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Sigatoka leaf spot of banana : epidemiology and management

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Maximum temperature (X1), minimum temperature (X2), relative humidity in the morning (X3), relative humidity in the evening (X4), rainfall (X5) and number of rainy days (X6), were taken into consideration as independent variables to correlate with the disease severity (PDI) as dependent variable (Y) using multiple regaression analysis. Relative humidity at morning was observed to be positively correlated with PDI, while in stepwise multiple regression studies maximum and minimum temperature were assessed as the significant environmental parameter during shooting stage of the crop. Minimum temperature (X2), relative humidity at morning (X3) and rainfall (X4) were identified as critical factors when severity of the sigatoka was calculated at harvesting stage. Susceptibility of the crop increased with age and rate of spread (r) was highest during September-October.

Efficacy of the selected 10 fungicides calculated against the sigatoka disease showed that all the chemicals had reducing effect. Propiconazole, carbendazim. tridemorph and chlorathalonil were highly effective to check the disease severity in the field. Out of these, propiconazole was evaluated as best fungicide against the pathogen. Four spraying of fungicide @ 0.1% at 21 days intervals effectively controlled the disease and greatly increased the bunch yield over the control. Cost benefit ratio calculated was also maximum with propiconazole treatment.

Key words: Banana, sigatoka, epidemiology, management

INTRODUCTION

Leaf spot or Sigatoka of banana caused by *Cercospora musae (Mycosphaerella musicola* Leach) is the most important foliar disease of banana causing economic loss of crop. The disease is prevalent in almost all the banana growing countries. In India the disease is a serious problem in all the growing states including West Bengal, Assam, Andhra Pradesh, Maharastra, Tamil Nadu and Karnataka. Number and area of functional leaves are drastically reduced by the disease which affect the yield and quality of fruit (Marcelino and Sattler, 1988). The disease has the potentiality to cause yield loss from 33% and 76% during first and second cropping cycle respectively (Mobambo *et al.* 1996). Weather factors have significant role in severity of the disease. Disease severity is known to vary according to resistance and susceptibility of the host and also due to changed environmental conditions (Meridith, 1970). Present study has been made to assess the influence of meteorological parameters on disease development and also to assess suitable fungicide(s) to manage the disease under field conditions.

MATERIALS AND METHODS

The investigation was conducted in the lower Gangetic alluvial zone of West Bengal. Nine fungicides were tested in two consecutive field trial to select the most effective fungicide. These were chlorathalonil, carbendazim, hexaconazole, propiconazole, tridemorph, SAAF (carbendazim + mancozeb), mancozeb, thiophanate methyl and propineb. Control treatment with water spray was also maintained. The popularly grown silk group cultivar 'Martaman' (AAB), susceptible to Sigatoka disease was selected for this purpose. Triton—'X' (sticker) was used to maintained the efficacy of the fungicides on the waxy leaf surface to banana. Experiments were laid out with randomized block design with three replications. Total of 36 plants per treatment were maintained in each of the two consecutive years (2003 and 2004). Spraying was started when approximately 1.0% leaf area was affected during early monsoon (last week of June). Four spraying were imposed at 30 days interval. Disease data were recorded 30 days after final spray following the above mentioned formula (Gauhl *et al.,* 1993). Physical parameters were recorded at shooting where as yield parameters were at harvest. Cost-benefit ratios were also calculated to show the economics of the treatments. Standard horticultural management was followed for proper growth and development of the crop.

Suckers were planted at monthly interval for a period of two years following standard experimental design. Natural epiphytotic development of the disease in the field was permitted. Disease was scored following 0 – 6 scale (Gauhl *et al.,* 1993) where, (0=no symptoms, 1=up to 1% of lamina with symptom, 2=1-5% of lamina with symptoms, 3=6-15% of lamina with symptoms, 4=16 – 33% of lamina with symptoms, 5 = 34-50% of lamina with symptoms, and 6 = 51-100% of lamina with symptoms). PDI (per cent disease) were calculated with the following standard formula

$$PDI = \frac{\Sigma nb}{(N-1) \times T} X\ 100,$$

where n = number of leaves in each grade, b = grade, N = number of grades used in the scale (7) and T = total no. of leaf scored.

Per cent leaf area affected were measured at monthly interval to find out the rate of disease spread (r) in the field following Van der plank (1963) formula.

All the selected parameters, maximum temp (°C), minimum temp (°C), RH (%) at morning and evening, total rainfall (mm) and number of rainy days were collected from the local meteorological observatory.

RESULTS AND DISCUSSION

Data recorded from the monthly planting crop at different age showed that severity of the disease increased with the age i.e., plants having younger age were less affected with Sigatoka pathogen and susceptibility increased as the crop became older. Plants during harvesting stage were most susceptible. Susceptibility of the disease was also recorded higher during monsoon and post monsoon season (Table 1). Present findings have supported the earlier work of Jacome and Schuh (1992), where they have reported older plants were more susceptible than younger one. Higher susceptibility of the crop at older age might be due to cessation of new leaf production, less available fresh leaf for infection and also might be due to crops age factor.

It was evident that relative humidity at morning and number of rainy days had significant positive effect

Table 1: Differential leaf infection (%), per cent disease index and rate of spread (r) of Sigatoka disease at different age level

Month of years 2003-2004	Age of plants (in months)	Per cent leaf infected	Per cent disease index (PDI)	Rate of spread in the field
June	4	7.95	4.05	0.00
July	4	14.52	4.26	0.17
August	6	19.90	6.25	0.19
September	7	32.36	10.11	0.58
October	8	48.75	16.86	0.62
November	9	54.22	22.64	0.43
December	10	60.81	30.15	0.34
January	11	74.28	34.82	0.21
February	12	89.76	37.20	0.12
March	13	96.64	40.36	0.08
April	14	100.00	43.82	0.04

on per cent disease index. Following stepwise multiple regression indicated that minimum temperature, relative humidity at morning and rainfall significantly influenced the disease severity. Rawal and Summonwar (2001) reported faster spread of the disease during rainy season was due to high relative humidity and warm temperature which corroborate with the present findings.

All the data recorded from fungicide assessment trial were analysed and are represented in the Table 2. Findings revealed that application of chemicals were always better than unsprayed control. Severity of the disease widely varied i.e. differential response of the fungicides were recorded. Out of 9 fungicides tested propiconazole showed best performance against the disease. Efficacy of tridemorph and carbendazim were also found to be good. Minimum disease severity was recorded with propiconazole during the years 2003 (28.88) and 2004 (30.05) respectively which were significantly different than the other treatments. Carbendazim (33.38) and SAAF (36.25) also showed good performance in 2003 while carbendazim (35.52) and tridemorph (35.88) in the year 2004. Mancozeb (42. 80) was found to be least effective among the fungicides.

Number of infected leaves were recorded minimum (2.10 and 1.80) in case of propiconazole treated plants. Efficacy of tridemorph, propineb and SAAF were also found to be considerably good against the leaf spot disease. Highest yield (328 and 338 Q/ha) was also obtained with propiconazole which was calculated to be 55.76% and 55.76% higher than the control (224 and 217 Q/ha). Cost benefit ratios also calculated and observed to be maximum in propiconazole (1 : 10 and 1 : 11) followed by tridemorph and carbendazim (1 : 9 and 1 : 10). Efficacy of propiconazole against yellow Sigatoka was reported by Hoq *et al.*, (1994) and Misra *et al.* (2004) while against black Sigatoka by Guzman and Romero (1997).

Table 2: Field management of Sigatoka leaf spot of banana using chemical fungicides.

Treatments (Fungicides)	Numer of infected leaves		Number of healthy leaves		Disease severity (PDI)		Yield (Q/ha)		C-B ratio
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04
Tridemorph	3.75	2.88	8.25	9.82	37.24	35.88	316	320	1.09
Hexaconazole	4.58	4.94	9.42	7.90	38.36	38.90	294	303	1.04
Propiconazole	2.10	1.80	11.90	11.56	28.88	30.05	328	338	1.10
Propineb	4.42	3.75	7.58	8.82	37.68	38.76	305	306	1.08
Chlorathalonil	5.64	5.62	6.36	7.54	39.85	41.18	280	297	1.06
Carbendazim	4.25	3.90	8.75	8.93	33.38	35.52	320	321	1.09
SAAF	4.65	3.62	8.35	9.40	36.25	37.34	302	313	1.08
Mancozeb	6.42	5.87	5.58	7.26	41.75	42.80	305	289	1.07
Thio-methyl	5.15	4.62	7.85	8.46	34.4	40.65	287	308	1.06
Control (water)	9.26	8.48	2.74	4.60	61.88	62.25	224	217	—
S.Em	0.34	0.28	0.97	0.94	1.98	1.99	17.5	16.4	—
C.D. at 5%	0.71	0.58	2.04	1.97	4.16	4.19	36.96	34.4	—

Stepwise multiple regression equations for prediction of Sigatoka severity in the field.

$Y = -377.099 - 2.035 X_1 + 3.457 X_2 + 4.006 X_3^{**} + 0.278 X_4 - 0.004 X_5 - 0.445 X_6$

$Y = -357.111 - 1.237 X_1 + 2.525 X_2 + 3.739 X_3^{**} + 0.255 X_4 - 0.\text{-}54 X_5$

$Y = -438.949 + 1.743 X_2^{**} + 4.324 X_3^{**} + 0.251 X_4 - 0.051 X_5^{**}$

$Y = -467.556 + 1.985 X_2^{**} + 4.728 X_3^{**} - 0.039 X_5^{*}$

where,

X_1 = Maximum temperature (°C), X_2 = Minimum temperature (°C), X_3 = Relative humidity at morning (%), X_4 = Relative humidity at evening (%), X_5 = Rainfall (mm) and X_6 = Number of rainy days. Symbols indicate test of significance at 5% (*) and 1% (**) level.

It can be assessed from the present findings that crop age is directly correlated with disease severity. Maximum rate of spread in the field is recorded during September-Ocotber when atmospheric humidity is very high together with moderate high temperature (30-35°C) and consequently fungicidal spray would be imposed in July–August along with other methods for efficient management of Sigatoka leaf spot in the field.

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