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Management of bract mosaic disease through higher dose of fertilizers in banana cv. Ney Poovan (AB)

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ABSTRACT

An experiment was conducted to find out the effect of increased doses of fertilizer on healthy and banana bract mosaic virus (BBrMV) affected plants of cv. Ney Poovan. The result showed that increased doses, i.e. 125 and 150% of recommended dose of fertilizer (RDF) have compensated the yield loss in BBrMV infected Ney Poovan plant crop. The disease was mitigated with higher dose of fertilizer application. But in ratoon crop, due to increased severity of virus infection, plants did not respond to higher doses of fertilizers. Days taken to flowering were more in virus affected plants than in healthy plants, irrespective of the fertilizer levels. With this investigation, it was concluded that the bract mosaic viral disease can be mitigated in plants of Ney Poovan banana with application of higher doses of fertilizer but not in ratoon crop. Hence, in Ney Poovan banana, even if plants develop viral symptoms after planting, the effect of disease could be mitigated with higher dose of fertilizers to get optimum yield, provided the vector population is managed through insecticides.

Key words: Banana, banana bract mosaic virus, management, fertilizer, yield.

INTRODUCTION

Banana is one of the important vegetatively propagated fruit crops grown for subsistence in India by small and marginal farmers. India is the largest producer of bananas in the world. Many viral diseases are known to infect banana and reduce the yield significantly. Bract mosaic viral disease was first reported as *kokkan* disease of unknown etiology in Kerala by Samraj *et al*. (9). Later, Jones (4), Rodoni *et al.* (8) and Singh *et al.* (11) have authentically reported that the *kokkan* disease in Nendran banana is caused by banana bract mosaic virus (BBrMV). Besides bunchy top viral disease, bract mosaic disease caused by BBrMV spread widely in banana growing regions *viz.,* Kerala, Tamil Nadu, Karnataka and Andhra Pradesh in the past decade (Singh *et al.,*11; Cherian *et al.,* 2; Kiranmai *et al.,* 5; Mokashi *et al.,* 6). The yield loss caused by this viral disease in Kerala was 70 and 40 per cent in cvs. Robusta and Nendran respectively (Cherian *et al.,* 2). In Tamil Nadu, the average loss was estimated as 30 per cent in Nendran (Selvarajan and Jeyabaskaran, 10). In case of banana bunchy top virus, the affected plant will not throw any bunch which is 100 per cent loss, whereas bract mosaic virus affected plants can yield bunch of reduced economic value. The farmers are not interested in removing the bract mosaic virus affected plants as they can get at least some marketable bunches from affected plants. There are no control measures for viral diseases of any crop species as done for fungal and bacterial diseases. However, adverse weather factors affecting virus multiplication, nutrient status of soil, vigour of plants are known to reduce the loss due to viral diseases in many crops. In the present study, an attempt was made to know the effect of increased dose of fertilizers in bract mosaic affected plants of commercial banana cultivar Ney Poovan, which has higher susceptibility to BBrMV.

MATERIALS AND METHODS

This study was conducted at research farm of National Research Centre for Banana, Tiruchirapalli, Tamil Nadu during 2005 - 2007. Tiruchirapalli is located at 11.50°N latitude and 74.50°E longitudes and the altitude is 90 m above mean sea level. The annual average maximum temperature, minimum temperature, relative humidity and the annual rainfall were 34°C, 23.2°C, 65.9 % and 557 mm respectively in 2005-06, and 34.29°C, 23.78°C, 64.53 %, 538 mm respectively in 2006-07. Banana cultivar Ney Poovan (AB) was planted in a factorial RBD design. Healthy suckers and bract mosaic affected suckers weighing around 1.25 to 1.5 kg were chosen for planting. Presence of bract mosaic virus in the symptomatic suckers was confirmed by RT-PCR using bract I and II primers as per Rodoni *et al*. (8). Healthy suckers without any BBrMD symptoms were also tested and confirmed to be negative for the virus (Fig.1). Paring and pralinage was done for all the suckers to avoid nematode and weevil infection. Suckers were planted at 2 m × 2 m spacing. The recommended dose of fertilizer for Ney Poovan is 200 g N: 30 g P_2O_5 and 350

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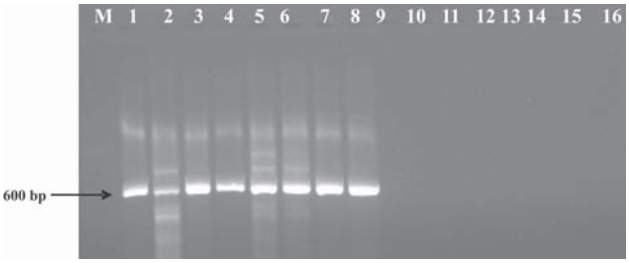

Fig. 1. Agarose gel electrophoresis of RT-PCR amplified products of BBrMV obtained from banana plants of cv. Ney Poovan used in this experiment. M- Marker; Lanes 1- 8: Positive BBrMV infected symptomatic suckers; 9-16, Healthy suckers.

g K_2O per plant. In order to see the effect of different levels of fertilizer dosage on the BBrMV infected and healthy plants of banana cv. Ney Poovan, the following five treatments *viz.,* T1: 50% of recommended dose of NPK (RD of NPK), T2: 75% RD of NPK, T3. 100% RD of NPK, T4: 125% RD of NPK and T5: 150% RD of NPK were applied. All the recommended package of practices for banana was followed including management of leaf spot diseases. For ratoon crop (RC), daughter suckers were allowed one month after flowering in the main crop (PC) and the growing shoot was twisted and chopped to make uniformity in the RC. The growth, yield parameters and disease severity were recorded for both the plant and the ratoon crops. The data collected were statistically analyzed using IRRI statistical software.

RESULTS AND DISCUSSION

Effect of graded dose of fertilizers on the growth and yield parameters of BBrMV infected and healthy plants of cv. Ney Poovan are furnished in Table 1 and 2. In case of plant crop, the mean height of healthy plants (312.56 cm) and infected plants (293.76 cm) differed significantly. A' brook and Heard (1) have also reported that there was a reduction in height in rye grass affected with rye grass mosaic virus. There was no significant correlation (r) of plant height with graded doses of fertilizer for both healthy and BBrMV infected plants. In case of girth, there was no significant difference among treatments in plant crop whereas in ratoon, the girth of infected plants significantly reduced when compared to healthy plants. This is because of increased severity of the diseases in ratoon crop than plant crop (Table 3). Disease severity has drastically increased in the ratoon crop and whereas in first plant crop, with increased doses of fertilizer the symptom severity was very mild to mild mosaic. Total number of fingers were more in healthy than in infected plants. T1 recorded 160.65 fingers and 169 fingers in infected and healthy, respectively. The average number of days taken for flowering was more in infected plants (291.2 days) than in healthy plants (273.18 days) (Fig. 2). Irrespective of the fertilizer levels, the days taken for flowering was more only in infected plants. Delayed flowering and prolonged duration in BBrMV infected banana have been previously reported by Thangavelu *et al*. (13). The bunch yield obtained in different treatments in plant crop of Ney Poovan is furnished in Table 1.

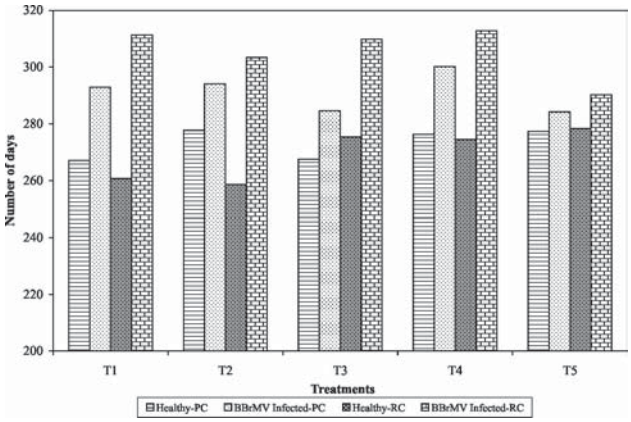

Fig. 2. Effect of increased dosages of fertilizers on days taken to flowering in BBrWV infected and healthy plants of Ney Poovan banana.

The result showed that the yield gap between infected and healthy plants were more in lower levels of fertilizer application than the RDF. Application of 150 % RDF has recorded an average bunch weight of 16.02 kg in infected plants and 16.37 kg in healthy. The bunch yield difference between them was very less (0.35 kg) than that obtained with lower dosage of fertilizer application. Though the differences in bunch weight between the infected and healthy plants was not significant at RDF (T3), by increasing the dosage of fertilizer to 150% the bunch weight was increased by 17.11% in infected and 16.26% in healthy plants over the RDF (T3). Thus, the higher level of fertilizer, lower the yield gap between infected and healthy Ney Poovan banana (Fig. 3). This is in corroboration with the observations of Selvarajan and Jeyabaskaran (11) who have reported that the yield differences between BBrMV infected and healthy plants of cv. Nendran was less in fertile soils. Pacumbaba *et al.* (7) also observed that the application MOP at higher rate, i.e. 150 and 200 kg/ha decreased the incidence of soybean mosaic virus and increased the yield of soybean. In the present study, there was significant positive correlation between the graded levels of fertilizers with the bunch weight from both BBrMV infected and healthy plants

Table 1. Effect of graded dose of fertilizers on growth and yield parameters in BBrMV infected and healthy plants of main crop of banana cv. Ney Poovan.

Treatment	Height (cm)			Girth (cm)			No. of leaves			No. of fingers			Bunch wt. (kg)		
	I*	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean
T1	296.83	321.16	309.00	70.33	70.50	70.41	14.00	12.83	13.41	160.65	169.49	165.07	10.33	11.84	11.08
T2	287.50	310.33	298.91	67.50	66.83	67.16	14.16	13.83	14.00	174.38	182.16	178.27	10.91	13.10	12.00
T3	302.50	308.66	305.58	67.66	68.00	67.83	16.33	16.16	16.25	178.94	178.66	178.80	13.68	14.08	13.88
T4	281.33	303.50	292.41	67.50	67.66	67.58	15.83	14.00	14.91	182.21	182.05	182.13	13.82	14.49	14.15
T5	300.66	319.16	309.91	68.83	70.00	69.41	13.33	14.83	14.08	173.10	186.99	180.04	16.02	16.37	16.19
Mean	293.76	312.56	303.16	68.36	68.60	68.48	14.73	14.33	14.53	173.86	179.08	176.47	12.95	13.97	12.95
r value*	0.026	-0.231	-	-0.385	-0.017	-	-0.241	-0.055	-	0.628	0.846	-	0.969	0.981	-
CD at 5%															
P: Infected /Healthy	12.106			NS			NS			NS			0.660		
T: Fertilizer doses	NS			NS			NS			NS			1.044		
PXT	NS			NS			NS			NS			NS		

*BBrMV infected plants; H: Healthy plants

Table 2. Effect of graded dose of fertilizers on growth and yield parameters in BBrMV infected and healthy plants of ratoon crop of banana cv. Ney Poovan.

Treatment	Height (cm)			Girth (cm)			No. of leaves			No. of fingers			Bunch wt. (kg)		
	I*	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean	I	H	Mean
T1	245.20	275.00	260.10	54.40	63.00	58.70	15.20	15.80	15.50	146.40	158.00	152.20	4.14	5.22	4.68
T2	261.80	273.60	267.70	57.20	60.40	58.80	14.20	16.40	15.30	139.20	167.40	153.30	4.72	6.82	5.77
T3	283.20	263.00	273.10	53.40	62.80	58.10	13.80	15.20	14.50	139.40	160.20	149.80	5.00	7.10	6.05
T4	252.80	278.80	265.80	59.40	61.40	60.40	13.20	15.40	14.30	147.20	152.20	149.70	5.16	6.18	5.67
T5	245.60	290.80	268.20	55.20	60.20	57.70	14.00	15.60	14.80	144.80	181.60	163.20	5.48	6.76	6.12
Mean	253.68	280.28	266.98	55.92	61.56	58.74	14.08	15.68	14.88	143.40	163.88	153.64	4.90	6.41	5.65
r value*	-0.08	0.580	-	-0.250	-0.55	-	-0.737	-0.480	-	0.127	0.941	-	0.975	0.516	
CD at 5%															
P: Infected /Healthy	9.876			1.950			0.854			13.342			0.607		
T: Fertilizer doses	NS			NS			NS			NS			0.961		
PXT	NS			NS			NS			NS			NS		-

*BBrMV infected plants; H: Healthy plants

in plant crop of Ney Poovan (Fig. 4). In corroboration with our findings, Spittel and Van-Huis (12) reported that application of green manure in fields with low soil fertility compensated the yield loss due to cassava mosaic disease in cassava in Zanzibar.

In ratoon crop, one side sucker for each plant was allowed one month after the emergence of bunch and the same treatments of dosage of fertilizer application were repeated. The data recorded for ratoon crop (RC) of Ney Poovan is furnished in Table 2. In RC, the plant height was comparatively less than the plant crop (PC). The average plant height in the ratoon was 266.98 cm compared to 303.16 cm in PC, but there was significant difference between the infected and healthy plants. Similarly, the average girth of the ratoon plants was only 58.74 cm which is less than the plant crop (68.48 cm). The reduction in average plant girth of infected ratoon crop from that of plant crop was12.44 cm which is much more than that of healthy plants (7.04 cm). In case of number of fingers there was drastic reduction (153.64) in RC as compared to PC (176.47) irrespective of the treatments but in RC, only 143.40 fingers recorded in infected plants as compared to 163.88 fingers in healthy plants. Application of 150% of RDF, has reduced the days taken for flowering in infected plants.

The bunch weight was drastically reduced in the RC irrespective of the treatments. The average bunch weight obtained was 5.65 kg. Maximum bunch weight of 7.10 kg was recorded in the healthy plants under RDF. Increased fertilizer dose did not influence the yield in healthy plants in RC. However in case of infected plants, the bunch weight was increased with increasing levels of fertilizer doses and was significantly correlated. Similar correlation was observed with the findings of Pacumba *et al*. (7) in soy bean. The same workers reported that application of complete fertilizers (20:20:20, NPK) at the rate of 100kg/ha decreased the virus incidence and increased the yield.

Table 3. Symptom severity recorded in bract mosaic infected plants of plant and ratoon crop of Ney Poovan banana with graded doses of fertilizers.

T. No.	Plant crop		Ratoon crop	
	5th month	7th month	5th month	7th month
T1	++	++	+++	+++
T2	++	++	+++	+++
T3	+	+	++	+++
T4	+	+/-	++	+++
T5	+	+/-	++	+++

+: Mild mosaic; ++: Severe; +++: Very severe; +/- very mild symptoms

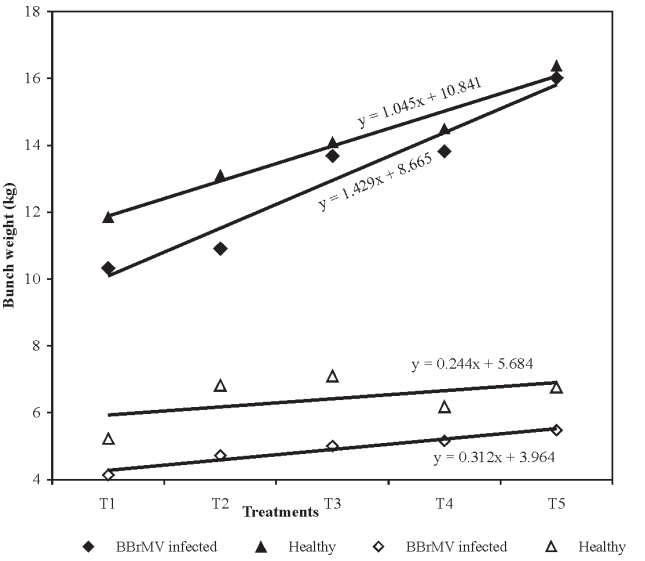

Fig. 3. Linear regression between increased doses of fertiliser and bunch weights of BBrMV infected and healthy plants of plant crop (PC) and ratoon crop (RC) of banana cv. Ney Poovan.

Fig. 4. Bunches of Ney Poovan (AB) from bract mosaic disease affected plant (right) and healthy (left).

As such, the season exposed for the ratoon might not have favored the higher yield as obtained in PC. This overall reduction might be due to adverse nature of the season for the RC. However, significant reduction in bunch weight was observed in infected plants. Normally the ratoon crop is not allowed in case of Ney Poovan, Nendran and Robusta under wetland cultivation condition practised in Trichy owing to the reduced yield in ratoon in these varieties.

In ratoon crop of Ney Poovan, proportionate increase in bunch weight was recorded for graded doses of fertilizers. The regression analysis showed a linear trend and the yield gap did not narrow in ratoon crop (Fig. 3). A regression equation has been drawn to compare the yield increase due to increased doses of fertilizer both in infected and healthy plants of Ney Poovan banana. The yield increased proportionately but the yield gap between infected and healthy plants narrowed down with increasing levels of fertilizer in plant crop (PC). Whereas in ratoon, there was increase in bunch weight in both healthy and infected plants but the gap did not get reduced with increasing levels of fertilizer application. This might be due to the increased severity of the virus infection in ratoon as compared to new crop and also the less vigour of the plants due to overload of viral inoculum. Hull and Watson (3) also reported that increased dose of fertilizer increased the root and sugar yield in both infected and healthy plants but the losses caused by infection increased proportionately as the mean yield increased. The present result suggests that only plant crop can be protected from the yield loss due to viral infection but not the ratoon crop, in case of Ney Poovan banana.

It is concluded that the application of 125-150% of RDF to BBrMV infected plants had compensated the yield loss due to virus in plant crop of cv. Ney Poovan. The same trend was not observed in ratoon crop. In future, multi-location trials have to be taken up to confirm the effect of application of higher dose of fertilizer on BBrMV affected plants at different locations comprising of other soil and climatic factors.

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