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Impact of Weather Parameters and Nutrition of Banana Plant on the Occurrence of Sigatoka Leaf Spot Disease in Biswanath District of Assam

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A B S T R A C T

Banana (*Musa* spp.) is one of the most important commercial fruit crops especially in the tropics. Of the many diseases occurring on banana, sigatoka leaf spot disease incited by *Mycosphaerella musicola* Leach, is considered as serious threat to world banana production. Given the importance of yellow Sigatoka in banana plantations and lack of information on its epidemiology, the present study was conducted to assess the incidence of Sigatoka leaf spot in banana plants cultivated through organics manures and inorganic fertilizer. Infection index was calculated on the basis of the scores for each plant at monthly interval. The field experiment was carried out in the Instructional cum Research Farm, Department of Horticulture, B.N. College of Agriculture, AAU, Biswanath Chariali comprising of five treatments viz. T_1: FYM + Microbial Consortia, $T_{2:}$ Enriched Compost, T_3: Vermicompost, T_4: Microbial Consortia, T_0: Recommended dose of fertilizer (Manure + NPK). The study revealed that incidence of Sigatoka leaf spot was high in the banana plants grown in the organic plot as compared to the plants in the inorganic plot with recommended dose of fertilizer. The incidence of Sigatoka leaf spot was observed to be highest in the month of July in and the lowest in the month of January.

Introduction

Banana (*Musa* spp.) is one of the most important commercial fruit crops especially in the tropics and has a high consumer demand worldwide (Tamuli, 2017). Bananas are monocotyledonous plants that belong to the family Musaceae and the genus Musa originated in Southeast Asia (Ploetz, 2001). Banana is grown widely in Assam and its year round availability, affordability, varietal range, taste, nutritive and medicinal values makes it the favourite fruit among all classes of people.

Plant disease is one of the prominent factors in reducing yield of horticultural crops. It has been estimated that production could be increased at least by 28% if the crop could be fortified against various diseases. The climate of Assam harbors numerous plant pathogens and provides luxuriant environment for the growth and reproduction of the plant pathogens which causes hundreds of different

diseases of crops. Determining the effect of weather parameters on the formation, release and germination of inoculum in different pathosystems have been focused by many researchers worldwide (Pinkerton *et al.,* 1998; MacHardy *et al.,* 2001; Mondal and Timmer, 2002). In Assam of the many disease occurring on banana, Sigatoka leaf spot disease incited by *Mycosphaerella musicola* Leach, is considered as serious threat. It causes from premature death of leaves, reduced growth and development and lower fruit quality and yield. Adequately nourishment of plants, also influence the occurance of diseases. Plants with balanced nutrition have rapid leaf emergence, shoot production at shorter intervals and improve the resistance capacity of the plants. Therefore the present study was undertaken to investigate the effects of temperature, rainfall, humidity and plant nutrients grown both in organic and inorganic plots on the sigatoka disease of banana.

Materials and Methods

Experimental site

The field experiment was conducted in the Instructional cum Experimental Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali during 2016-2017. The experimental site is situated at $26^0 43^/ 32^{//}$ N latitude and $93^0 08^/ 01^{//}$ E longitudes having an elevation of 86.70 m above mean sea level.

Experiment details

The experiment was laid out in a certified organic block. Four treatments (T_1, T_2, T_3 and T_4) were laid out in randomized block design replicated five times. The net plot size was 6 m x 6 m. There were altogether twenty plots of equal size in the organic block under the experiment. Five plots of equal size were laid out for the treatment of T_0 (inorganic fertilizer application) outside the organic block. Banana plantlets cv. Amritsagar were planted at 2.1m x2.1m spacing. Treatment details were given in Table 1

Climate and weather condition

Biswanath College of Agriculture (BNCA), located at Biswanath Chariali, falls within North Bank Plain Agro-climatic Zone (NBPZ) of Assam. The prevailing climatic condition of Biswanath Chariali is subtropical having hot and humid summer, dry and cold winter seasons. The rainy season and the summer season are overlapping and rainfall starts from March and reaches maximum during July-August and decreases gradually up to December (Table 2).

The station is receiving average annual rainfall of 1980.0 mm. The summer season continues from May to August and the cold winter continues from December to January, whereas a mild winter is experienced during September to November and February to April.

The meteorological observations during the period of experimentation as recorded at meteorological observatory of Biswanath College of Agriculture**.**

Estimation of infection of Sigatoka disease

Sigatoka severity scoring of banana leaves was done as per the method of Gauhl *et. al.,* (1993). Scoring was done in youngest completely unfurled leaf and all the upright leaves on each test plant at monthly interval from September, 2016 to June, 2017. Infection index was calculated on the basis of the scores in for each plant at monthly interval. Score and percentage of infection of sigatoka disease in banana leaves is shown in Fig. 1.

Scores	Percentage of infection
0	: No symptom
1	: Less than 1% of lamina with symptoms (only streaks and/or up to 10 spots)
2	: 1 to 5 % of lamina with symptoms
3	: 6 to 15 % of lamina with symptoms
4	: 16 to 33 % of lamina with symptoms
5	: 34 to 50 % of lamina with symptoms
6	: 51 to 100 % of lamina with symptoms
7	: Missing leaf or dead leaf hanging down the pseudostem, (when a leaf is missing or dead and hanging down the pseudostem, it should be included in the infection index calculation)

Leaf sample analysis for N, P and K

The third leaf from the apex of the selected plant was taken for leaf analysis (Murray, 1960). Samples at vegetative stage (4^{th} month after planting), at shooting and at harvest were taken from the middle portion of the leaf lamina. Thus collected samples were sundried, followed by oven dried and powered. The samples were kept in small air tight containers for analysis.

Estimation of nitrogen

Nitrogen in leaves was estimated by Microkjeldal's method as illustrated by Jackson (1973) and expressed in percentage.

Estimation of phosphorus

Phosphorus content in leaves was estimated by Vanadomolybdate method after acid digestion as detailed by Jackson (1973).

Estimation of potassium

The Potassium content in the plant was estimated from triacid digested material using a flame photometer as described by Jackson (1973).

Results and Discussion

Infection of sigatoka disease was recorded at monthly interval from September, 2016 to July, 2017 and presented in Table 3. It was observed that the percentage of sigatoka disease infection gradually decreased from September, 2016 and found to be least in January, 2017 in both organic treatments and RDF *i.e.* 10.52 and 5.67 respectively. Again the infection gradually increased from February, 2017 and was found highest in July, 2017 in both organic treatments (41.06) and RDF (21.82). It might be due to the rainfall pattern and temperature in different months of the growing season as the pathogen *Mycosphaerella musicola* Leach, was favoured by wet and humid condition along with high temperature.

It has been observed that the temperature and number of rainy days decreased from September, 2016 and was lowest in the month of January, 2017 as shown in Fig. 2. Thus, in the month of January, 2017 the weather was dry and colder resulting the least incidence of the disease because the pathogen did not get the favourable condition for growth and multiplication.

On the other hand, when the temperature and number of rainy days increased from February, 2017 the incidence of sigatoka leaf spot also increased due rise in temperature and more humidity. And found to be the highest in July, 2017 where the number of rainy days and humidity was also highest accompanied by high temperature in the month.

Table.1 Detail of the treatments

Notation	Treatments
T_1	FYM @ 12 kg/plant + Microbial Consortia @ 30 g/plant at planting followed by FYM @ 6 kg/plant+ Microbial Consortia @ 15 g/plant at 5 months after planting
T_2	Enriched Compost @ 5 kg/plant at planting + Enriched Compost @ 3 kg/plant at 5 month after planting
T_3	Vermicompost @ 5 kg/plant + Vermicompost @ 3 kg/plant at 5 months after planting
T_4	Microbial Consortia @ 30 g/plant during planting as slurry + Microbial consortia @ 15 g/plant at 5 month after planting by mixing with 1 kg compost
T_0	Recommended dose of fertilizer (RDF)

Table.2 Meteorological data of the period of field experimentation, 2016-2017

Month	Rainfall (mm)	Temperature°C		Relative Humidity (%)		No of rainy days
		Maximum	Minimum	Morning	Evening	
September, 2016	259.8	32.3	25.3	92	71	**17**
October, 2016	95.4	31.8	18.0	88	59	**7**
November, 2016	1.8	28.8	15.6	85	53	**2**
December, 2016	4.0	26.4	11.3	85	54	**1**
January, 2017	4.2	25.4	8.8	82	56	**2**
February, 2017	70.7	27.1	13	85	48	**3**
March, 2017	54.2	26.8	16.18	85	49	**7**
April, 2017	275.8	28.7	20.1	88	65	**14**
May, 2017	242.4	30.2	22.6	88	69	**16**
June, 2017	421.8	31.4	24.8	91	70	**19**
July, 2017	**378.3**	**32.4**	**22.5**	**90**	**77**	**20**

Table.3 Month-wise Sigatoka disease infection

Treatments	Months											
	Sept	Oct	Nov	Dec	Jan	Feb	March	Apil	May	June	July	Mean
T_1	37.60 (37.82)	25.10 (30.07)	20.36 (26.85)	17.84 (24.95)	10.75 (19.09)	13.31 (21.39)	19.31 (26.06)	25.15 (30.07)	34.57 (36.03)	37.60 (37.82)	40.10 (39.29)	25.60 (30.40)
T_2	32.80 (34.94)	26.03 (30.66)	24.83 (29.87)	21.86 (27.90)	10.53 (81.91)	12.92 (21.05)	18.52 (25.48)	25.82 (30.53)	32.14 (34.51)	36.81 (37.35)	41.09 (39.87)	25.75 (30.46)
T_3	34.38 (35.91)	20.82 (27.13)	19.34 (26.06)	18.21 (25.25)	10.44 (18.81)	11.50 (19.82)	18.30 (25.33)	22.26 (28.18)	31.32 (34.02)	34.09 (35.73)	40.45 (39.47)	23.73 (29.13)
T_4	32.04 (34.45)	20.39 (26.58)	15.75 (23.34)	13.92 (21.89)	10.39 (18.81)	11.66 (20.00)	19.06 (25.92)	22.85 (28.52)	33.05 (35.06)	35.64 (36.63)	42.64 (40.74)	23.39 (28.93)
SEd ±	2.37	2.49	6.62	2.17	0.94	1.44	2.61	1.94	3.02	4.48	4.23	
CD (P=0.05)	**4.15**	**4.34**	**11.56**	**3.80**	**1.64**	**2.52**	**4.57**	**3.39**	**5.27**	**7.83**	**7.38**	
OM (Mean)	34.20 (35.79)	23.08 (28.73)	20.07 (26.64)	17.95 (25.03)	10.52 (18.91)	12.35 (20.53)	18.80 (25.70)	24.01 (29.33)	32.77 (34.94)	36.03 (36.87)	41.06 (39.87)	24.62 (29.73)
RDF (Mean)	19.82 (26.42)	14.05 (21.97)	11.01 (19.37)	8.27 (16.74)	5.67 (13.81)	9.44 (17.85)	12.44 (20.62)	16.65 (24.04)	19.29 (25.06)	20.00 (26.56)	21.82 (27.83)	14.40 (22.30)

Table.4 N, P and K contents of banana leaves at harvest

Treatments	N (%) content	P (%) content	K (%) content
T_1 = FYM +Microbial Consortia	3.29	1.84	9.17
T_2 = Enriched Compost	3.18	1.72	8.86
T_3 = Vermicompost	3.07	1.70	8.76
T_4 = Microbial Contortia	2.76	1.65	8.56
T_0 (RDF)	3.32	1.88	9.31

Fig.1 Score and percentage of infection of sigatoka disease in banana leaves

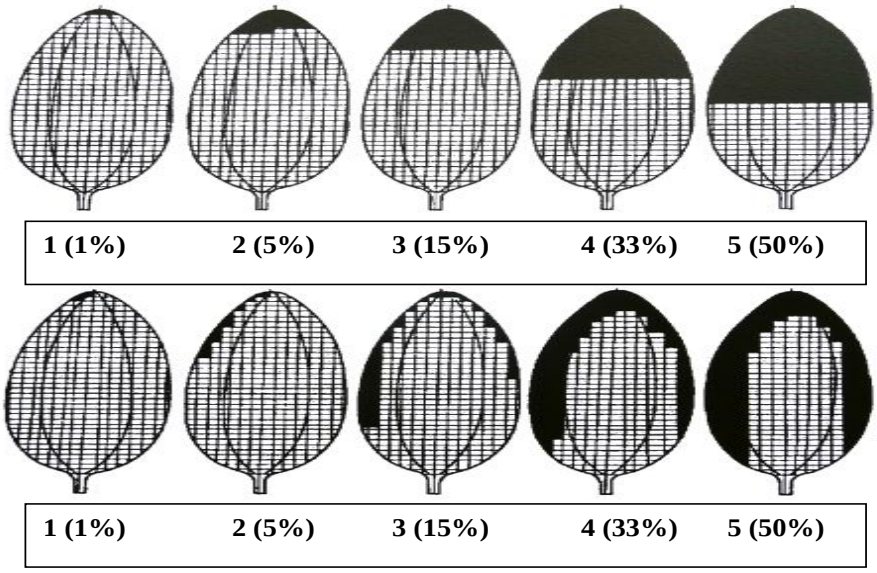


Fig.2 Disease incidence index during the period of experimentation (2016-2017)

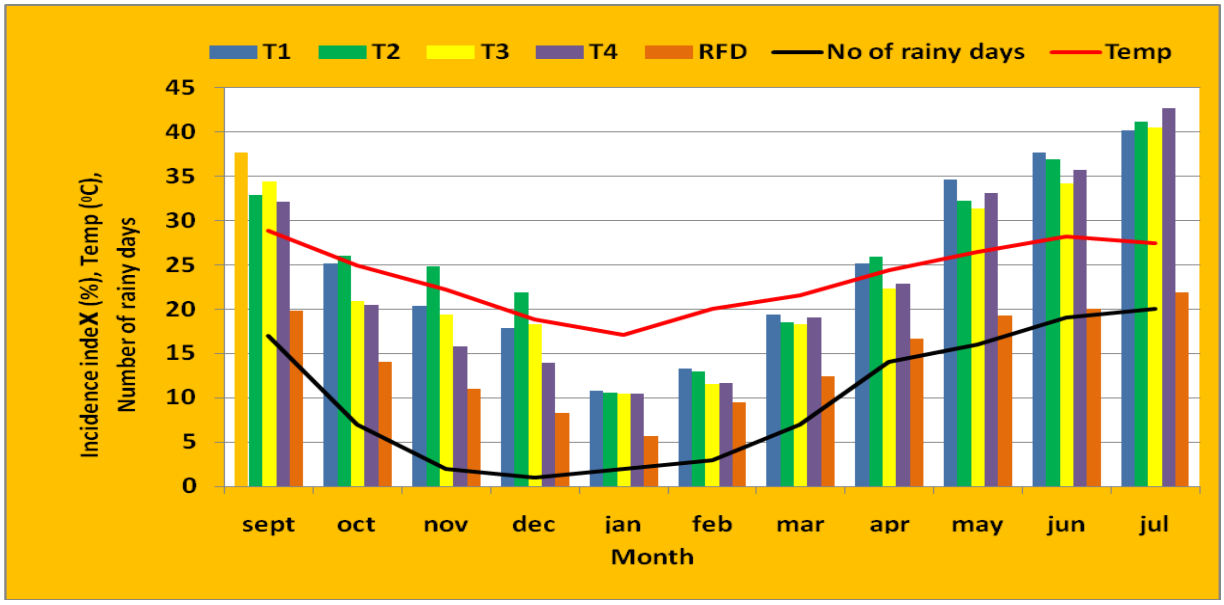
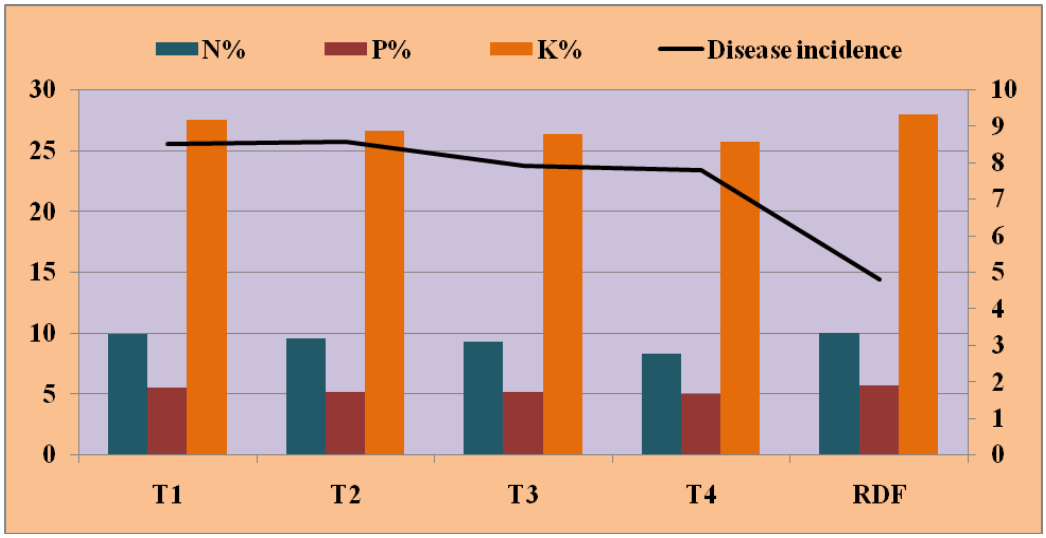


Fig.3 Sigatoka disease incidence in relation to plant nutrient uptake



Considering the nutrient of banana plants, Sigatoka leaf spot occured more in the plants with organic treatments than the RDF as shown in Fig. 3. The plants treated with RDF had the least occurrence of Sigatoka leaf spot might be due to the higher uptake of N, P and K. It is also found that balance amount of P and K in the plants provides resistances to various diseases. N, P and K contents of leaves estimated at harvest is presented in Table 4

From the experiment it can be concluded that the weather of a geographical area directly influence the incidence of sigatoka leaf spot. But the weather phenomenons are not under the control of human beings. Therefore to counteract the incidence of diseases balance nutrient is imperative that enhance the resistance capacity of the plants. Other management practices such as quarantine, clean cultivation and use of resistant varities are used to control diseases.

Growing awareness of health and environmental issues associated with the intensive use of chemical inputs if a farmer chooses organic farming strict preventive measures should be taken as it was found that in organic cultivation the disease incidence was more as compared to the inorganic cultivation. Moreover chemical cannot be used to control the disease even if it is in devasting form. Therefore care should be take right from selecting disease free planting material to harvesting.

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