

Original Research Article

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Effect of Banana Pseudostem Sap and *P. fluorescens* on Mango Diseases in Field Condition

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ABSTRACT

Mango (*Mangifera indica* L.) is an important fruit crop of India and other sub-tropical and tropical countries of the world. Mango fruit is one of the most popular, nutritionally rich fruits with unique flavor, fragrance, taste, and health promoting qualities, making it number one among new functional foods, often labelled as “super fruits”. In pre-harvest condition, several diseases are found on the mango which reduces the yield, decreases marketability and shelf life after harvest of the fruits. Widely used fungicides have led to increased activity in the development of biological control against plant pathogens. Hence, the present investigation on the biological control of mango diseases was carried out in *in vivo* condition, the efficacy of banana pseudostem sap and bio-control agent (*P. fluorescens*) on the disease severity of anthracnose, powdery mildew and grey blight of mango and found that spraying and drenching of banana pseudostem sap @ 2.0 % and 15%, respectively reduce the per cent disease intensity of anthracnose and powdery mildew as compared with control and increase the average yield of mango (average 81.58 kg/plant). In biochemical parameter significantly highest phenol content was also observed in this treatment.

Keywords

Fruit crop, Sub-tropical and tropical countries, Mango.

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Introduction

Mango (*Mangifera indica* L.) is grown in tropical and subtropical regions of south-east Asia and the one the world’s most important and esteemed fruit and described by some as the “king of the all fruits”. India is the second largest producer of fruits in the world and holds first position in production (18.43 million tones) from 2516 thousand hectares of area of mango (Ganeshmurthy *et al.*, 2016). It is a potential source of sugar, pectin, vitamin-A, vitamin-C, and minerals like phosphorous, calcium *etc.* Diverse production condition and vast area grown, mango suffers from number

of diseases like powdery mildew, anthracnose, black banded, shooty mould, mango malformation, red rust, angular leaf spot, and MBCD caused by various fungi and bacteria. Though, numerous strategies are currently being employed to manage and control of mango diseases. The indiscriminate use of different fungicides causes potential threat to human health, increase in pathogen resistance, mutation and cause environmental hazards. Therefore, biological control can play a role in integrated disease management system to reduce our dependence on chemical

pesticides and hold disease below economic threshold without damaging the agro ecosystem (Papavizas and Lumsden, 1980). Hence, the present investigation under taken to evaluate the efficacy of botanicals (Banana pseudostem sap) and bio-agents (*P. fluorescens*) for manage of mango pre-harvest diseases like Anthracnose, Powdery mildew and Grey leaf blight.

Worldwide mango anthracnose is recognized as the most important field and post -harvest disease (Poletz and Prakash, 1997) and causes 30-60% yield losses on mango across different countries of the world (Akern, 2006; Chowdhury and Rahim, 2009). Powdery mildew is widespread in India, where it causes significant crop losses; Prakash and Srivastava (1987) reported losses of 30-90% in Lucknow. In China the disease reduces yields by 20-30% (Li GuiZhen *et al.*, 2006). Losses of 80-90% have been reported in South Africa (Kotze, 1985), while losses of up to 20% have been recorded in Florida in some seasons (Cook, 1975). Grey blight is also considered as one of the commonest disease of mango. The disease was observed throughout Taiwan in moderate to severe form, thus affecting the general health of mango trees and orchards (Ko *et al.*, 2007). Grey blight or Pestalotia leaf spot of mango was reported in India by Vala *et al.*, (1985) and Verma *et al.*, (1991).

Anthracnose disease occurs tan to dark brown in colour, often with a darker border. Infection appears as lesion along the margin of the pale green leaves, in which case they are semi-circular shape (Ploetz, 2001). Wagle *et al.*, (1928) reported in powdery mildew, the young leaves and inflorescences are covered with a whitish powdery mass. Flowers on the infected inflorescence remain unfertilized and drop off prematurely and attacks young tissues of all parts, leaves and their stalks, flower scales, buds of tender flowers and

fruits in the early stage and mature stage on leaves develop purplish brown spots. Infected fruits are often malformed and off-coloured. In grey blight of mango, initial symptoms were small, yellow to brown spots on leaves. Later, the irregularly shaped spots, ranging from a few millimetres to a few centimeters in diameter, turned white to grey and coalesced to form larger grey patches. Lesions had slightly raised dark margins. On mature lesions, numerous black acervuli were developed on the grey necrotic areas (Patel, 1988).

Many plants have been used because study of antioxidant and antimicrobial properties, phytochemical screening and analysis of sap extracted from banana (*Musa acuminata*) pseudostem, which are due to compounds synthesized in the secondary metabolism of the plant (Nagarajan *et al.*, 2013). Sampath Kumar *et al.*, (2012) reported the antifungal and antibiotic activity of peel and pulp of fully ripe bananas and a fungicide in the peel and pulp of green fruits is active against a fungus disease of tomato plants. Priya *et al.*, (2014) reported the phytochemical screening and analysis of pseudostem sap indicated the presence of these carbohydrates, protein and phenolic compounds and the antimicrobial studies with different fungal and bacterial strains indicated the antimicrobial properties for the sap as well.

Materials and Methods

The experiment entitled “Effect of foliar and drenching application of NAUROJI NOVAL organic fertilizer (Banana pseudostem sap) and bio-agent *Pseudomonas fluorescens* (NAU isolate) on 8-10 year old mango cv. “Kesar” tree. Three times treatments were applied at 20 days intervals starting from development of new flash (Oct.–Nov., 2015) on mango tree. Trees were sprayed till run-off with approximately 20 l of spray solution per

tree by using tractor operated sprayer. Different spraying concentration of Banana pseudostem sap is 1.0%, 1.5% and 2.0% and drenching concentration is 5%, 10% and 15% and both spraying and drenching combination and spraying and drenching concentration of *Pseudomonas fluorescens* (NAU isolate) 0.1% and 0.2%, respectively and combination of both spraying and drenching. Treatments were assigned in a randomized complete block design with thirteen treatments and three replications per treatment. Tree with water served as a check.

Recorded the diseases severity of Anthracnose, Powdery mildew and Grey leaf blight was recorded at 20 days interval from twigs and panicles from each treated and properly labelled plant by using the 0-5 scale of anthracnose (Sharma, H. *et al.*, 2010) as: 0 = healthy; 1 = up to 10 ; 2 = > 10 to 20 ; 3 = >20 to 30 ; 4 = >30 to 50 ; 5 = > 50 percent leaf area infected, 0-4 scale of powdery mildew (Reuveni and Reuveni, 1995) as : 0 = no powdery mildew colony ; 1 = 1 to 10 ; 2 = 11 to 25; 3 = 26 to 50 ; 4 = >50 percent covered by powdery mildew colonies and 0-5 scale of grey leaf blight (Patel, 1988) as: 0 = healthy; 1 = 1 to 10 ; 2 = 11 to 25; 3 = 26 to 50 ; 4 = 51 to 75; 5 = > 75 percent leaf area infected respectively.

Per cent disease intensity (PDI) was computed by using the formula

$$\text{PDI} = \frac{\text{Sum of all the numerical ratings}}{\text{No. of leaves/panicles observed} \times \text{Maximum rating}} \times 100$$

Also recorded the per cent fruit retention per plant, yield parameters like total no. of fruits per plant, fruit yield (kg/plant), fruit yield (t/ha), Physical parameters like fruit weight (g) and fruit size (cm) and bio chemical parameters like Total soluble solids (TSS)

(⁰Brix), Reducing, Non reducing, Total sugars (%), Total phenol and Vit.-C (mg/100g pulp) content by using standard determination methods (Ranganna, 1986).

Results and Discussion

The samples of infected mango parts like leaves, twigs and panicles showing typical symptoms of mango diseases were collected randomly from college farm, NMCA, NAU, Navsari, Gujarat. The anthracnose infected leaves, twigs, petioles, flower clusters and fruits. They are tan to dark brown in colour, often with a darker border. Infection appears as lesion along the margin of the pale green leaves, in which case they are semi-circular shape. Such types of finding were also observed by Snowdon (1990), Ploetz (2001), Hasabnis (1984) caused by *Colletotrichum gloeosporioides*. In powdery mildew, the young leaves, inflorescences and flower are covered with a whitish powdery mass and Flowers remain unfertilized and drop off prematurely and attacks young tissues of all parts, leaves and their stalks, flower scales, buds of tender flowers and fruits in the early stage and mature stage on leaves develop purplish brown spots. Infected fruits are often malformed and off-coloured.

That types of observation also recorded by Wagle *et al.*, (1928), Singh (2000), McGrath and Thomas (1996), Palti *et al.*, (1974), and Howard *et al.*, (1994). Powdery mildew disease attacks the young tissue of all parts and fruit also, such types of symptoms recorded by Burchill (1978). In grey blight of mango, initial symptoms were small, yellow to brown spots on leaves. Later, the irregularly shaped spots, ranging from a few millimetres to a few centimetres in diameter, turned white to grey and coalesced to form larger grey patches. Lesions had slightly raised dark margins. On mature lesions, numerous black acervuli were developed on

the grey necrotic areas. The symptoms described by Patel (1988), Kyada (2006).

Effect of the banana pseudostem sap and *Pseudomonas fluorescens* (NAU isolate) in *in vivo*

The efficacy of the banana pseudostem sap and *P. fluorescens* on disease severity, fruit, yield and bio-chemical parameters was studied on cv. Kesar at mango orchard of NAU farm, Navsari during 2015-16. The study indicated that all the treatments were found non-significant over unsprayed control (51.00 PDI) for the management of anthracnose but spraying (2.0%) and drenching (15%) of banana pseudostem sap was effective with 44.33 Percent Disease Index(PDI) after 3rd spray (Table 1). In case of powdery mildew of mango treatment T₉ *i.e.* spraying and drenching of banana pseudostem sap @ 2.0 % and 15%, respectively was found significant (18.00 PDI) followed by treatment

T₁₂ *i.e.* spraying and drenching of *P. fluorescens* @ 0.1% and 0.2%, respectively over control (28.33 PDI). The result revealed in table 1 showed that all the treatments were found non-significant over unsprayed control (27.00 PDI) for the management of grey blight of mango but spraying (0.1%) and drenching (0.2%) of *P. fluorescens* was effective with 20.00 percent disease index (PDI) after 3rd spray. The present results are in line with the findings of Nagarajan, *et al.*, (2013) who studied the antioxidant and antimicrobial properties, phytochemical screening and analysis of sap extracted from banana (*Musa acuminata*) pseudostem. Present results are also in affirmation with Sampath Kumar *et al.*, (2012) who reported the antifungal and antibiotic activity of peel and pulp of fully ripe bananas against a fungus disease of tomato plants. Priya *et al.*, (2014) also reported the antimicrobial properties of banana pseudostem sap against different fungal and bacterial strains.

Table.1 Effect of Banana pseudostem sap and *P. fluorescens* on mango diseases in field condition after 3rd spray.

Treatment	Disease Severity (%) after 3 rd spray		
	Anthracnose	Powdery mildew	Grey Blight
T ₁	48.00	23.67	20.67
T ₂	47.00	24.67	20.17
T ₃	46.67	24.00	21.00
T ₄	48.67	25.00	20.83
T ₅	49.00	24.33	20.33
T ₆	46.00	23.67	20.83
T ₇	48.00	22.67	21.00
T ₈	48.33	23.67	20.33
T ₉	44.33	18.00	21.67
T ₁₀	48.67	23.00	20.33
T ₁₁	45.33	24.00	21.17
T ₁₂	46.33	20.00	20.00
T ₁₃	51.00	28.33	27.00
C.D. (0.05)	N.S	3.86	N.S
CV %	10.36	9.76	10.53

Table.2 Effect of Banana pseudostem sap and *P. fluorescens* on mango harvesting parameters in field condition

Treatment	Fruit Retention (%)	Total no. of fruits per plant	Fruits Yield per plant (kg)	Fruits weight (g)	Fruit yield (t/ha)	Fruits size (cm)	
						Length	Breadth
T ₁	11.10 (19.45)	171.21	60.27	372.73	6.03	11.48	7.91
T ₂	9.29 (17.72)	124.79	45.79	388.73	4.58	12.04	7.99
T ₃	9.58 (18.00)	132.77	46.68	357.73	4.67	11.31	7.55
T ₄	8.79 (17.19)	144.78	47.33	341.00	4.73	10.99	7.33
T ₅	9.33 (17.56)	158.44	54.73	348.47	5.47	11.31	7.42
T ₆	9.33 (17.69)	153.78	50.95	343.20	5.10	11.27	7.27
T ₇	11.55 (19.86)	181.73	67.17	373.73	6.72	11.26	7.35
T ₈	12.25 (20.48)	217.38	72.30	333.53	7.23	11.23	7.35
T ₉	15.36 (23.06)	224.94	81.58	369.53	8.16	11.63	7.79
T ₁₀	9.07 (17.51)	136.86	47.88	355.67	4.79	11.32	7.15
T ₁₁	9.46 (17.90)	137.81	45.93	338.93	4.59	11.27	7.15
T ₁₂	13.13 (21.24)	178.58	71.18	398.73	7.12	11.66	7.85
T ₁₃	6.18 (14.38)	131.02	44.39	265.87	4.44	10.53	6.83
C.D. (0.05)	2.37	N.S	1.19	N.S	-	N.S	0.63
CV%	7.5	13.44	9.44	16.75	-	5.17	4.97

Table.3 Effect of Banana pseudostem sap and *P. fluorescens* on Bio-chemical parameters of mango fruits

Treatment	Total soluble solids (TSS) (°Brix)	Total Sugar (%)	Reducing sugar (%)	Non reducing sugar (%)	Phenol Content %	Vit. C (mg/100g pulp)
T ₁	21.42	13.27	6.15	7.11	0.44	12.80
T ₂	20.08	15.36	4.61	10.74	0.44	11.47
T ₃	21.75	14.78	4.55	10.23	0.46	11.73
T ₄	23.42	14.68	4.69	9.99	0.45	11.20
T ₅	21.00	14.56	4.97	9.60	0.44	11.73
T ₆	21.35	14.01	4.52	9.49	0.46	10.13
T ₇	20.75	14.94	4.51	10.43	0.45	10.13
T ₈	20.17	13.44	4.37	9.07	0.48	10.00
T ₉	22.50	14.07	4.58	9.49	0.49	10.40
T ₁₀	21.42	13.51	4.51	9.00	0.46	11.73
T ₁₁	21.58	15.80	4.21	11.59	0.45	13.60
T ₁₂	20.58	14.84	4.10	10.75	0.47	12.27
T ₁₃	20.48	13.25	4.73	8.52	0.39	11.73
C.D. (0.05)	N.S	N.S	N.S	N.S	0.04	N.S

Effect on fruit retention, harvesting and Biochemical parameters of plant

The results in terms of highest fruit retention was found in treatment T₉ with 15.36% and treatment T₁₂ with 13.13 % which were at par with the treatment T₈, T₇ and T₁ with 12.25, 11.55% and 11.10%, respectively as compare to T₁₃ (control) (Table 2). It is evident from the results that highest average total number of fruits were found in treatment T₉, T₈, T₇ and T₁₂ with 224.94, 217.38, 181.73 and 178.58 fruits, respectively whereas lowest average number of fruits was observed in treatment T₂(124.79). Non-significant differences were observed among highest average fruit weight was found in treatment T₁₂, T₂, T₇ and T₁as 398.73, 388.73, 373.73 and 372.73, respectively and lowest average fruit weight was found in treatment T₈ with 333.53. Though, non-significant differences were observed among different treatments. It is evident from the results that highest fruit size (length) was observed in treatment T₂, T₁₂ and T₉ (12.04, 11.66 and 11.63), respectively while lowest fruit length was in treatment T₈ with 11.23. Whereas, highest fruit size (breadth) in treatment T₂, T₁ and T₁₂ (7.99, 7.91 and 7.85), respectively. Lowest fruit breadth was observed in treatment T₁₀ and T₁₁(7.15). The results in terms of highest fruit yield in kg/plant and t/ha was found in treatment T₉ and T₈(81.58 kg; 8.16 t and 72.30 kg; 7.23 t) followed by treatment T₁₂. The lowest yield was observed in treatment T₂ and T₁₃ (control). The present results are similar as reported by Anon, (2011b) who observed the effect of banana pseudostem sap and vermiwash on fruit setting in mango.

There were seven treatments of sap and vermiwash in 1:1 ratio as compared to control. Salunkhe (2010) also reported that banana pseudostem sap as a liquid fertilizer @ 2000 l/ha through micro irrigation system

increase the plant height, leaf area per plant, bulb weight, average bulb weight and dry matter yield of onion as compared to control. Similarly, application of three litre of banana pseudostem sap per plant + 80 % of RDF through drip irrigation in banana also increase the fruit yield (Anon., 2011b).

The biochemical parameters like reducing, non-reducing and total sugar (%), total soluble solids, ascorbic acid (Vit. C) and phenol content (%) were determined in laboratory and the results are presented in table 3. The treatments were failed to change the value of biochemical parameter significantly. However, the significantly highest phenol content was recorded in treatment T₉ (0.49%) and lowest phenol content was recorded in treatment T₁₃ (0.39%). (Table 3) Priya *et al.*, (2014) recorded the phytochemicals present in the banana pseudostem sap like carbohydrates, protein and phenolic compounds.

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