



Research Article

NOVEL APPROACH FOR SELECTION OF BANANA SUCKERS WITH THE DECLINE OF *FUSARIUM OXYSPORUM* F. SP. CUBENSE POPULATION

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Abstract: The Banana (*Musa* spp.) is an important cash fruit crop of India. It ranks first in production and third in area among fruit crops. It is grown in the eastern parts of the Bihar. The Foc may both limit the growth of suckers from which reproduction of banana is achieved, and reduce fruit quality and quantity. The effect of Foc on suckers based on distance to mother plant has not been fully understood. Therefore, this study was aimed to determine effect of the distance of sucker plants from mother plants to the Foc population and disease incidence. Foc isolation was performed by infected plant diseased soil samples were collected from banana plants of different micro plots showing typical wilt symptoms. The pathogen was isolated from infected diseased plant soil samples following standard methods. Results revealed that foc population and disease incidence of new seedlings obtained from the first sucker of the tissue culture mother plant were 22.00%, 20.50%, 18.00%, 14.50% and 12.00% per plant, respectively in five districts of Bihar viz., Katihar, Purnea, Khagaria, Kishanganj and Bhagalpur. Whereas it was 58.50%, 56.00%, 52.00%, 42.00% and 40.50% per plant in the control plots. Overall, a negative correlation was determined about distance of sucker plant from mother plants and Foc population. In addition, PDI were declined because of lower Foc population. The suckers next to the local cultivar of mother plants were unable to grow due to the higher Foc density and susceptibility of the plants. The efficiency of suckers can be enhanced against fusarium wilt by replacing the local cultivar with the tissue culture plant and incorporating integrated wilt management strategies.

Keywords: Sucker, *Fusarium*, Banana, Wilt

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Introduction

In order to cater to the needs of escalating population, banana production needs to be doubled and estimated production requirement by 2020 is around 25 million tons [1]. Since increase in area of cultivation is impossible, the alternative approach is to increase the productivity is the threat posed by the pest. Among the diseases, Fusarium wilt also known as panama wilt caused by *Fusarium oxysporum* f. sp. Cubense is the major constraint to banana production and the disease has major fungal disease of banana in India.

Disease reduction is the most often attributed to improved disease free planting materials to prevent Foc population and its activity. In this context, the present study has been undertaken with the aim of managing *Fusarium oxysporum* f. sp. cubense with disease free planting materials. The infected plant develops root injury, browning and rotting of rootlets and blocked to the xylem vessels that progressively spread near base of the pseudo stem. The pathogens are more prevalent in Bihar. It is primarily a root disease and causes yellowing of older leaves and finally lodging of plants along with fruits bunch but under favorable environmental conditions mainly in rainy season, the wilt severity is more. Since banana is a cash crop in eastern Bihar, the magnitude of crop losses is very high and more over not much work on disease free planting materials and management aspects have been reported on this destructive disease. Therefore, the present study in regards to correlation between the disease severity and planting materials and Foc population factors were under taken.

As monoculture banana cultivation is conducted in Bihar, yield and quality decrease due to foc damage, leaves concentrate on the top and banana cluster weight decrease.

Continuous banana cultivation is conducted in same locations either on land or in greenhouses. Foc populations in the mother plant prevent sucker root development, which is the basis of the next generation fruit. The present study aimed to investigate the effect of Foc population on plant and distance using suckers that are remote from the root of the mother plant. The Foc count and percentage effects on the disease incidence were obtained with the analysis of the diseased samples/soil on the suckers that were at a one-meter distance from the mother plant.

Materials and Methods

The experiments were conducted in banana micro plots of tissue culture and local cultivar, at different district of Bihar during 2017 and 2018. Five plants were selected for each replication, and each application was conducted on 15 plants. Banana yield, distance from the mother plant and diameter of each plant were measured.

Observations recorded and methodology for isolation of pathogen

Fungal species were isolated from the rhizosphere soils by serial dilution plate technique [2]. A known amount (10g) of material was suspended or agitated in a quantify volume of sterile water blank (90ml so as to make the total volume to 100ml) to make a microbial suspension. Finally, 1ml aliquots of various dilutions were added to sterile petri dishes (triplicate for each dilution) to which were added 15ml (approximately) of the sterile, cool and melted (45°C) media. Potato Dextrose Agar media was used for Foc analysis and incubated at 27 ± 2°C for 2 to 7 days.

Banana suckers for pathogen inoculants

A rhizome emerged in March were allowed to grow and others were culled. The suckers were cut flat and carved on June, 2017. The rhizomes were left next to the mother plant for banana sucker development for the following year. The farmer practice growing local cultivar was evaluated as control in micro plots. The sucker's diameter was measured in February. Likewise in September, soil samples/plant were collected at the distances of 0-20, 20-40, 40-60, 60-80 and 80-100 cm up to 0-30 cm soil depth for each application. Two kg samples were collected into plastic bags [3,4]. Samples were transferred to the Plant Pathology laboratory and 100 g soil obtained from these samples was placed in to Petri dishes. The pathogen was isolated from soil by following standard methods [5].

Statistical analysis for occurrence of *Fusarium* infection

The Foc population on basis of per cent wilt disease incidence in the soil sample was calculated as per formula.

Percent occurrence = [Number of colonies of a particular fungus / Total number of colonies of all the fungi] x 100

The statistical analysis was carried out by comparing mean values with t-test (multiple range) test, and 95% (P <0.05) confidence level was accepted as statistically significant.

Results and Discussion

Effect of pathogen (Foc) population on Banana suckers

The experimental results revealed that, the Foc population count in the soil samples /plant decreased during the month of October, since they moved away from the main plant.

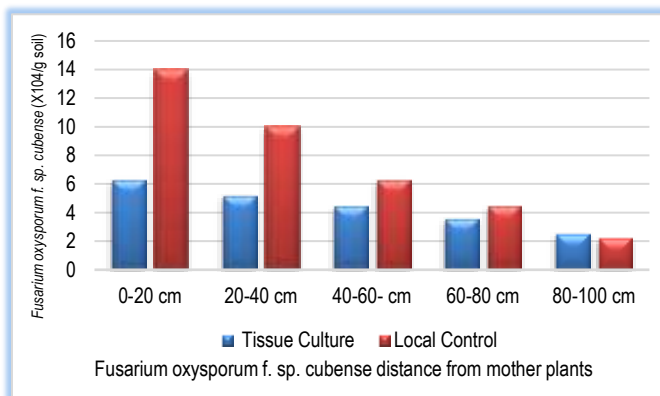


Fig-1 Foc populations per 100 g soil obtained at different distances from the banana mother plant

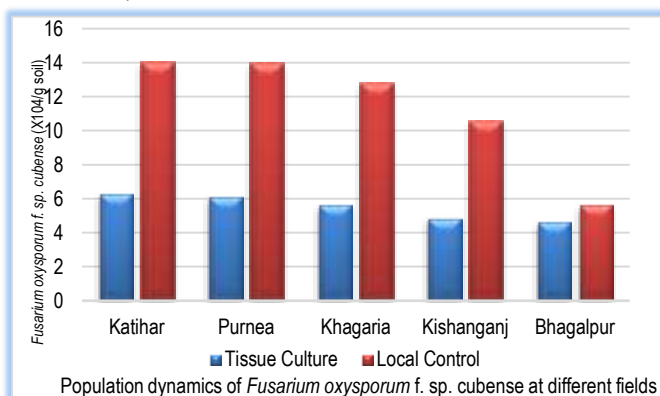


Fig-2 Population dynamics of Foc in banana field at different district of Bihar

However, 6.31/g cfu within 0-20 cm of the mother plant were observed and these counts were declined up to 5.23/ g cfu within a distance of 20-40 cm followed by 4.47, 3.63 and 2.56 /g cfu within a distance of 40-60-cm, 60-80 cm and 80-100 cm respectively in tissue culture micro plot [Table-1] and [Fig-1] whereas in local cultivar Foc population were higher 14.00/g cfu within 0-20 cm of the mother plant, the count declined to 10.00/g cfu within a distance of 20-40cm followed by 6.32,

4.51 and 2.25/g cfu at the distance of 40-60cm, 60-80 cm and 80-100 cm respectively in Katihar region and likewise similar trend were observed in Purnea, Khagaria, Kishanganj and Bhagalpur district of Bihar [Table-2] and [Fig-2].

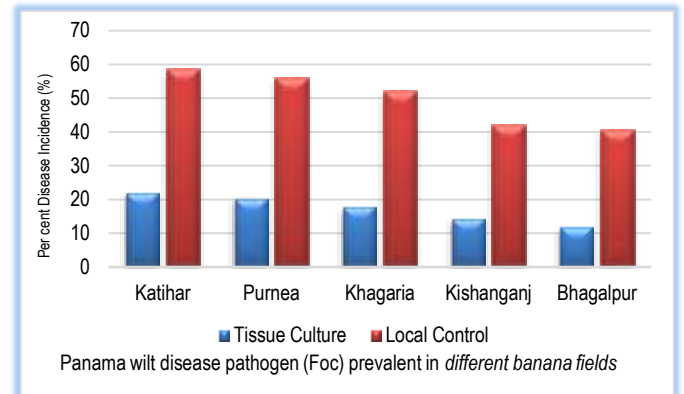


Fig-3 Per cent Disease Incidence of Panama wilt disease of banana in different district of Bihar

Effect of banana sucker's selection on PDI

It was also determined that suckers that would be low PDI the following year had very low chance to cause the disease when located at 40-60 cm from both mother plants; tissue culture and local cultivar due to the lower cfu count while PDI was higher (58%) in case of local cultivar due to more virulent of pathogen in comparison to tissue culture plant 22.00%. The total count of cfu were lower 22.20 cfu/g in Katihar region followed by 21.35, 19.77, 17.13, 14.79 and 14.15 cfu/g in Purnea, Khagaria, Kishanganj and Bhagalpur district of Bihar respectively [Fig-3]. Earlier, it was demonstrated by Ploetz, 2006 [6], that Foc population developed the wilt disease incidence due to their ability to cause plant diseases. Although the banana roots could develop up to 1 m, it is known that the roots that grow around 0-40 cm could maintain the plant [7].

In general, it was determined that when the cfu/g of Foc count was higher, the chance of PDI is also higher. Thus, Foc population become enhanced in the soil where bananas were continuously cultivated using local cultivar of diseased mother plants. The reason for the presence of maximum Foc cfu/g in all micro plots were due to the high virulence of pathogen and susceptibility of the plants, which specifically hosted the Foc for disease incidence. Banana cultivation is monoculture, Foc population continues to increase and there is a continuous source of Foc inoculums in the soil. Even low Foc population during winter affects the development of suckers. However, most banana growers are yet not aware of the fact that Panama wilt disease incidence is more due to infected suckers [8].

During the course of investigation, it was also found that the Foc of cfu/g were higher in the suckers obtained from the mother plant of local cultivar in comparison to tissue culture plants and the disease incidence were also remain higher in the suckers selected from local cultivar plants.

Effect of distance of banana sucker on disease incidence

Overall, a negative correlation was determined in between the distance of sucker plant from mother plants and Foc population. In respect to the distances of suckers from mother plant, reduction in disease incidences i.e., 58.50%, 56.00%, 52.00%, 42.00% and 40.50% were observed in both the treatments (Tissue culture and control plants in five district of Bihar). In addition, PDI were also declined because of lower Foc population. The suckers next to the local cultivar of mother plants were unable to grow due to the higher Foc density [9].

As a result, Foc attack on plant roots and disrupt the functions of the plant root, preventing water and nutrient intake. They decrease the root mass and plant wilt up. It is, therefore, necessary to develop control strategies against wilt by considering the damage caused by Foc population. In the present study, we allowed the suckers that emerged in April 2017 to grow and then cut them in July 2017 to allow the growth of new suckers far from the mother plants. It was found that since the new plant was obtained far from the mother plant, the Foc population was declined and low disease incidence [10,11].

Table-1 *Foc* populations per 100 g soil obtained at different distances from the banana mother plant

Location	Micro plots	Foc population at different distance from mother plant					Mean
		0-20cm	20-40cm	40-60cm	60-80cm	80-100cm	
Katiyar	Tissue Culture	6.31	5.23	4.47	3.63	2.56	22.20
	Local cultivar	14.00	10.00	6.32	4.51	2.25	37.08
Purnea	Tissue Culture	6.12	5.02	4.24	3.52	2.45	21.35
	Local cultivar	13.94	10.94	6.40	4.40	2.14	37.82
Bhagalpur	Tissue Culture	4.66	3.27	2.24	2.30	1.68	14.15
	Local cultivar	5.68	5.25	4.56	2.56	1.72	19.77
Khagaria	Tissue Culture	5.62	4.27	3.24	2.30	1.70	17.13
	Local cultivar	12.81	9.17	6.32	4.32	2.13	34.75
Kishanganj	Tissue Culture	4.87	3.56	2.43	2.31	1.62	14.79
	Local cultivar	10.53	8.38	5.82	2.82	1.84	29.39
CD (P=0.005)		3.85	3.44	2.95	2.66	2.32	-
SEm±		1.43	1.26	1.17	1.12	1.10	-

Table-2 Population dynamics (no. of colonies/g) of *Fusarium oxysporum* f. *Sp. cubense* in the banana fields

Location	Micro plots	Foc population from the mother plant (cfu/g)	PDI (%)
Katiyar	Tissue Culture	22.20	22.00
	Local cultivar	37.08	58.50
Purnea	Tissue Culture	21.35	20.50
	Local cultivar	37.82	56.00
Bhagalpur	Tissue Culture	14.15	12.00
	Local cultivar	19.77	40.50
Khagaria	Tissue Culture	17.13	18.00
	Local cultivar	34.75	52.00
Kishanganj	Tissue Culture	14.79	12.00
	Local cultivar	29.39	42.50
CD (P=0.005)		5.82	-
SEm±		1.46	-

Conclusion

Minimum chances to cause the disease when suckers distance keep at 40-60 cm from both mother plants; tissue culture and local cultivar due to the lower cfu count while PDI was higher (58%) in case of local cultivar due to more virulent of pathogen in compression to tissue culture plant. The suckers next to the local cultivar of mother plants were unable to grow due to the higher Foc density. The efficiency of selected suckers of tissue culture plant can be increases and replacing the local cultivar suckers with the tissue culture plant by incorporating integrated wilt management strategies in the banana cultivation practices.

Application of research: The causation of disease will be lower by keep proper distance suckers at 40-60 cm from plants. Tissue culture plant shows with less virulent of pathogen in compression local cultivar. Efficiency of selected suckers of tissue culture plant can be increases and replacing the local cultivar suckers. Tissue culture plant by incorporating integrated wilt management strategies in the banana cultivation may be practices.

Research Category: Plant Pathology

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****Principal Investigator or Chairperson of research: Dr Gireesh Chand**

University: Central Agricultural University, Pasighat, 791102, India

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Study area / Sample Collection: Katiyar, Purnea, Khagaria, Kishanganj and Bhagalpur, Bihar, India

Cultivar / Variety / Breed name: Banana (*Musa* spp.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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