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DEVELOPMENT OF BIO-RATIONAL MANAGEMENT PACKAGE FOR FUSARIUM WILT AND SIGATOKA DISEASE OF BANANA

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Abstract

Efficacy of different bio-rational based fungicides was studied at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Shibpur, Narsingdi during the period of April, 2021 to May, 2022 to find out the effective management package(s) against Fusarium wilt and sigatoka diseases of banana. Four treatments combinations were compared with the farmer's practices (control where no fungicide) under natural epiphytotic conditions. Among the tested treatments, T_4 = Decoprima (5g/pit) + Soil recharge (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre of watre) displayed maximum reduction of Fusarium wilt disease incidence (100%) at 180 days after planting (DAP). In case of sigatoka, the highest disease severity of 26.67 % was recorded in T_5 (Farmers practices) treated plants at 180 DAP and the lowest in T_4 treated plants where severity was 10%. The highest banana fruit yield (11 kg per bunch) was obtained from T_4 treated plants while the lowest yield (6.40 kg per bunch) in T_5 treated plants.

Keywords: BARI Tricho-compost, Dynamic WP, Decoprima, Recharge, and Tilt 250EC Fusarium wilt, Sigatoka, banana.

Introduction

Banana (*Musa* spp.) is one of the most popular nutritious fruits in Bangladesh belongs to the family Musaceae. The fruit is available round the year with a great demand to the people for its lower price, easily digestible and palatable in nature In Bangladesh it is cultivated in 35,000 ha of land and produces nearly 2.6 million tons of banana annually (BBS, 2012). Banana production faces several constraints, and diseases play a significant role in limiting successful cultivation globally including Bangladesh. The most common and widely damaging diseases of banana in Bangladesh are Fuasarium wilt (*Fusarium oxysporum* f. sp. *cubense*), Sigatoka (*Mycosphaerella musicola*), burrowing nematode (*Rodopholus similis*), Mosaic and Streaks virus (Meah and Khan, 1987). Among the diseases Fusarium wilt disease is the most devastating disease which affecting commercial and subsistence banana production throughout the banana producing areas of the world (Ploetz, 2005). The disease is ranked as one of the top 6 important plant diseases in the world (Ploetz and Pegg, 1997). In Bangladesh, 24% disease incidence of fusarium wilt was

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recorded from Jessore in Sabri variety (Hossain and Rashid, 1999). Sigatoka of banana caused drastic reduction in yield in terms of weight and quality of the fruits (Ramsey *et al*., 1987) due to blighted of affected leaves and reduction of normal photosynthesis of the plant. Several management strategies have been developed in controlling the spread of Fusarium wilt and sigatoka diseases. However, they were unable to provide long-term solutions to the problem. Solely relying on chemical fungicides is not always effective for managing plant diseases. Moreover, chemical control can negatively impact the agro-ecosystem. On the other hand, utilizing biological agents offers several advantages such as reduced risk of adverse effects on the environment and human health. Therefore, the current research was aimed to develop bio-rational based management package(s) to combat the Fusarium wilt and sigatoka diseases of banana.

Materials and Methods

The experiment was conducted at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Shibpur, Narsingdi during the period of April, 2021 to May, 2022. Different combinations of BARI Tricho-compost, Dynamic WP, Decoprima, Recharge, and Tilt 250EC were tested against the Fusarium wilt and Sigatoka disease of banana under natural field conditions. The Dynamic WP, a biological fungicide contains *Bacillus amyloliquefaciens* that attacks cell walls of fungus and bacteria, deprives pathogenic fungi of space and nourishment by colonizing plant roots and produces metabolites that inhibit plant pathogens. The Decoprima, another bio-pesticide contains *Streptomyces* sp., *Geobacillus* sp. and *Trichoderma* sp. that act as bio-sterilization and aerobic decomposer ingredients, which can be used alone or in combination with fungicides or chemical insecticides. The Recharge (Lycomax) contains *Trichoderma harzianum, Trichoderma viride, Metarhizium anisopila* and *Beauveria bassiana* that can protect plants from the attack of pathogenic fungi. The experiment was conducted in randomized complete block design with three replications. The unit plot size was 4m × 10m and plant spacing was 2m × 2m. The banana (Sabri) plants were grown under uniform cultural practices . Four treatment combinations were compared with the farmers practice. The treatments were T_1: BARI Tricho-compost (10g/pit) + Sucker treatment with Dynamic WP (2g/litre of water) + Alternate foliar spray with Dynamic WP (2g/litre of water) and Tilt 250 EC (0.5ml/litre of water), T_2: Soil application of Recharge (5g/pit) + Sucker treatment with Dynamic WP (2g/pit) + Alternate foliar spray with Dynamic WP (2g/pit) and Tilt 250 EC (0.5ml/litre of water), T_3: Decoprima (5g/pit) + Alternate foliar spray with Dynamic WP (2g/pit) and Tilt 250EC (0.5ml/litre of water), T_4: Decoprima (5g/pit) + Soil Recharge (5g/pit) + Alternate foliar spray with Dynamic WP (2g/pit) and Tilt 250 EC (0.5ml/litre of water) and T_5: Farmers practices (control) where no fungicide was applied.

BARI Tricho-compost (10g/pit), Recharge (5g/pit) and Decoprima (5g/pit) were applied during sucker planting. Alternate foliar application of fungicides Tilt 250

EC (0.5ml/litre of water) and Dynamic (2g/litre of water) was started when first symptom of the disease was noticed and continued up to flower initiation stage at 30 days interval. The incidence of Fusarium wilt and Sigatoka disease was recorded at 120, 150 and 180 days after transplanting. The disease incidence of banana plants was determined by the following formula (Rai and Mamatha, 2005):

$$\text{Plant infection (\%)} = \frac{\text{Number of diseased plants}}{\text{Number of total plants observed}} \times 100$$

Percent Disease Severity (PDS) was determined by the following formula (Rai and Mamatha 2005):

$$\text{Percent disease severity (leaves)} = \frac{\text{Area of leaf tissue infected by disease}}{\text{Total leaf area of the plant}} \times 100$$

The percent data were transformed into square root and arc-sign transformed values and analyzed statistically using Statistix 10 software package.

Results and Discussion

Incidence of Fusarium wilt: The incidence of Fusarium wilt disease in banana plants varied significantly among the treatments (Table 1). The highest disease incidence 16.67, 41.67 and 41.67% was recorded at 120, 150 and 180 days after planting, respectively in T_5 (control) treated plants. No incidence of wilt disease (0%) was observed in T_1 and T_4 treatments even at 180 days after planting. The reduction in wilt incidence ranged 60-100% among the treatments at 180 days after planting. The reduction of wilt incidence at 180 DAP was maximum (100%) in both T_1 and T_4 treatments followed by T_3 treatment (80.01%). Thangavelu (1999) reported that the incidence of Fusarium wilt ranged from 0.5 to 20% in main crop and it was maximum (85%) in the second crop in India. The incidence of panama disease (Fusarium wilt) was found as 30% in Batticaloa district of Sri Lanka (Shanika and Prasannath, 2016).

Table 1. Effect of different fungicides on disease incidence of Fusarium wilt of banana at different days after planting

Treatments	Fusarium wilt disease incidence (%)			Disease reduction (%) over Control at 180 DAP
	at 120 DAP	at 150 DAP	at 180 DAP	
T_1	0.00	0.00	0.00	100.00
T_2	8.33	16.67	16.67	60.00
T_3	8.33	8.33	8.33	80.01
T_4	0.00	0.00	0.00	100.00
T_5	16.67	41.67	41.67	-

DAP = Days After Planting.

T_1: BARI Tricho-compost (10g/pit) + Sucker treatment with Dynamic WP (2g/litre water) + Alternate foliar spray with Dynamic (2g/litre water) and Tilt 250 EC (0.5ml/litre watre), T_2: Soil application of Recharge (5g/pit) + Sucker treatment with Dynamic (2g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre water), T_3:

Decoprima (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre of water), T_4: Decoprima (5g/pit) + Soil recharge (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250EC (0.5ml/litre water) and T_5: Farmers practices (control) where no fungicide.

Incidence and Severity of Sigatoka disease: The incidence of Sigatoka disease in banana plants at 180 days after transplanting did not differ significantly among the treatments and all banana plants under study were infected (100%) by Sigatoka disease at 180 days after planting (Table 2). Besides, the severity of Sigatoka disease varied significantly among the treatments at 180 days after planting where the highest disease severity of 16.67, 20.00 and 26.67% was recorded in T_5 treated plants at 120, 150 and 180 days after planting, respectively (Table 2). The treament T_2 treated plants showed severity of 10.00, 13.33 and 18.33% at 120, 150 and 180 days after planting, respectively. The lowest disease severity of 6.67, 9.67 and 10% was recorded in T_4 treated plants at 120, 150 and 180 days after planting (Table 2). . Islam *et. al*. (2017) reported that the sigatoka disease incidence ranged from 21.90 to 54.33% with the severity from 42.67 to 85.67% in eighteen upazillas of Narsingdi, Tangail, Gaibandha, Rangpur, Bogra, and Jhikorgacha, Jessore districts of Bangladesh. In India, Thammaiah (2003) conducted a survey on Sigatoka disease of banana and reported the highest severity in Munavalli village of Sindagi Taluk (66.96%) followed by Bijapur (64.56%). Shanika and Prasannath (2016) reported 42% infection of sigatoka disease in Batticaloa district of Sri Lanka.

Table 2. Effect of different fungicides on disease incidence and severity of sigatoka of banana at different days after planting

Treatments	Sigatoka disease incidence (%)			Sigatoka disease severity (%)		
	at 120 DAP	at 150 DAP	at 180 DAP	at 120 DAP	at 150 DAP	at 180 DAP
T_1	58.33 (55.00)	75.00 (70.00)	100.00 (90.00)	6.67 (14.76)	10.00 (18.43)	11.67 (19.95)
T_2	66.67 (60.00)	100.00 (90.00)	100.00 (90.00)	10.00 (18.43)	13.33 (21.15)	18.33 (24.81)
T_3	50.00 (41.35)	91.67 (80.00)	100.00 (90.00)	9.00 (17.44)	10.67 (19.05)	13.33 (21.34)
T_4	41.67 (41.35)	58.33 (55.00)	100.00 (90.00)	6.67 (14.76)	9.67 (18.08)	10.00 (18.38)
T_5	66.67 (60.00)	100.00 (90.00)	100.00 (90.00)	16.67 (23.36)	20.00 (26.19)	26.67 (31.00)
LSD (0.05)	51.55	37.18	-	8.93	7.03	8.58

DAP = Days After Planting; Values within the parentheses are arc-sign transformed values.

Fruit yield of banana: The fruit yield of banana was varied significantly among the treatments (Figure 1). The highest fruit yield of 11 kg per plant or bunch was found in T_4 treated plants and the lowest fruit yield of 6.40 kg per bunch in the T_5

treated plants (control plot). The fruit yield was higher where the banana plants showed lower incidence and severity of Fusarium wilt and Sigatoka disease. The highest disease severity of 26.67% was recorded in T_5 treated plants where the fruit yield was lowest of 6.4 kg. The results revealed that higher incidence and severity of diseases declined the development of banana finger and produced lower fruit yield.

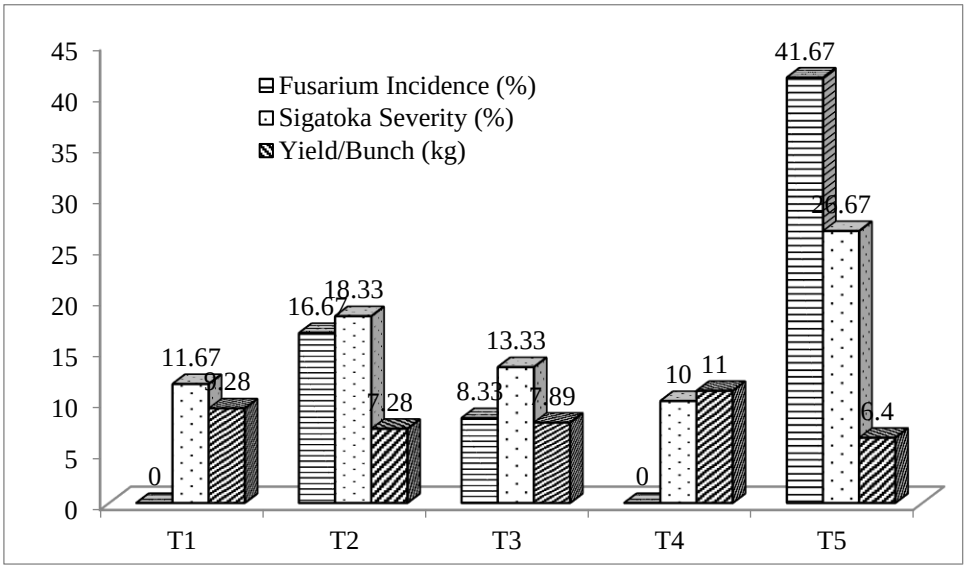

Fig. 1. Effect of different fungicides combinations on Fusarium wilt and Sigatoka diseases of banana and fruit yield of the crop.

T_1: BARI Tricho-compost (10g/pit) + Sucker treatment with Dynamic WP (2g/litre water) + Alternate foliar spray with Dynamic (2g/litre water) and Tilt 250 EC (0.5ml/litre watre),

T_2: Soil application of Recharge (5g/pit) + Sucker treatment with Dynamic (2g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre water),

T_3: Decoprima (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre of water),

T_4: Decoprima (5g/pit) + Soil recharge (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250EC (0.5ml/litre water)

T_5: Farmers practices (control) where no fungicide was used.

Conclusion

Results from the present study revealed that two treatments i.e. T_4 = Decoprima (5g/pit) + Soil recharge (5g/pit) + Alternate foliar spray with Dynamic (2g/pit) and Tilt 250 EC (0.5ml/litre of water) and T_1 = (BARI Tricho-compost (10g/pit) Sucker treatment with Dynamic (2g/litre of water) + Alternate foliar spray with Dynamic (2g/litre of water) and Tilt 250 EC (0.5ml/litre of water) were better for the

management of Fuasarium wilt disease of banana. Besides, T_4 treatment was better for controlling the sigatoka disease and increasing fruit yield of banana. Considering both of the diseases and yield performance the treatment T_4 was the best in reducing diseases and increase fruit yield of banana.

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