THE EFFECT OF A SYSTEMIC INSECTICIDE ON THE SPREAD OF MOSAIC AND ON CERTAIN SUGARCANE INSECTS

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Introduction

None of our commercial sugarcane varieties is immune to mosaic disease although some, like N50/211, are highly resistant, and others, like N:Co.339, show evidence of tolerance. The adverse effect of the disease, especially in N:Co.376, N:Co.292 and N:Co.293, has been convincingly demonstrated.[4] Mosaic is spread in two ways. Primary infection follows propagation by means of cuttings from diseased plants, and secondary infection results from transmission of the virus from diseased to healthy plants by insect vectors. Several leaf-sucking insects belonging to the family Aphididae are reported to transmit mosaic in various sugarcane countries, but the only species known to be a vector in South Africa is *Rhopalosiphum maidis* (Fitch).

Primary infection can be avoided by using cuttings from healthy plants for propagation and this can be facilitated by producing planting material in seed nurseries which can be kept free of mosaic by inspection and rogueing. By comparison, secondary infection is not as easily controlled. The vector, *R. maidis*, does not readily form colonies on sugarcane and individuals will normally survive for only a few days on this crop, but this does not prevent it from transmitting mosaic since a plant can apparently acquire the disease as the result of a single feeding puncture by an infective insect. Very large populations of *R. maidis* often develop in fields of maize but the insect also lives on a number of wild grasses including *Sorghum verticilliflorum* and several species of *Panicum* and *Setaria* which keep colonies alive during the months when maize is absent. Maize and several wild grasses readily become infected with sugarcane mosaic, and insects migrating from them as the plants mature may transmit the disease to sugarcane. In addition, spread of mosaic within a sugarcane field may result from the vectors feeding first on diseased and then on healthy plants.

The danger of secondary spread might be reduced by not growing maize and by eliminating wild host plants, but this is not always possible, especially when these plants are outside the boundary of the farm concerned. Consequently, chemical control of the vector has been suggested. Partial control might be ineffective since the actual number of insects feeding on a plant is presumably irrelevant, and complete control in host plants which often cover a wide area surrounding canefields might be uneconomic. It was therefore decided to investigate the effect on mosaic transmission of a systemic insecticide applied to the sugarcane itself.

Procedure

A trial was laid out at the Experiment Station in November 1967, consisting of randomised blocks with split plots in 16 replications. Main plots were planted with two varieties of sugarcane: N:Co.339 which very readily becomes infected with mosaic and N:Co.376 which is more resistant. Sub-plots, each consisting of three rows of five stools of cane, were separated by a single row of maize of the variety 'Hickory King' and the maize plants were artificially inoculated with mosaic. Sub-plots were either left untreated, or they were sprayed at weekly intervals, with dimethoate (Rogor), at a rate equivalent to 16 fluid ounces of a 40% emulsifiable concentrate in 60 gallons of water per acre. At the stage when the maize was beginning to develop male flowers, it became heavily infested with *R. maidis*. Uniform populations were ensured by transferring aphids from the more heavily to less heavily infested plants. Insecticide treatment started two weeks after the sugarcane was planted, when the first shoots emerged from the soil, and continued for 14 weeks, until the maize plants had dried up and the aphids had disappeared from them. Mosaic counts were carried out at weekly intervals, the final one being two weeks after the last application of insecticide.

Results

Mosaic symptoms started to appear in the second week of January, some eight weeks after emergence of the first sugarcane shoots, and the numbers of infected stools continued to increase until March when counting was discontinued. The number of stools per sub-plot exhibiting mosaic symptoms was used to assess the results. (Table I). As had been expected, N:Co.339 was significantly more heavily infected than N:Co.376, but the difference in incidence between untreated and sprayed sub-plots was not statistically significant. A result which may be of some practical importance was the fact that, in both untreated and sprayed sub-plots, the cane row nearest to the maize was significantly more heavily infected than the rest of the plot, infection falling off in a linear fashion towards the third row. A decrease in infection associated with distance from the source of both insects and disease would, of course, be expected but it was surprising to find that differences were statistically significant over such a short distance.

If this result is valid on a field scale it suggests that insect control on alternate host plants might, in fact, be of practical value, since treatment of a relatively narrow band might be all that is required to prevent secondary spread of mosaic from this source. Further investigations along these lines may be worth undertaking. On the other hand, weekly treatment with dimethoate at the rate used in this trial is expensive, costing at least R1.50 for each application, so that investigations to determine the minimum effective rate and frequency of application would have to be carried out. Alternatively, less expensive insecticides could be tested.

TABLE I
Number of stools infected with mosaic, as influenced by variety insecticide and proximity to maize

Variety	Treatment	Row 1	Row 2	Row 3	Total
N:Co.339	Untreated	48	46	33	127
N:Co.339	Sprayed	41	33	31	105
		89	79	64	232
N:Co.376	Untreated	16	8	8	32
N:Co.376	Sprayed	17	8	6	31
		33	16	14	63

Effect on Other Insects

During examination of the cane in this experiment for the incidence of mosaic it was noticed that many of the leaves contained insect eggs, usually inserted into the midrib. Besides a certain number of eggs of unknown insects, which could not be identified in this stage, the species represented were *Numicia viridis* Muir. and *Perkinsiella* sp. (probably *insignis* Dist). For these insects the incidence of oviposition has been found to provide a moderately accurate index to the size of the population, and the presence of eggs in this field presented an opportunity of studying the effect of dimethoate on them. Shortly after the last inspection for mosaic, all leaves containing eggs were collected and microscopically examined in the laboratory. Eggs were dissected out of the leaves and separated into four categories: hatched, unhatched but still viable, parasitised, and collapsed. The last category included those eggs which had died from undetermined causes. For *Numicia*, individual eggs were counted but this is sometimes difficult for *Perkinsiella* especially when the eggs have hatched. For this insect, therefore, egg batches were counted.

Two hymenopterous parasites are known to attack the eggs of *Numicia: Ootetrastichus beatus* Perkins and *Oligosita* sp. *Ootetrastichus* is more important as a control factor as it is a more robust insect of which a single individual can account for six or seven host eggs. Individuals of the more delicate *Oligosita* parasitise only a single host egg[1, 2]. In the present trial, practically all the parasites of *Numicia* eggs were *Oligosita* (Fig. 1), only 17 individuals of *Ootetrastichus* being found among about 2,800 parasites. They were all in untreated sub-plots but the numbers were too low for this to have much significance.

The status of *Perkinsiella insignis* as a pest is as yet questionable, although there is evidence that the presence of large numbers may be associated with poor sugarcane growth and distorted stalks. It belongs to the same genus as the three or more species known to be vectors of Fiji disease. The eggs are attacked by the hymenopterous parasite *Ootetrastichus pallidipes* Perkins[3] which was probably the species present in this experiment.

Figures obtained from the analysis of egg material

FIGURE 1: Eggs of *Numicia* dissected out of a sugarcane leaf. The pale ones are healthy and the dark ones parasitised by *Oligosita*.

are summarised in Table II. They show that more *Numicia* eggs were present in N:Co.376 than in N:Co.339, the difference being statistically significant. Dimethoate caused a highly significant reduction in the numbers of eggs laid but did not significantly affect percentage parasitism. There were fewer parasites in treated sub-plots, presumably because fewer host eggs were available. For *Perkinsiella* there were significantly fewer egg batches in treated sub-plots but no significant difference in their occurrence on the two sugarcane varieties. Percentage parasitism was lower than in *Numicia* and was not significantly influenced by the insecticide.

Although the numbers of eggs of both species were lower in the treated sub-plots, the difference being statistically significant, the control obtained: 65% for *Numicia* and only 25% for *Perkinsiella*, would probably not provide a return which would justify, economically, the high cost of repeated applications of dimethoate.

TABLE II
The effects of dimethoate on eggs of Numicia and Perkinsiella

	UNTREATED			DIMETHOATE		
	Total	*Parasitised*	*% Parasitised*	*Total*	*Parasitised*	*% Parasitised*
Numicia eggs						
N:Co.376	3,541	1,475	41.65	1,308	388	29.66
N:Co.399	1,866	787	42.18	610	219	35.90
Total	5,407	2,262	41.83	1,918	607	31.65
Perkinsiella egg batches						
N:Co.376	981	52	5.30	675	22	3.26
N:Co.339	685	68	9.93	586	28	4.78
Total	1,666	120	7.20	1,261	50	3.97

Summary

In an attempt at minimising secondary infection by mosaic disease, sugarcane of two varieties was regularly treated with a systemic insecticide, dimethoate, aimed at the vector *Rhopalosiphum maidis* (Fitch). As was expected, the degree of subsequent infection differed between the varieties, but it was not significantly influenced by the insecticide. Incidence of mosaic decreased linearly with increasing distance from the source of the infection and vectors, this effect being noticed over a surprisingly short distance.

Eggs of two other insects, *Numicia viridis* Muir and *Perkinsiella* sp., found in the leaves of sugarcane in experimental plots were examined. Treatment with dimethoate decreased oviposition by both species but did not significantly affect parasitism by Hymenoptera. Control, though statistically significant, was too low to be of economic value.

References

1. Carnegie, A. J. M. (1966). The progress of an untreated outbreak of *Numicia viridis* Muir. Proc. S. Afr. Sug. Technol. Ass. 40 p. 319-327.
2. Rep. Exp. Stn. S. Afr. Sug. Ass. 1965-66. p. 71-78.
3. Rep. Exp. Stn. S. Afr. Sug. Ass. 1966-67. p. 90-100.
4. Thomson, G. M. (1963): The mosaic tolerance of five sugarcane varieties in Natal. Proc. S. Afr. Sug. Technol. Ass. 37, p. 123-126.

Discussion

Mr. Carnegie: The parasite that is regarded as very common in the North is rather rare here.

It is fortunate that the parasites are not affected by insecticides because although insecticides are the immediate means of controlling an outbreak there is always the fear that their application might do more harm than good by destroying parasites.

Although the insecticide used in this work was not completely effective it indicated what type should be used in following up the investigation.