SOME FURTHER INSECTICIDE TESTS AGAINST THE ELEGANT GRASSHOPPER

By J. DICK.

This paper is a continuation of one which was read to this Congress in 1948,[1] in which an account was given of laboratory tests on insecticides against the Elegant grasshopper, or totoviyane, *Zonocerus elegans* Thnb. In these tests, a benzene hexachloride dust containing 2 per cent. of the gamma isomer was found to be very effective against young hoppers, the average kill in six different tests being over 96 per cent. Towards the end of the hopper season, a test was carried out with a cheaper form of benzene hexachloride dust, containing 0.5 per cent. of the gamma isomer. By this time, however, hoppers had become scarce, and the experiment had to be designed with fewer replications. The insects were also older, and the results obtained were not properly comparable with those of earlier tests.

In November, 1948, further experiments were carried out, in which the insect material consisted of a mixture of the first three instars, as was the case in the earlier tests described in the previous paper.

First Test.

The insecticides used in the first test were:—the dusting powder containing 2 per cent. gamma benzene hexachloride, applied at a rate equivalent to 12 pounds per acre; Bexadust, a powder containing 0.5 per cent. gamma benzene hexachloride, applied at the same rate; and a 27 per cent. DDT emulsion, diluted to 2.7 per cent. with water, and applied at the equivalent of 50 gallons per acre. The experiment consisted of eight replications for the control and each of the three treatments, 100 hoppers being treated in each replication.

Figures showing the mortality up to the second and eighth days after treatment are given in Tables I and II. The figures were analysed statistically, and the differences between totals required for significance, at odds of 19 to 1 and 99 to 1, were calculated. The significant differences for each set of data are appended to the tables.

TABLE I.

Mortality per hundred hoppers after two days.

Cage No.	Control.	Bexadust.	BHC 2 per cent.	DDT emulsion.
1	0	93	69	50
2	1	100	82	59
3	1	90	99	33
4	0	92	91	49
5	2	94	77	42
6	3	99	78	55
7	0	100	57	36
8	1	100	65	53
Totals...	8	768	618	377

Significant difference between totals: 73.2 at 19 to 1
99.6 at 99 to 1

TABLE II.

Mortality per hundred hoppers after eight days

Cage No.	Control.	Bexadust.	BHC 2 per cent.	DDT emulsion.
1	2	100	85	85
2	3	100	85	96
3	4	97	99	78
4	0	97	98	77
5	3	98	95	83
6	4	100	85	84
7	1	100	70	98
8	2	100	75	99
Totals...	19	792	692	700

Significant difference between totals: 65.9 at 19 to 1
89.7 at 99 to 1

Second Test.

A second test was carried out four weeks later, using the same insecticides under similar conditions. The mortalities on the second and eighth days after treatment are shown in Tables III and IV.

TABLE III.

Mortality per hundred hoppers after two days.

Cage No.	Control.	Bexadust.	BHC 2 per cent.	DDT emulsion.
1	0	95	30	50
2	0	99	36	36
3	1	100	33	58
4	0	92	22	53
5	0	82	24	28
6	0	99	64	42
7	0	100	55	50
8	0	100	20	40
Totals...	1	767	284	357

Significant difference between totals: 75.6 at 19 to 1
102.9 at 99 to 1

TABLE IV.

Mortality per hundred hoppers after eight days.

Cage No.	Control.	Bexadust.	BHC 2 per cent.	DDT emulsion.
1	2	100	66	82
2	7	100	62	92
3	9	100	65	100
4	3	100	64	100
5	1	100	69	74
6	4	100	83	93
7	2	100	74	93
8	4	100	55	99
Totals...	32	800	538	733

Significant difference between totals: 54.3 at 19 to 1
73.9 at 99 to 1

It will be seen from the figures in Tables I to IV that Bexadust, which contains 0.5 per cent. of the gamma isomer of benzene hexachloride, was consistently better than the other materials. In both tests the 2 per cent. benzene hexachloride was less effective than the 0.5 per cent. dust, although a material stated to contain the same amount of the gamma isomer was found, in tests described last year, to cause mortalities approaching 100 per cent. It will be noticed, also, that the mortality caused by this dust in the second test was lower than in the first.

It is doubtful whether data derived from two different experiments can properly be analysed together. However, this was done for the two sets of figures for this treatment, as it was thought that some idea might be obtained of the degree of difference required for significance. For the figures indicating the mortality eight days after treatment the required differences were found to be about 93 at 19 to 1, and 135 at 99 to 1. The results obtained with this dust in the second test would thus appear to be significantly lower than those obtained in the first.

Further investigation will be required to discover the reasons for the very inconsistent results given by the 2 per cent. dust. The mortality figures for the other treatments do not show any falling off between the two tests, which would appear to indicate that the insect material was not less susceptible to treatment in the second test. The possibility is therefore suggested that the insecticide itself becomes altered in some way which causes it to become less toxic to the insects. Data on the materials used as diluents in the benzene hexachloride might throw some light on the question. Unfortunately, further tests could not be carried out this season as no more hoppers, at the correct stage of development, were available.

The DDT emulsion killed almost 90 per cent. of the hoppers in each test. It was significantly less effective than the Bexadust, but more so than the other benzene hexachloride dust, especially in the second test. It will be noticed that DDT was slower than benzene hexachloride in showing its full effect.

Third Test.

As a verbal claim had been heard that common salt would give effective control of the Elegant grasshopper, experiments were designed to discover to what extent this claim could be substantiated. In the present test, the substances used were a commercial grade of sodium chloride, as a 30 per cent. solution, applied at a rate equivalent to 80 gallons per acre; the same substance as a dust, at about 60 pounds per acre; and Bexadust, applied at 12 pounds per acre. The experiment consisted of eight replications of each treatment and eight controls, each replication starting with 100 hoppers. The mortality after eight days is shown in Table V.

TABLE V.

Mortality per hundred hoppers after eight days.

Cage No.	Control.	Salt solution.	Salt dust.	Bexadust
1	3	59	9	100
2	2	41	37	100
3	2	49	12	97
4	4	28	40	98
5	1	38	31	100
6	2	62	11	100
7	4	50	15	100
8	3	29	45	99
Totals...	21	356	200	794

Significant difference between totals: 92.8 at 19 to 1
126.3 at 99 to 1

It will be noticed that the salt solution was significantly better than the dry salt. This may have been due to the fact that a more even distribution was obtained from the solution. Of the hoppers sprayed with salt solution, 44.5 per cent. were dead on the eighth day after treatment, the corresponding figure for the dust being 25 per cent. Neither of the salt treatments, however, approached Bexadust in effectiveness.

The hoppers which had been dusted or sprayed with salt remained wet and sticky for some days after treatment, on account of the hygroscopic action of the salt. Mortality might have been due to choking of the spiracles by the concentrated salt solution produced. The following experiment was designed to discover whether water alone would have a similar effect on insects confined in cages.

Fourth Test.

In this test, sets of hoppers were sprayed with salt solution at a rate equivalent to 80 gallons per acre, and plain water at the same rate. For comparison, another set was dusted with Bexadust at 12 pounds per acre. The mortality after eight days is shown in Table VI.

TABLE VI.

Mortality per hundred hoppers after eight days.

Cage No.	Control.	Water.	Salt solution.	Bexadust
1	4	4	26	100
2	1	0	61	99
3	2	1	43	100
4	2	3	39	100
5	6	7	19	100
6	3	3	39	100
7	8	6	18	100
8	1	1	45	100
Totals...	27	25	290	799

Significant difference between totals: 68.0 at 19 to 1
92.6 at 99 to 1

These results show that water, as such, had no lethal effect under the conditions of this experiment. However, the insects sprayed with plain water soon dried, while those sprayed with salt solution remained wet for several days. The experiment does not, therefore, preclude the possibility of death having been due to choking of the spiracles. The osmotic effect of the concentrated salt solution might also have been involved, as such a solution would presumably have a desiccating effect on the hoppers.

It is doubtful whether the salt had any effect as a stomach poison, as very little feeding took place on the foliage present in the cages when spraying was carried out. The insects which survived resumed feeding after they had been supplied with fresh foliage.

Summary.

An account is given of a further series of laboratory tests on insecticides against the Elegant grasshopper. Bexadust, a powder containing 0.5 per cent. of the gamma isomer of benzene hexachloride, was the most satisfactory insecticide tested, giving a kill of almost 100 per cent. A 2.7 per cent. DDT emulsion killed about 88 per cent., while a solution of common salt killed about 40 per cent.

REFERENCE.

[1] Dick, J. (1948): Some Insecticide Tests against the Elegant Grasshopper. Proc. S.A. Sugar Tech. Assoc., **22**, 97.

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The PRESIDENT stated that one of the most interesting points arising out of the paper was the fact that benzine hexachloride seemed to have lost a lot of its effect in the second year; and while some reasons had been suggested, he hoped the author would be able to pursue the matter further and find the exact reasons for this phenomenon.

Mr. N. C. KING asked the author how long the insecticides could last, and if it were not possible that they deteriorated on keeping.

Dr. DICK replied that he was unable to test this out, for he could get no more of the insects in the same stage to carry out a second experiment. He would have preferred to have had guaranteed freshly-prepared insecticides from the manufacturers, and if these could be obtained he would follow the matter up more closely.

Dr. DODDS said that it was strange that one product containing four times the concentration of the other in benzene hexachloride should prove much less effective. Could this have been due to the composition of the material? Benzene hydrochloride occured in four isomers, of which only the gamma form was very effective as an insecticide. Was the explanation, then, that there was no guarantee of the two per cent. content of the gamma isomer, or was there the possibility that one form of benzene hexachloride merged into another? It was remarkable that four different isomers identical in chemical composition and differing only slightly in arrangement in the molecule should have such differing behaviour. The same thing occurs with D.D.T.

Dr. DICK stated that the figures shown were the percentage of the gamma isomer as supplied by the manufacturer. He did not know of the possibility of one isomer changing into another as was suggested, and as far as differences in molecular arrangement was concerned, was this not similar to what occurred in the case of some sugars?

Dr. DODDS pointed out that in the case of those substances there was a more definite difference in structure. To trace the difference in arrangement of the molecules of the various forms of benzene hexachloride a solid model was required, for it could not be shown on a blackboard or on paper.

Dr. MCMARTIN suggested that the difference in effectiveness might be due to the conditions under which the insecticides were applied. The volatility might thus be affected.

Dr. DICK replied that while that was a possibility, he had used two lots of benzene hexachloride, and if volatility were the factor involved he would expect both to be equally affected. It was possible that the two per cent. dust might be old and therefore not so strong, as there was no guarantee as to the time when it had been manufactured.

Dr. BATES thought that there was a further possibility which might explain the difference, and that was that there might have been different carriers used in the two dusts.

Mr. CHRISTIANSON said that while D.D.T. emulsion appeard to have nearly caught up in effectiveness with Bexadust on the eighth day, insects in cages would have less chance of wiping off the spray than in the field.

Dr. DICK replied that he thought D.D.T. started acting straightaway, but was a slow way of killing insects. He was not sure what would happen if the insect were dusted and then wiped after a certain period, but he considered there would always be a certain amount of effect.