

THE MOSAIC TOLERANCE OF FIVE SUGARCANE VARIETIES IN NATAL

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Summary

In order to determine the effects of mosaic disease on five Natal sugarcane varieties an experiment was planted at Mount Edgecombe in which plots were represented by single stools. The two treatments were "planted healthy" and "planted diseased".

The results from the plant cane crop and first ratoon crop show that N:Co.339 is more tolerant than the other varieties although it cannot be said to be unaffected by mosaic disease. The tolerance of N:Co.334 is of the same order as N:Co.339. The variety N:Co.376 shows the least tolerance while N:Co.292 and N:Co.293 are affected to more or less the same degree.

There was evidence of recovery from mosaic disease in N:Co.292, and to a lesser extent in N:Co.293 and N:Co.376. There was no recovery in N:Co.334 or in N:Co.339.

Introduction

During the course of disease survey work over the past two years a disconcerting number of cases of mosaic-infected N:Co.376 was noted. The degree of infection in this variety appeared to be increasing and furthermore it was apparent that the disease was having a considerably adverse effect on the variety.

This survey work also suggested differences between various varieties in their reaction to infection and indeed the reaction of N:Co.339, traditionally accepted as being tolerant, was open to question.

Method

In order to determine the effects of mosaic disease on five well-known varieties, an experiment was laid down at the Experiment Station in which the plots were represented by single stools, spaced at 5 ft. in the line. The line spacing was 5 ft. 6 ins. There were two treatments, ("planted healthy" and "planted diseased") and 12 replications.

Early Observations

As can be seen from Table 1, the germination of the healthy setts was distinctly better than that of the mosaic-infected setts, with the exception of N:Co.376.

Table 1
Percentage Germination

	N:Co.292	N:Co.293	N:Co.334	N:Co.339	N:Co.376
Planted Healthy	79	71	75	69	56
Planted Diseased	52	58	65	56	58

In January, 1961, four months after planting, the effects of planting mosaic-infected setts were becoming evident. This showed up in a pronounced stunting of the diseased plots compared with the "planted healthy" stools. This effect was particularly noticeable in N:Co.292, N:Co.293 and N:Co.376.

Six months after planting a check was made on the extent of secondary infection in the "planted healthy" plots. The following table shows the number of stools (out of 12 originally planted with healthy setts) which had become infected.

Table 2

Extent of Secondary Infection

(Number of infected plots after 6 months)

N:Co.292	1
N:Co.293	1
N:Co.334	8
N:Co.339	9
N:Co.376	6

The Course of the Disease and the Yields over Two Crops

Frequent inspection of the developing crops indicated just how much these varieties vary in their reaction to mosaic disease. The expression of these differences in the two crop yields certainly presents an interesting picture and in at least one case brings to light new facts to be considered.

N:Co.292.—The symptoms of mosaic disease in N:Co.292 are very clear with a pronounced difference between the chlorotic areas and the normal green of the leaf. The major portion of the leaf is chlorotic.

Most of the "planted healthy" plots remained free of the disease but there were odd cases of secondary infection and subsequent recovery.

Thirteen months after the plant cane harvest half of the "planted diseased" plots showed no symptoms of the disease although the plants themselves were very weak with a pronounced chlorosis. Small quantities of material taken from such plots and planted in the greenhouse produced healthy shoots on germination.

One month after the second crop was harvested only four plots showed symptoms of the disease and the plots which had recovered earlier appeared more vigorous.

In this variety the percentage decrease in the number of stalks, comparing the two treatments, amounted to 52 per cent in plant cane and 63 per cent in first ratoons whereas the corresponding decrease in weight of cane was 69 per cent and 76 per cent respectively. (See Tables 3 and 4.) These effects are well illustrated in the accompanying photograph which also shows the pronounced stunting effect.

N:Co.293.—This variety also shows a severe type of symptom with pronounced chlorosis.

A certain amount of secondary infection did take place in the "planted healthy" plots but most of these recovered subsequently so that one month after the first ratoon harvest only one stool remained diseased.

All the "planted diseased" plots remained so until the most recent inspection when two stools had apparently recovered. This condition will have to be confirmed at a later date as it may only be a delay in the appearance of the symptoms.

The effect of mosaic disease on N:Co.293 is of the same order as that in N:Co.292. As can be seen in the tables the decreases were more marked in the ratoon crop being 74 per cent in number of stalks and 86 per cent in weight of cane per plot. The effect of the disease on stalk number and stalk length is shown in the photograph.

N:Co.334.—This variety seems to show a severe type of symptom in younger cane but at later stages the pattern is milder and of the normal N:Co.339 type.

In the "planted healthy" treatment eight plots had become infected, six months after planting. At the plant cane harvest there were nine infected plots. After the second crop however, a certain amount of recovery was evident when only six plots exhibited symptoms.

The "planted diseased" plots have shown no tendency to recover.

This variety has shown a greater degree of tolerance to mosaic than the others with the exception of N:Co.339.

The decrease in number of stalks and weight of cane remained more or less static over the two crops harvested so far and there has been no pronounced stunting effect. This is contrary to observations in the other varieties (except N:Co.339) where the adverse effects of the disease were greater in the ratoon crop.

N:Co.339.—The symptom pattern in this variety shows variations from the normal mild type which is probably the most common, to a more severe type. This suggests strain differences in the virus.

No evidence of recovery was found in the "planted diseased" plots and all the "planted healthy" plots had become infected before the first harvest.

This variety has always been classified as tolerant to mosaic disease. However, in the early stages of this experiment it was obvious that a difference existed in the vigour of the plots of the two treatments. The plots planted with healthy seed cane consisted of stools which were much more vigorous than those derived from diseased seed cane. This difference is still evident despite the fact that there are now no healthy plots of this variety. However, a comparison of yields of the two crops indicates that the difference between "planted healthy" and "planted diseased" is lessening which suggests that the secondarily infected plots are now being affected by the disease.

This variety is not featured in the photograph, the growth being so variable that it was difficult to select a typical pair of plots as an illustration.

The results shown in the tables indicate that on the average of the two crops N:Co.339 is the least affected by the disease in this experiment.

N:Co.376.—This variety exhibits a very severe type of symptom associated with very pronounced chlorosis.

In the "planted healthy" plots half of the plants had become infected six months after planting and at the plant cane harvest seven plots were diseased. In three of the latter however, only single stalks were showing the symptoms.

By the first ratoon harvest only two plots exhibited symptoms and one month later all twelve plots were healthy again.

Three of the "planted diseased" plots appear to have recovered according to the latest inspection but this may be a case of delay in symptom expression.

This variety exhibits extreme intolerance to mosaic infection. Evidence for this is the stunting effect which amounted to a 50 per cent decrease in mean length of stalk in the diseased plots. The stunting effect is well illustrated in the photograph. As can be seen from the tables the percentage decrease in number of stalks was 65 per cent and 79 per cent in plant cane and ratoon cane respectively, while the corresponding decreases in weight of cane were 80 per cent and 89 per cent respectively.

Discussion

Statistically the design of this experiment has a number of limitations which might tend to increase the apparent effect of the disease on the varieties concerned. Where diseased stools are growing adjacent to healthy stools the competitive factor enters into the picture especially where growth is retarded in the diseased plot. The growth retardation is likely to increase as adjacent healthy plots become dominant.

In cases like N:Co.339 and N:Co.334, but particularly the former, where high susceptibility to the disease is involved, the intended control, i.e. healthy cane, is no longer present so that no basis remains for comparing healthy and diseased cane, the essence of a tolerance trial. However, in this particular experiment a comparison between "planted healthy" and "planted diseased" (irrespective of secondary infection) is of interest.

Nevertheless there is a distinct tendency towards intolerance in three of the varieties concerned, viz. N:Co.292, N:Co.293 and N:Co.376. This is an observable fact and requires little in the way of statistical confirmation. In the cases of N:Co.334 and N:Co.339 the tolerance to mosaic infection is at a higher level but by no means a foregone conclusion.

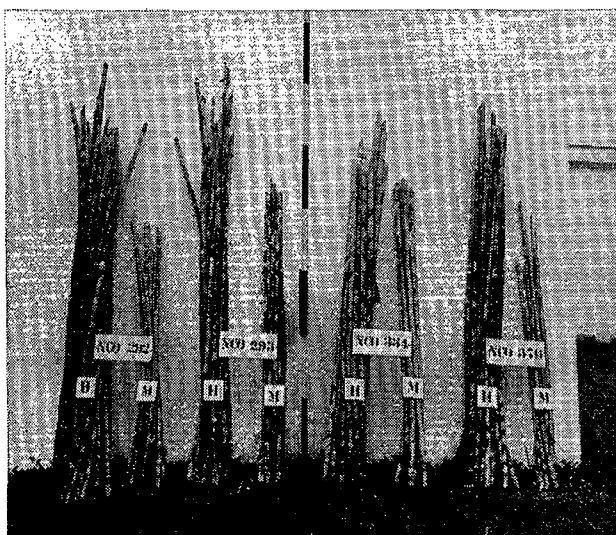
It is shown that the planting of mosaic-infected seed cane of any of these varieties can have serious consequences irrespective of whether the variety exhibits a tendency to recover from the disease or not. The variety N:Co.339 is a noteworthy inclusion in this group.

Table 3
Mean Weight per Plot (Lbs.)

	N:Co.292		N:Co.293		N:Co.334		N:Co.339		N:Co.376	
	P	R1	P	R1	P	R1	P	R1	P	R1
Planted Healthy	64.67	48.75	39.00	56.08	47.50	48.33	54.17	47.58	54.25	53.33
Planted Diseased	20.42	11.83	13.55	8.00	26.92	25.33	28.17	38.08	10.58	5.81
% Decrease	69	76	64	86	44	48	48	21	80	89

Table 4
Mean Number of Stalks Per Plot

	N:Co.292		N:Co.293		N:Co.334		N:Co.339		N:Co.376	
	P	R1	P	R1	P	R1	P	R1	P	R1
Planted Healthy	29	27	17	23	21	24	30	33	26	28
Planted Diseased	14	10	10	6	15	17	20	27	9	6
% Decrease	52	63	41	74	29	29	33	18	65	79



The effect of mosaic disease on the varieties N:Co.292, N:Co.293, N:Co.334 and N:Co.376. Each bundle is a complete plot (stool) from the experiment. Note the pronounced stunting effect in three of the varieties and the difference in number of stalks between "planted healthy" (H) and "planted diseased" (M) in all four varieties.

Mr. Wilson said that the main interest in this paper centred round the effects of mosaic on the varieties but he found the question of recovery from the disease very intriguing. He therefore asked if there was any possibility of any immunity arising from a mild inoculation of the disease, and what would happen if one propagated from a plant which had recovered; could it be re-infected again?

Mr. Thomson said there had been evidence of recovery especially in N:Co.310 and cuttings from such recovered cane planted in a greenhouse came up healthy but the new plants could easily be re-infected by inoculation or when planted in the field. There was another type of recovery, which was recovery from diseased stalks.

Dr. Dodds asked where N:Co.310 would now be classified as far as the effect of mosaic was concerned as it was the most popular cane still and he would like to know how it compared with the newer varieties. N:Co.376 was such an excellent variety in so many respects that it was disappointing to learn that it was so intolerant to mosaic disease.

Mr. Thomson replied that N:Co.310 would be somewhat similar to N:Co.293 with regard to resistance and tolerance, but it has also a very distinct tendency towards recovery.

Dr. Brett asked if there was more chance of recovery in stools which became infected after planting than in ones which had been derived from diseased cuttings, and in which, therefore, all shoots could be expected to be diseased. He also asked if N:Co.376 showed any noticeable amount of recovery in the field.

Mr. Thomson said the varieties mentioned could be divided into two groups. One which showed very severe types of symptoms consisted of N:Co.292, N:Co.293 and N:Co.376 and the other group namely N:Co.339 and N:Co.334 did not show always such severe symptoms. The varieties which showed the more severe symptoms had a larger tendency towards recovery. There appeared to be no permanent recovery in the case of N:Co.292 and N:Co.376.

Mr. Main asked if suitable climatic conditions and adequate use of fertiliser providing good growing conditions, would tend towards greater recovery. After a drought when the vitality of the cane was lowered, would such a condition tend towards greater incidence of the disease? One of his fields of N:Co.310 had mosaic and he was considering ploughing it out but if increased fertiliser application and the use of irrigation could help towards recovery, he would not plough the cane out.

Mr. Thomson replied that if the percentage of mosaic in a field of N:Co.310 was not high, and he doubted that it would be, he would not advise ploughing it out from the point of view of mosaic alone.

There was a masking of symptoms leading to these showing up at odd times but he did not consider fertiliser practice could have any effect on recovery of N:Co.376.

Mr. Coignet said it was noticeable that there was an absence of mosaic visible in cane growing a mile or two from the sea. He asked if this was due to climatic conditions leading to the absence of vectors or the effect of iodine or sodium chloride in the air, or was this only ascribable to a masking of symptoms.

Mr. Thomson stated that efforts were now being made to determine why mosaic disease had this peculiar distribution. He thought that the fact of its lesser incidence near the sea might be due to effect on the vector. Within one or two miles from the coast there was probably a deposit of sodium chloride on the leaves which made them less attractive to the insect. He did not think there was masking or recovery in this case.

Dr. Cleasby said he had observed a case of recovery in N:Co.376 in the field. He asked if there was any connection between mosaic and hot water treatment for ratoon stunting disease. The incidence of mosaic seemed to be increased by this treatment.

Mr. Thomson said he had first come across mention of the connection between mosaic susceptibility and heat treatment followed work done in America, where it appeared that mosaic was increased by heat treatment. Dr. Abbot had stated that planters in Louisiana were refusing to use heat treatment because of the danger of mosaic being increased by this, particularly in N:Co.310, which in Louisiana was highly susceptible to mosaic.

If it were the case that heat treatment increased the chance of mosaic disease, Mr. Thomson still maintained that this treatment should be continued in this country because ratoon stunting disease was a bigger danger to our Industry, with its present varieties, than was mosaic. Some experiments had been carried out at the Experiment Station, unfortunately too late for a field test, but in the greenhouse, where artificial inoculations were made on canes which had been heat treated. The results were up to now inconclusive but one factor to be considered was that of artificial inoculation.

In the United States of America field trials had been made on N:Co.310 from which it appeared that heat treatment led to more mosaic. The impression was two-fold, one side of the argument being that the variety had changed because of heat treatment. The other argument was that the cane germinated more quickly after heat treatment (not our experience here), and was available to the insect longer.

Dr. Dick (in the Chair) said that to use commercial fields as a source of plant material was a mistake. It was much better to establish nurseries for the propagation of seed material for such small areas could be adequately inspected and rogued. Mosaic could be controlled by roguing while ratoon stunting could not, and necessitated heat treatment, which should therefore be continued.