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Field evaluation of soil application of bio-fertilizer for intensity of Sigatoka leaf spot and yield of banana

RV Deshmukh and SV Dhutraj

Abstract

A field experiment was conducted during 2016-17 at banana Research Station, Nanded to study the effect of soil application of biofertilizer on the intensity of sigatoka leaf spot disease and yield of banana. Three Biofertilizers Viz *Trichoderma harzianum*, *Azospirillum lipoforum* and phosphate solubilizing bacteria (PSB) *Pseudomonas polymixa* were applied through soil at 25 g per plant in split doses. Soil application of biofertilizer is applied with 75 per cent and 100 per cent recommended dose of fertilizer considering the effectiveness of soil application of bio fertilizers along with 75 per cent RDF and 100 RDF, treatment T₉ i.e. 100 per cent RDF with soil application of *Trichoderma harzianum* + *Azospirillum* + PSB@25 g per plant recorded significantly minimum per cent diseases severity index of sigatoka leaf spot (20.92%) and obtained maximum banana yield (109.15 mt /ha).

Keywords: Biofertilizer, Banana, Sigatoka, Yield

Introduction

Banana (*Musa* spp.) is one of the important fruit crop of the tropics. the fruit are rich source of carbohydrate and energy. India is the largest producer of banana contributing 27% of the world production (FAO, 2009)

Integrated nutrient management is found beneficial for maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining crop productivity through optimization of benefits from all possible source of plant nutrient in an integrated manner. It was found that early vegetative phase of growth of banana especially upto 3rd and 6th month after transplanting and bunch development stage are the critical stages of banana at which yield is affected (Prameela, 2010). Combine application of 100 per cent recommended dose of fertilizer (RDF) along with FYM 10 kg per plant and phosphate solubilizing bacteria (PSB) and *Azospirillum* each at 25 g per plant increased pseudostem height, crop duration, and yield attributes (Bhalerao et al 2009) [1]. *Trichoderma* strains are known to induce resistance in plants. three classes of compound that are produced by *trichoderma* and induce resistance in plant are now known. These compound induce ethylene production hypersensitive response and other defence related reaction in plant cultivars. Present investigation was carried out at Banana Research station, Nanded during the year 2016-17 to evaluate the efficacy of bio-fertilizer application on the intensity of sigatoka leaf spot diseases and yield of banana.

Materials and Methods

The experiment was conducted at Banana Research Station, Nanded of Vasantrao Naik Marathawada Krishi Vidyapeeth, Parbhani during the year 2016-17. The experiment was conducted in Randomised Block Design with three replication and nine treatments. The grass plot size was kept 9.0x 7.5M and net plot size was 7.5X6.0 M, Recommended spacing of 1.5M X 1.5M was maintained. Grand Naine tissue culture saplings were used as a planting material. Planting of the crop was done in last week of July 2016. Biofertilizer *Azospirillum lipoforum*, phosphate solubilizing bacteria (*Pseudomonas polymixa*) and *Trichoderma harzianum* @25 g per plant in two split doses at the time of planting and 75 days after planting with T₂-75 % RDF + *Trichoderma harzianum*, T₃-75 % RDF + *Azospirillum*, T₄-75 % RDF + Soil application of PSB, T₅-75 % RDF + *Trichoderma harzianum* + *Azospirillum* + PSB, T₆-100 % RDF + Soil application of *Trichoderma harzianum*, T₇-100 % RDF + Soil application of *Azospirillum*, T₈-100 % RDF + Soil application of PSB, T₉-100 % RDF + *Trichoderma harzianum* + *Azospirillum* + PSB. Observation on growth characters, per cent disease index of sigatoka leaf spot. and yield of banana were recorded.

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Disease Management

Disease development and efficacy of each treatment were assessed at monthly interval on 5 plant of similar maturity par plot using the younger leaf spotted method. (stover and Dickson 1970). The severity index were assessed by using Gauhls modification of stover severity scoring system (Gauhls *et al* 1993)

The proportion of leaf area showing symptoms was recorded on a scale 0 to 6 as follows

0 = No disease symptoms

1= Less than 1 per cent symptoms

2= 1-5 per cent showing symptoms

3= 6-15 per cent showing symptoms

4= 16-33 per cent showing symptoms

5= 34-50 per cent showing symptoms

6 = More than 50 per cent shoeing sympyoms Disease severity index (DSI) was calculated as following

$$PDI = \frac{\text{Infection Index (PDI)} = \sum nb \times 100}{(N-1) T}$$

Where,

n = number of leaves in each grade

b = grade

N = Number of grades used in the scale

T = Total number of leaves graded on each plant.

Results and Discussion

Results presented in Table 1 revealed that the significant results were observed due to soil application of different biofertilizers in respect of height of plant and girth of stem.

Significantly maximum height of plant (232.0 cm) and girth of stem (71.7 cm) was recorded by the treatment T₉ i.e. 100 % RDF with Soil application of *Trichoderma harzianum*, *Azospirillum* and PSB followed by the treatment T₇ (230.7) i.e. 100 % RDF with Soil application of *Azospirillum* and treatment T₅ i.e. 75 % RDF with Soil application of *Trichoderma harzianum*, *Azospirillum* and PSB (230.3 cm)

Data presented in Table 2 revealed that the significant results of percent disease index of sigatoka leaf spot were observed due to the soil application of different bio-fertilizers with 75 % RDF and 100 % RDF. Significantly minimum percent disease index of sigatoka was recorded by the treatment T₉ i.e. 100 % RDF with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB (20.92%) and treatment T₅ i.e. 75 % RDF i.e. soil application of *Trichoderma harzianum*, *Azospirillum* and PSB (21.32 %) and were found at par with each other as compared with rest of the treatments of bio-fertilizers. Intensity of sigatoka leaf spot on treatment T₉ and T₅ is considerably less than other treatment may be due to the development of resistance in plant due to the application of biofertilizers. Bio-fertilizers play a significant role in improving soil fertility by fixing atmospheric nitrogen. It solubilises insoluble P and produces plant growth substances in soil. They help in disease resistance and withstand in stress condition by different mechanism. The present finding are in agreement with Thangaselvabai (2009) [7]. Hazarika *et al* (2011) [3]. and Medhi *et al* (2007) [4].

Results presented in Table. 3 showed that significant differences in number of fingers/ bunch, weight of bunch/ plant and yield of banana (Mt/ha) were observed due to the different treatments of soil application of bio-fertilizers.

Table 1: Effect of soil application of different Bio-fertilizer on the growth characters of banana.

Treatments	Height of plant (cm)	Girth of stem (cm)	Number of leaves / plant
T ₁ - 100 % RDF (Control)	213.3	59.3	14.0
T ₂ - 75 % RDF + Soil application of <i>Trichoderma harzianum</i>	221.3	64.7	15.7
T ₃ - 75 % RDF + Soil application of <i>Azospirillum</i>	224.3	66.0	16.0
T ₄ - 75 % RDF + Soil application of PSB	229.3	63.7	15.3
T ₅ - 75 % RDF + Soil application of <i>Trichoderma harzianum</i> + <i>Azospirillum</i> + PSB	230.3	68.0	15.7
T ₆ - 100 % RDF + Soil application of <i>Trichoderma harzianum</i>	227.3	68.3	15.0
T ₇ - 100 % RDF + Soil application of <i>Azospirillum</i>	230.7	69.7	16.3
T ₈ - 100 % RDF + Soil application of PSB	227.7	66.3	15.3
T ₉ - 100 % RDF + Soil application of <i>Trichoderma harzianum</i> + <i>Azospirillum</i> + PSB	232.0	71.7	17.3
SE±	1.85	1.16	0.69
CD at 5%	5.54	3.46	NS

Table 2: Effect of soil application of bio-fertilizers on the intensity of sigatoka leaf spot of banana

Treatments	Percent disease intensity of sigatoka leaf spot									Average PDI of sigatoka
	Sept-16	Oct- 16	Nov- 16	Dec- 16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	
T ₁ -100 % RDF (Control)	17.5 (24.71)	23.5 (28.94)	25.0 (29.97)	26.3 (30.86)	26.8 (31.18)	29.3 (32.78)	29.9 (33.18)	30.8 (33.72)	32.1 (34.52)	30.91
T ₂ -75 % RDF + <i>Trichoderma harzianum</i>	15.77 (23.38)	16.83 (24.20)	17.17 (24.46)	17.5 (24.72)	18.0 (25.09)	17.7 (24.85)	17.7 (24.91)	18.4 (25.4)	18.7 (25.52)	24.77
T ₃ -75 % RDF + <i>Azospirillum</i>	13.7 (21.7)	15.83 (23.44)	16.17 (23.69)	16.67 (24.08)	16.5 (23.95)	17.8 (24.95)	18.7 (25.61)	18.8 (25.67)	19.06 (25.88)	24.41
T ₄ -75 % RDF + Soil application of PSB	15.17 (22.9)	15.83 (23.44)	16.33 (23.81)	17.0 (24.33)	11.67 (24.84)	18.5 (25.46)	19.9 (26.53)	19.8 (26.38)	20.3 (26.79)	25.07
T ₅ -75 % RDF + <i>Trichoderma harzianum</i> + <i>Azospirillum</i> +PSB	12.17 (20.38)	12.8 (20.97)	13.5 (21.54)	13.5 (21.54)	13.17 (21.27)	12.9 (21.06)	13.0 (21.76)	13.2 (21.29)	13.9 (21.91)	21.32
T ₆ -100 % RDF + Soil application of <i>Trichoderma harzianum</i>	14.77 (22.54)	14.83 (22.61)	15.83 (23.43)	16.3 (23.82)	16.3 (23.83)	17.5 (24.75)	17.6 (24.76)	17.7 (24.83)	18.8 (25.69)	24.12
T ₇ -100 % RDF + Soil application of <i>Azospirillum</i>	12.5 (20.68)	13.43 (21.48)	14.0 (22.16)	14.9 (22.72)	14.3 (22.23)	15.8 (23.43)	15.8 (23.42)	15.4 (23.07)	16.3 (23.81)	22.84
T ₈ -100 % RDF + Soil application of PSB	14.43 (22.31)	15.5 (23.17)	16.0 (23.57)	17.0 (24.34)	17.3 (24.59)	18.1 (25.17)	19.5 (26.24)	20.0 (26.6)	20.5 (26.91)	24.91

T ₉ -100 % RDF + <i>Trichoderma harzianum</i> + <i>Azospirillum</i> +PSB	11.5 (19.80)	12.23 (20.46)	12.5 (20.69)	12.67 (20.84)	12.47 (20.67)	13.36 (21.43)	12.8 (20.98)	13.3 (21.4)	13.6 (21.6)	20.92
SE±	0.69	0.77	0.58	0.34	0.32	0.517	0.489	0.58	0.60	0.54
CD at 5%	2.07	2.32	1.75	1.02	0.96	1.54	1.46	1.75	1.80	1.63

Table 3: Effect of soil application of bio-fertilizers on yield and yield contributing characters of banana.

Treatments	Number of hands/ bunch	Number of fingers/ bunch	Weight of Bunch/ Plant (kg)	Yield of banana (Mt/ha)
T ₁ -100 % RDF (Control)	8.0	137.0	17.83	79.24
T ₂ -75 % RDF + <i>Trichoderma harzianum</i>	8.3	146.7	20.0	89.02
T ₃ -75 % RDF + <i>Azospirillum</i>	8.7	144.7	20.27	90.06
T ₄ -75 % RDF + Soil application of PSB	8.3	143.7	19.47	86.5
T ₅ -75 % RDF + <i>Trichoderma harzianum</i> + <i>Azospirillum</i> +PSB	9.0	155.0	22.57	109.15
T ₆ -100 % RDF + Soil application of <i>Trichoderma harzianum</i>	7.7	146.3	20.47	90.94
T ₇ -100 % RDF + Soil application of <i>Azospirillum</i>	8.3	149.3	22.80	101.3
T ₈ -100 % RDF + Soil application of PSB	8.3	144.3	21.67	96.26
T ₉ -100 % RDF + <i>Trichoderma harzianum</i> + <i>Azospirillum</i> +PSB	9.3	155.0	23.80	114.2
SE±	0.38	5.30	0.61	3.72
CD at 5%	NS	NS	1.83	7.93

Number of fingers/ bunch

Significantly maximum number of fingers/ bunch were recorded by the treatment T₅ i.e. 75 % RDF with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB and treatment T₉ i.e. application of 100 % RDF with *Trichoderma harzianum*, *Azospirillum* and PSB (155.0) followed by treatment T₇ i.e. 100 % RDF with soil application of *Azospirillum* @ 25 gram/ plant (149.3) which were found at par with each other as compared with rest of treatment of bio-fertilizers under study.

Weight of bunch (kg/ plant)

Significantly maximum weight of bunch per plant were recorded by the treatment T₉ i.e. application of 100 % RDF along with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB @ 25 gram per plant (23.8 kg/ plant) treatment T₇ i.e. 100 percent RDF with soil application of, *Azospirillum* @ 25 gram per plant (22.8 kg/ plant) and treatment T₅ i.e. 75 % RDF with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB @ 25 gram per plant (22.57 kg/ plant) which were found at par with each other as compared with rest of the treatments of bio-fertilizers under study.

Yield of banana (Mt/ha)

Significantly maximum yield of banana were obtained from treatment T₉ i.e. 100 percent RDF with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB @ 25 gram per plant (114.15 Mt/ha) followed by the treatment T₅ i.e. 75 % RDF with soil application of *Trichoderma harzianum*, *Azospirillum* and PSB @ 25 gram per plant (109.15 Mt / ha) which were found at par with each other as compared with rest of the treatment of Biofertilizes. Similar results were reported by Bhalerao *et al* 2009 [1], that the combine effect of 100 per cent RDF along with FYM 10 kg per plant and phosphate solubilizing bacteria (PSB) and *Azospirillum* each at 25g per plant increased pseudostem height, girth, crop duration and yield attributes.

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