control approaching that of 2.8 lb. of aldrin per acre.

CONTROL.

Necessity to Apply Control Measures.

In the previous paper, Barrett (1966) discussed the effect of larvae on various host plants. Populations of over three to four larvae per square foot, depending on the species, age and vigour of the plant, are capable of causing marked damage to grass. (*Plate* III)

Since the population of larvae falls as the season progresses, a set time of counting is necessary and the above figures apply in early January.

Relatively large spring flights of beetles will indicate the possibility of sufficient numbers of larvae to cause damage and areas of grass, if of a susceptible species, should be examined in early January.

Sampling to Determine Larval Population.

Presence of larvae in areas which it is desired to protect may be determined by counting the numbers in sampling holes. Each hole must be 1 ft. square, and dug to a depth of 6 to 8 in. Larval populations are variable, hence a minimum of 10 holes *or* 40 larvae is required to give a dependable estimate of the population in an area. Where an area extends over a number of acres, more than one series of sample holes is necessary.

Control Materials.

Complete removal of larvae can be expected following the application of—

(*a*) *Aldrin* as a 0.05 per cent. solution in water at the rate of 1 gal. to 12 sq. yd. (2 lb. of active constituent per acre) ; or

(*b*) *Dieldrin* as a 0.025 per cent. solution in water at the rate of 1 gal. to 12 sq. yd. (1 lb. of active constituent per acre) ; or

(*c*) *BHC* as a 10 per cent. dust at the rate of 4 oz. per 12 sq. yd. (10 lb. of active constituent per acre).

Plate III.—*Lepidiota vogeli* damage, Goroka, in the area adjacent to the trial. The grass roots have been eaten off an inch below the ground and the mat of grass is shown after being broken and rolled back to leave loose grub-turned soil. (Note matchbox)

Application.

Grass on the area to be treated should be cut as short as possible and the cuttings removed prior to the application of the insecticides.

It should be noted that the above rates are the maximum necessary to give good control within four weeks of application. Control will persist for at least two seasons and some effect can be expected up to the fourth year. This will cover one cycle of abundance of the beetle, as indicated in the previous paper by Barrett (1966).

Since low populations of larvae may beneficially affect 'sod-bound' stands of grass by removing old roots, it may not be desirable to establish complete control. In this case a reduction in the above rate of application should be considered. The above trial results suggest that a reduction of up to 50 per cent. could give a sufficient control. In the case of BHC dust an even greater reduction in the rate of application may be satisfactory.

The choice of materials should be based on the relative cost per unit area of the treatment. In the above trials the readily available emulsion formulations of aldrin and dieldrin were used. For the treatment of large areas water application may be inconvenient. Aldrin and dieldrin are both available as dusts but these formulations were not used in the trials. Similar results could be anticipated at equivalent rates of application per acre, but the rate of initial kill may be a little slower.

Prevention of Damage.

Areas planted to grass in years of beetle prevalence may be conveniently treated at planting. This will allow more effective penetration of the insecticide into the soil and prevent damage to the sward before it becomes established.

Availability of Materials.

Diminishing acceptability of the chlorinated hydrocarbons is evident for the treatment of pastures, and chemical companies are reducing the production of this type of chemical. At present no alternative materials of acceptable toxicity and persistence are available. While there is no great hazard in the use of aldrin and dieldrin in non-grazed areas these materials may become less readily available and further work may be necessary to establish new methods of control.

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