

METHODS AND RESULTS OF SUGARCANE MOSAIC RESISTANCE AND TOLERANCE TESTS

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Since van Musschenbroek first described mosaic as a disease in Java in 1892, it has been found in practically every cane-growing country in the world and has probably been studied more than any other cane disease. Most cane-growing countries seem to have been affected by this disease at some time or another. We in this country had our troubles prior to 1927, and our work now is to prevent a recurrence of those troubles.

In the literature on virus diseases, the words tolerant, resistant, susceptible and immunity are frequently used, and a definition of these terms would be helpful. By tolerant we mean that a variety can acquire the disease, but the subsequent crop, as far as yield is concerned, is not affected. By a resistant variety we mean that a variety can be infected with difficulty and usually only a few stools with mosaic can be found here and there. A susceptible variety is one which is easily infected with the disease and usually a large number of stools are found infected. When we talk of a cane being immune, we mean one which does not get the disease under any circumstances.

This question of resistance and tolerance has influenced our mosaic testing programme. In preliminary trials the susceptible canes are weeded out, and later a properly replicated tolerance trial is laid down with any promising new varieties.

The method used in our preliminary trials is to plant a short line of about 20 feet with the variety to be tested and on the sides a line of mosaic cane is planted. The whole area is then planted with maize. (The maize plant is one of the principal hosts of the mosaic vector *Aphis maidis*, and is also an alternative host for the sugarcane mosaic.) We have found that this method is not entirely qualitative, but that within certain limits it is qualitative and we are able to pick out canes with different degrees of susceptibility.

If any of these canes show good agricultural qualities, then the mosaic material from the preliminary trial is planted out and bulked up and a properly replicated tolerance plot trial is laid down.

The following is an account of the method used and results of a tolerance trial planted in January, 1949.

The trial was laid down as a split-plot, 4 × 4 Latin square design. Each plot consisted of three lines 19 feet long, and 10 three-budded setts were space-planted in each line, so that each sub-plot had 30

stools and the main plots 60 stools. In cases where the sett failed to germinate it was replaced by a pre-germinated sett so that these stools were not set back at all. The sub-plots were planted with mosaic and healthy cane of the varieties in the main plots, namely, Co.301, Co.281, N:Co.291 and N:Co.310. Guard lines were planted on either side of the main plots, using the same variety as was in the main plot.

When the canes germinated they were inspected for mosaic, and it was found that those planted healthy, germinated healthy, but some that had been planted diseased, germinated healthy, i.e. there had been recovery.

A record was kept of the spread of the disease from the diseased to the healthy plants, and it was soon seen that the spread was very rapid and considerable as shown by Table I, which was compiled at the completion of germination.

TABLE I.—FINAL GERMINATION COUNTS.

Variety.	Cane planted with healthy setts.			Cane planted with diseased setts.		
	No. of healthy shoots.	No. of diseased shoots.	Per cent. infection from originally healthy cane.	No. of healthy shoots.	No. of diseased shoots.	Per cent. recovery from originally diseased cane.
N:Co.291 ...	51	09	57	0	120	0
N:Co.310 ...	89	31	26	7	113	5
Co.281 ...	99	21	17	0	120	0
Co.301 ...	89	31	26	46	73	39

It will be seen that the spread of the disease from diseased to healthy cane was quite considerable, and in the case of N:Co.291 it was as much as 57 per cent., so that the original object of the experiment of comparing yields from mosaic and healthy cane had to be abandoned and the experiment was converted into one of comparing the yields from primary and secondary infections.

At harvest, July 1950, the number of sticks with and without mosaic were counted as well as being weighed. Sucrose tests were also determined for all sub-plots.

TABLE II.—SHOWING NUMBER OF STICKS HARVESTED.

Variety.	Cane planted with healthy setts.			Cane planted with diseased setts.		
	No. of healthy sticks cut.	No. of diseased sticks cut.	Per cent. infection from originally healthy cane.	No. of healthy sticks cut.	No. of diseased sticks cut.	Per cent. recovery from originally diseased cane.
N:Co.291 ...	100	848	89.5	65	1,065	5.7
N:Co.310 ...	1,017	249	19.6	81	703	10.4
Co.281 ...	119	1,057	89.8	6	1,198	0.5
Co.301 ...	313	1,237	79.8	67	1,390	4.6

From the above figures of the number of sticks cut, it will be seen that the recovery in Co.301 is of

a lower order than at the completion of germination; this is accounted for by the initially recovered sticks being reinfected. The secondary spread to N:Co.310 was the least of all the varieties tested, and it also recovered the best from being initially diseased. It was very apparent that when N:Co.310 was diseased, a very few shoots were produced which were short and thin.

TABLE III.—ACTUAL WEIGHT OF CANE CUT FOR EACH TREATMENT.

Variety.	Cane planted with healthy setts.				Cane planted with diseased setts.			
	Tons cane per acre of diseased sticks.	Tons cane per acre of healthy sticks.	Tons cane per acre from setts originally planted healthy.	Per cent. from healthy cane.	Tons cane per acre of diseased sticks.	Tons cane per acre of healthy sticks.	Tons cane per acre from setts originally planted diseased.	Per cent. from diseased cane.
N:Co.291	46.7	4.7	51.4	90.7	49.5	2.3	51.8	4.5
N:Co.310	7.4	45.9	53.3	13.9	17.3	2.9	20.2	14.0
Co.281 ...	21.4	2.5	23.9	89.5	24.7	0.1	24.8	0.4
Co.301 ...	47.0	11.5	58.5	80.3	44.6	2.5	47.1	5.2

On analysing the weights obtained at harvest, it was found that primarily infected Co.301 gave a significantly smaller yield at 19:1 odds, than Co.301 planted healthy, although the latter was 80.3 per cent. secondarily infected. A similar but more pronounced result was obtained with N:Co.310, except that here the secondary infection was only 13.9 per cent. and the significantly smaller yield was at the odds of 99:1. It will be readily seen that if a crop of N:Co.310 was considerably infected with mosaic it would possibly be reduced by as much as 36.0 tons per acre.

The low yield in Co.281 was due to a very poor stand of cane, the sticks being much smaller, and in no way was this reduced stand of cane accounted for by mosaic disease.

Sucrose tests were done on the healthy and diseased plots throughout the experiment. The diseased cane gave a significantly higher sucrose than the healthy cane. This is of more interest than any possible agricultural advantage.

In applying the results of the above experiment to any commercial undertaking, one must bear in mind that the primary infection was nearly 100 per cent., and this position would hardly ever exist in actual practice. However, it does point out the potential danger of mosaic should it become very prevalent, and the need for continual roguing and eradication of diseased material cannot be stressed too strongly.

The conclusions which may be drawn from this experiment is that Co.281 and N:Co.291 are susceptible but tolerant, and there is not much recovery after once infected. Co.301 is susceptible but not tolerant, but there is a good chance of recovery. N:Co.310 is susceptible but not tolerant, but fortunately it does not acquire the disease easily and also recovers fairly readily.

In 1943 mosaic was found for the first time in Co.281, although it had been artificially infected prior to its release in 1933. Now the question arises as to what happened to the diseases in the intervening ten years. It is well known that the sugarcane mosaic virus can infect plants other than sugarcane. For example, *Setaria sulcata*, *Digitaria horizontalis*, *Sorghum verticilliflorum* and many more are being added to the list, and it is in these grasses, especially the perennial grasses, where mosaic survived the ten-year period. It is at once apparent that mosaic will always be present in Natal, but may not the apparent mild strain we have perhaps change to a more virulent one?

In plants infected with a virus disease there are millions of virus particles present. When these virus particles multiply it seems hardly likely that they will all multiply true to type; if they do not, then variants or strains are produced. In view of the large number of virus particles present, it is rather amazing that strains are not in evidence.

Up to the present we have no evidence that strains do exist here. In other parts of the world a number of strains of mosaic have been identified, and there does not seem to be any reason why strains should not exist in Natal. It is this change of strain for which we must be continuously on the watch, and by destroying all mosaic material we are lessening the chance of new strains being produced.

Summary.

Definitions are given of some of the most commonly used virus and mosaic terms.

A method for the preliminary testing against mosaic of sugarcane varieties is given and shows promise of being quantitative as well as qualitative.

The results and methods used for a tolerance trial are discussed, and results show that N:Co.310 and Co.301 are not tolerant, but that N:Co.291 and Co.281, although very susceptible, are tolerant.

The danger of possible virulent strains occurring in Natal is discussed.

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The President said the paper brought to the front a problem confronting sugarcane technologists at the present time. The whole position regarding mosaic had become complicated and placed a great deal of responsibility on the pathologist.

Mr. Barnes said the West Indies' position was parallel to Natal's and within the last forty years mosaic had been recognised as a very dangerous

disease. Some types of cane were attacked and appeared to recover, but cuttings taken from the apparently recovered cane displayed symptoms of the disease. It had been found in Jamaica that the same form of mosaic would show different symptoms on different varieties of cane. Inoculation of another variety from affected plants produced the normal symptoms of mosaic. Experiments were being conducted to show what loss, if any, in terms of cane and sugar, was brought about by susceptible but tolerant varieties of cane.

Dr. Dodds said that although mosaic disease had never yet caused serious direct loss in the South African cane crop, as it had done in many other countries, it had been a serious menace to the industry for about thirty years. In the first place mosaic greatly hampered the replacement of the highly resistant Uba variety by more productive varieties and had been a constant source of anxiety ever since. It was a difficult problem to find types of sugarcane varieties suitable to Natal conditions whose members did not show themselves sooner or later lacking in resistance to mosaic disease and perhaps even in tolerance.

In many other countries mosaic had become a disease of little importance but in Louisiana it had been a disaster and always a menace. In 1924 the Louisiana sugar crop fell from an average of about 300,000 tons per annum to only 42,000 tons as a result of mosaic disease and moth borer. Co.281 and Co.290 were introduced as mosaic resistant but after a few years became susceptible and had in turn to be replaced. In Louisiana new and more virulent strains of the disease very definitely developed, a possibility that might also occur in Natal, although it had not happened up to the present.

Mr. Renaud and **Mr. Bechard** asked if there was any possibility of treating mosaic with an antibiotic drug.

Mr. King said aureomycin had been tried on mosaic but did not cure it. It had been noticed that Co.281 had different markings on the leaves and at one time it was thought to be a different strain. When grown in the glasshouse under the same conditions the original peculiar markings disappeared and the usual mosaic symptoms were found.