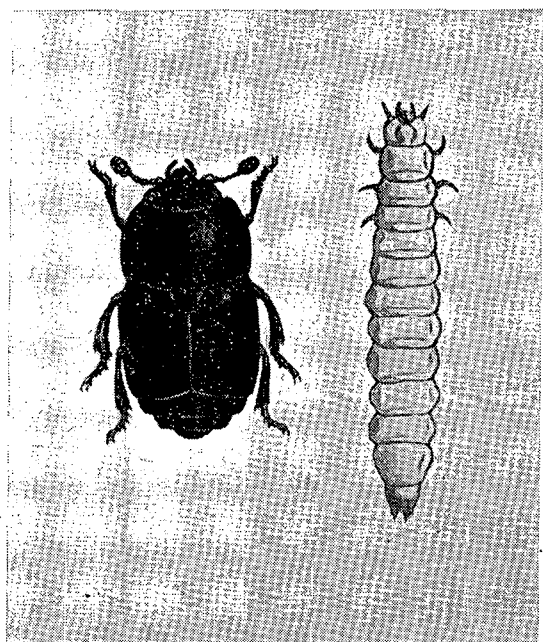


NITIDULID BEETLES IN SUGARCANE CUTTINGS

By J. DICK

When cane cuttings that have failed to germinate are dug up and examined, they are frequently found to be infested with the larvae and adults of Nitidulid beetles which, consequently, are often accused of responsibility for such failure. As additional evidence against them is adduced the rapidity with which replants may become infested in fields in which a high population of the beetles has been built up in the soil as a result of poor germination in the original planting. The investigations described here were carried out to determine to what extent this accusation is justified and to test methods of control in case these should prove necessary.

Although several different species are encountered, the commonest has been identified as *Carpophilus humeralis*, F. The adults are shiny black or dark brown beetles, three to four millimeters in length, which can be recognized by their distinctly clubbed antennae and by their truncated elytra (wing-covers) which leave the hind end of the abdomen uncovered. The larvae are whitish grubs, rather slender in build, and about six millimeters long when fully grown.



Carpophilus humeralis, adult and larva ten times natural size

Carpophilus humeralis has been recorded from fermenting bananas and oranges in this country, and is one of the species listed as occurring in damaged

sugarcane in Hawaii. Closely related species occur in many other kinds of fermenting vegetable matter, and a few are known as pests of dried fruit.

Since, in many of the instances investigated, it was possible to discover other causes of bad germination, such as drought, poor seed-cane and infection with pineapple disease, it was considered unlikely that the beetles would prove to be a primary cause of failure to germinate. However, the possibility was suggested that the presence of these insects might enable fermentation to spread more rapidly through the stick. Fermentation may commence at the ends of a cane sett almost immediately after it has been cut, but is considerably retarded on reaching the first node. It was thought possible that the feeding of the beetles might open a way through the node and enable the rest of the stick to be attacked by the organisms causing fermentation.

In a preliminary experiment, cane setts of the variety N:Co.310 were planted in tins, untreated or after dipping in Aretan (an organo-mercurial fungicide) at 1 ounce per gallon water, DDT suspension at $\frac{1}{2}$ ounce per gallon, or a mixture of Aretan and DDT. Four tins were planted for each treatment, each tin receiving three three-budded setts. Fifty adult insects were introduced into each tin, which was then covered with a cloth cage. The tins were kept in a greenhouse and watered when necessary. After a month, the shoots which had developed were counted; the figures obtained are shown in Table I.

TABLE I

Numbers of Shoots One Month After Planting

| Control | Aretan | DDT | Aretan and DDT |
|---------|--------|-----|----------------|
| 6 | 7 | 8 | 7 |
| 8 | 8 | 4 | 7 |
| 4 | 8 | 6 | 9 |
| 6 | 7 | 7 | 9 |
| — | — | — | — |
| 24 | 30 | 25 | 29 |

Although these figures suggest slightly better germination in the setts treated with Aretan, statistical analysis shows that the differences are not significant. Here, conditions favourable for germination had been provided artificially, and the shoots were well established before the setts could be damaged.

Subsequently, a similar experiment was planted in the field, in which sixteen setts of N:Co.310, with an average of four buds, were planted for each of the following treatments: C.—Control, untreated; A.—Dipped in Aretan; B.—Buds removed to prevent germination; AB.—Buds removed and setts dipped in Aretan. The soil was known to harbour beetles, since populations had previously been built up by burying cane with the buds removed.

Examination, one month after planting, showed that germination of the cane with undamaged buds had been good, 39 shoots having developed in the control line and 41 in that planted with setts treated with Aretan. In the cane with buds removed, the root-buds had sprouted. Examination of samples showed the presence of a few larvae in sticks from each treatment. In those treated with Aretan, none had penetrated beyond the first node from each end, even when the buds had been removed, while in the rest a few larvae had penetrated beyond the first node.

After four months, all the cane was dug up and examined, larvae and adults being found in all sticks. In the series treated with Aretan, infestation was practically confined to the first joint at each end, but in the untreated cane practically all sticks were completely infested. By this time the shoots from both untreated and Aretan-dipped setts in the series with undamaged buds were healthy and well established. Many of the original setts in the untreated series were completely hollowed out by various factors including the feeding of the beetles. Once the young cane is established, however, the destruction of the original sett is of no importance.

In order to determine what effect chemical treatment would have on infestation, a small field experiment was started in January, 1954. Setts of N:Co.310, with an average of five joints, were planted in short rows, with two replications for each treatment. Half of the rows were planted with cane from which the buds had been removed, in order to study the progress of infestation in setts which would not germinate. The other half were planted with undamaged cane, to determine whether any of the treatments would affect germination.

The treatments consisted of dipping the cuttings in the following:—

Control, tap water.

BHC, a suspension of benzene hexachloride containing 5.7 gms. of 4 per cent. gamma isomer per gallon water.

DDT, a suspension of 9.5 gms. of 50 per cent. per gallon.

Parathion, an emulsion of 3.3 ml. per gallon.

Systox, an emulsion of 3.3 ml. per gallon.

Toxaphene, a suspension of 18.9 gms. of 20 per cent. per gallon.

Aldrin, a suspension of 47.3 gms. of 25 per cent. per gallon.

Dieldrin, a suspension of 47.3 gms. of 25 per cent. per gallon.

Aretan, a solution of 23.6 gms. per gallon.

Lead Arsenate, a suspension of 14.2 gms. per gallon.

Lime Sulphur, containing 170 gms. dry mixture per gallon.

Hot water, immersion for two hours at 50°C.

The hot water treatment was included as it was considered desirable to obtain information on possible effects on fermentation or beetle infestation which might be brought about by the treatment recommended as a means of controlling ratoon stunting disease.

As it is difficult to distinguish between primary and secondary shoots in the field, all shoots which developed in the undamaged series were counted at monthly intervals. The figures obtained one month after planting, which approximate fairly closely to primary germination, and four months after planting, when counting was discontinued, are shown in Table II.

TABLE II

Numbers of Shoots Developed

| | After One Month | After Four Months |
|----------------------|--------------------|----------------------|
| Control | 32 | 140 |
| BHC | 34 | 173 |
| DDT | 32 | 165 |
| Parathion... .. | 30 | 158 |
| Systox | 32 | 161 |
| Toxaphene | 27 | 154 |
| Aldrin | 17 | 124 |
| Dieldrin | 17 | 141 |
| Aretan | 39 | 171 |
| Lead Arsenate | 32 | 145 |
| Lime Sulphur | 31 | 136 |
| Hot water | 13 | 96 |

Significant differences:

11.7 at 19:1 31 at 19:1
16.6 at 99:1 44 at 99:1

Germination was thus slightly better, though not significantly so, in cuttings treated with Aretan

than in the control. On the other hand, Aldrin, Dieldrin and the hot water treatment significantly depressed germination. Examination of the figures obtained four months after planting showed that the Dieldrin lines had overtaken the control, while the difference between the Aldrin lines and the control was no longer significant. There was still a significant depression in the hot water lines. On the other hand, the BHC and Aretan lines were now significantly better than the control, while DDT, Systox, Parathion and Toxaphene were suggestively, though not significantly, better.

The disbudded cane was dug up at intervals and examined, counts being kept of the numbers of joints infected with organisms causing fermentation as well as those infested by the beetles. Figures for the final count for both factors are given in Table III.

TABLE III
Numbers of Internodes Penetrated by

| | Fermentation | Beetles |
|----------------------|--------------|---------|
| Control | 59 | 46 |
| BHC | 49 | 30 |
| DDT | 38 | 14 |
| Parathion | 46 | 31 |
| Systox | 54 | 41 |
| Toxaphene | 58 | 52 |
| Aldrin | 40 | 25 |
| Dieldrin | 40 | 22 |
| Aretan | 46 | 34 |
| Lead Arsenate | 51 | 30 |
| Lime Sulphur | 61 | 56 |
| Hot water | 55 | 46 |
| TOTALS | 597 | 427 |

Significant differences between treatments:

11.9 at 19:1

15.8 at 99:1

Significant differences between totals:

44 at 19:1

63 at 99:1

These figures indicate that both fermentation and attack by the beetles have been significantly delayed in setts treated with DDT, Dieldrin, Aldrin, BHC, Parathion and Aretan, effectiveness against the beetles being in the order in which these materials are listed here. Lead arsenate has had no effect on fermentation but has significantly reduced attack by the beetles. The other treatments have been ineffective.

This experiment also gave a certain amount of information on the relationship between Nitidulids and fermentation. It was observed that, in practically every case, fermentation had penetrated further into the setts than had beetle infestation, as can be seen by comparing the totals for fermentation and beetles in Table III. It appears unlikely that the insects normally play an active part in facilitating the spread of fermentation through the stick, since they occur only in joints which have already fermented. Probably, therefore, their attack is not a primary cause of failure to germinate.

It should be noted that the major portion of this cane was left in the ground considerably longer than would normally be required for germination so that, even for the best treatments, a considerable proportion of the joints were attacked. The most that would be required in practice would be protection for one or two months. If conditions at the time of planting are suitable for rapid germination, the young shoots are able to develop and become independent before fermentation and beetles can spread through the stick. If, on the other hand, germination is delayed, both fermentation and beetles may have time to progress through the stick before the young shoots can become established. Once the new shoots are independent, the destruction of the original sett, which eventually takes place under normal conditions, is of no importance.

Acknowledgement

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Summary

Nitidulid beetles are frequently found in sugarcane cuttings which have failed to germinate. Investigations on their status have given results suggesting that these beetles are not a primary cause of failure to germinate, since they occur practically exclusively in internodes which have already started to ferment. Tests involving the dipping of setts in insecticides and a fungicide are described. Best results were obtained with a DDT suspension.

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Mr. King, the Chairman, said that this paper was of particular value to those who had to explain to planters why cane failed to germinate. It was particularly interesting to know that beetle attack

was not of primary importance. An interesting point was that Aretan did not only prevent disease attack and fermentation of the sett, but also helped prevent attack by the beetle.

Dr. Dick pointed out that Aretan itself was not an insecticide, but by preventing fermentation, it did limit the activity of the beetle.

Dr. McMartin, commenting on Dr. Dick's conclusion that fermentation was the reason for beetle attack, asked if varying organisms could have varying effects as far as this was concerned, or if other types of organisms were present, if this would not result in other types of insect attack.

Dr. Dick replied that the odour particularly attractive to these Nitidulid beetles was probably that of a dilute mixture of alcohol and acetic acid, which would be present in almost any kind of fermentation. Although other species of insects were sometimes found in fermenting setts, he did not know if this was due to the odours of different types of fermentation.

Mr. Brassey enquired if there were not some natural predators existing in the cane fields and if such predators could not be encouraged.

Dr. Dick stated that no parasites or predators had been found. The utilisation of natural enemies in control programmes had, in general, only proved successful where a pest introduced without its natural enemies could be attacked by introduced parasites and predators. In other cases, the pest and its enemies had usually established a form of equilibrium.

Mr. Coignet asked if there was any difference in virulence of attack by using setts from young cane, as compared with using setts from old cane.

Dr. Dick replied that setts from young cane often germinated more readily and therefore might not be so subject to beetle attack.

Mr. Park asked about the effect of hot water treatment used for ratoon stunting disease and whether this had a marked effect on germination and fermentation.

Dr. Dick replied that the germination of some varieties, for example, Co.301, might be adversely

affected by hot water treatment. He had not, however, found treated cane more adversely attacked by beetles.

Mr. Bax enquired if the cane was more readily attacked by such insects under wet conditions.

Dr. Dick said that he had found severe attack in instances where germination had been poor, on account of waterlogging.

Mr. Rault enquired of the progress made in the experiments carried out with the hot water treatment as far as ratoon stunting was concerned.

Mr. King replied that the experiments had not yet been harvested, so no definite reply could be given. There did not appear in some varieties to be any advantages in the hot water treatment.

Mr. Pearson said he had noticed on flats such as Umfolozi and Umhlatuzi, where supplying was necessary, that the setts supplied did not strike very well and he wondered if this was due to the attack of the beetle, which had been built up on the original planted cane. He would therefore like to know what the life cycle of the beetle was and if it were possible to build up an infestation on the lines he had indicated.

Dr. Dick said he had not yet worked out the life history of the beetle in its various stages, but he considered that the whole life cycle would be short, probably two months if conditions were suitable.

Mr. Twinch said that Aretan, being a mercury compound, might well prove to be of value as an insecticide.

Dr. Dick replied that such a possibility did exist, but it had not been completely studied by itself, but he thought that the primary effect of Aretan was its effect on preventing fermentation rather than as an insecticide.

Dr. McMartin asked Dr. Dick if it were not the case that the small amounts used as a fungicide dip would be insufficient to act as an insecticide.

Dr. Dick replied in the affirmative. He pointed out that a real study of the value of Aretan as an insecticide had not yet been made.