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Research Article

ECO-FRIENDLY MANAGEMENT OF MANGO PEST AND DISEASES ENHANCE THE MANGO PULP QUALITY

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Abstract: Mango fruit fly and anthracnose are major destructive threat in mango cultivation and caused 67 per cent pre and post-harvest loss. The indiscriminate pesticide spray has reduced the pulp quality, texture, flavor and accumulate the residual effect. A field trial with eco-friendly management options were carried out to control the mango anthracnose and fruit fly. The promising biocontrol agent *Pseudomonas fluorescens* (Pf1) was sprayed immediately after flowering @ 5ml/ lit for five times at 21 days interval and Fixing of fruit fly trap 12/ha for one ha in each demonstration. The quality analysis test *viz*., the TSS was measured with the help of a hand refractometer. The fruits harvested from ecofriendly measures adopted field recorded the TSS of 19 to 22°brix against the insecticide sprayed plot 15 to 17 °brix. In addition to that organoleptic test analysis of the pulp was conducted and it shows the evident by rate of scoring for taste 4.42 and aroma with flavor 3.96. Whereas in case of Novaluran@3ml/lit was sprayed by farmers has recorded the organoleptic test was 3.22 and aroma with flavor was 1.96. The surprising finding noted in this study that the eco-friendly adopted plots were invited more honey bee population when compared to farmers *i.e*., insecticide sprayed plot. The results concluded that the eco-friendly adopted plant protection for mango enhances the fruit quality, aroma and taste.

Keywords: *Mango, Eco-friendly, TSS, Organoleptic test*

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Introduction

Mango (*Mangifera indica* L.) belonging to the family Anacardiaceae is one of the most important, popular and delicious fruits grown throughout the tropics and sub-tropics of the world including India. Its special organoleptic features such as excellent flavour, pleasant aroma, attractive colour and taste, the consumption and export demand being increased. It is a rich source of vitamins, minerals and total soluble solids [1] and medium source of carbohydrate as ripe mango pulp contains 16.9% carbohydrate. The minimum dietary requirement of fruit/day/head is 85 g, whereas our availability is only 30-35 g, which is much lower than recommended daily allowance [2].

The demand for fruit (mango) is increasing day by day with growing population and decline in production results in scarcity every year. Pest and disease attach pre and post-harvest is a major threat in the mango cultivation. The pre and post-harvest loss due to pest disease in mango is nearly 43% and sometime caused complete loss in uncared orchards.

Among all of the mango diseases, anthracnose is the most common which is caused by *Colletotric-humgloeosporioides* [3]. Symptoms of anthracnose include tan to dark brown spots formation along the margin of leaves and spread to the inflorescences then immature mango fruit. The brown colors sunken spot with irregular shape in fruit with fruiting body of acervuli is causing huge economical loos in market. Mostly for the control of mango diseases, fungicides and different chemicals are applied. Generally, use of different chemicals is effective for preharvest control of mango diseases. Copper fungicides alone and in combination with other fungicides are used worldwide for diseases control [4]. Fruit fly is a destructive pest in mango and spoils the fruit pulp and turned into not suitable for consumption. Sometimes premature fruits drop and mature fruits per plant was reduced due to fruit fly infestation. In the past its control was based purely on chemicals especially synthetic insecticides. But non judicious application of highly toxic and persistent insecticides is causing several problems such as disrupting natural enemy complexes, development of insecticide resistance, secondary pest outbreak, pest resurgence, and environmental pollution.

Nearly more than seven times with different fungicides and pesticides combination which are irrespective of the target pest and diseases are sprayed in every season in mango cultivation. Under this circumstance, the present research was undertaken to manage anthracnose and fruit fly using eco-friendly adopted plant protection measures suitable organic farming system to improve the fruit quality [5-8].

Materials and Methods

A field experiment designed in randomized block design with five replications in mango orchard located at Reddiur village, Katpadi Taluk, Vellore district (26.47° North and 80.56° East) with an objective of assessment of eco-friendly management for mango anthracnose and fruit fly. The treatment consisted of five treatments *viz*., T1-Mancozueb 2 g/lit, T2-Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.75-1 g/l + Malathion @ 2.0 ml/l, T3-*Pseudomonas fluorescens* @ 5ml/lit (Pre flowering, button formation and maturity stages) + methyl eugenol (ME) pheromonae trap -25 no/ha, T4-Farmers Practices (Spraying of Novaluran@3ml/lit + Propiconazole) and T5-Control. These were laid out in randomized block design with five replications on well prepared mango orchard. The periodical observation was made. Disease incidence (percentage of diseased fruits) and disease severity (percentage of area affected on the fruit on average) was then obtained using the following formula:

PDI = [(Sum of numerical disease Ratings / Total no. of leaves, fruits assessed) X (100 / Maximum of Disease grade)]

Description	Disease grade
No infection	0
25 per cent of the leaves / fruit infection	1
26-50 per cent fruit infection	2
51-75 per cent fruit surface infection	3
More than 75 per cent fruit infection	4

Table-1 Eco friendly management of Mango pest and disease and its economics

Particulars	Anthracnose disease incidence in leaf (PDI)	Anthracnose disease incidence in fruit (PDI)	Fruit fly incidence (%)	Fruit Yield (q/ha)	Gross Cost (Rs.)	Gross Return (Rs.)	BCR
T1- Mancozueb 2 g/lit + malathion @ 2.0 ml/l.	17.4	18.6	14.6	65.12	42370	1,23,728	2.9
T2- Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.75-1 g/l + Malathion @ 2.0 ml/l,	11.9	6.5	18.3	69.41	53410	1,31,366	2.45
T3- *P. fluorescens*@5ml/lit + methyl eugenol (ME) pheromonae trap -25 no/ha	12.94	5.4	1.8	85.18	45770	161849	3.53
T4- Farmers Practices (Spraying of Novaluran@3ml/lit + Propiconazole),	21.3	27.8	18.6	56.3	44254	106970	2.4
T5- Control	61.52	71.98	59.09	51.02	36909	99539	2.4
SEd	1.27	2.4	1.31	3.8			
CD (P=0.05)	2.79	4.9	2.72	8.13			

Table-2 Quality assessment in eco-friendly plant protection adopted in mango orchard

Particulars	Alphonsa				
	TSS (°Brix)	pH	Acidity (%)	Flavour	Taste
T1- Mancozueb 2 g/lit + malathion @ 2.0 ml/l.	19.6	4.41	0.31	7.9	7.1
T2- Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.75-1 g/l + Malathion @ 2.0 ml/l,	17.6	4.46	0.41	8.1	7.2
T3- *P. fluorescens*@5ml/lit + methyl eugenol (ME) pheromonae trap -25 no/ha	22.1	3.42	0.32	9.3	9.0
T4- Farmers Practices (Spraying of Novaluran@3ml/lit + Propiconazole),	19.8	4.46	0.38	8.6	8.7
T5- Control	17.6	4.15	0.40	8.9	8.3
SEd	2.37	0.75	0.02	0.94	1.02
CD (P=0.05)	5.21	1.02	0.12	1.81	2.14

**Spraying of Pseudomonas fluorescens immediately after flowering @ 5ml/ lit for five times at 21 days intervalFixing of fruit fly trap 12/ha*

Fruit fly management

Methyl eugenol traps were installed at three locations at different frequencies. The trap consisted of a plastic box measuring 13 x 22 cm fitted with two open tubes. A cotton swab moistened with methyl eugenol was placed inside the tubes and replaced every two weeks. The traps were hung at a height of 2 m. The Pheromone trap was placed 25 nos/ha with equidistant in field. This was done when the mango fruits were attained at button stage and was continued until the fruits were harvested the infestation of fruits was recorded from a randomly selected sample of 100 fruits during the months of May to August. The number of flies attracted was counted once in week.

Estimation of Quality parameters

The fruit quality parameters such as total soluble solids were recorded by refractometer and acidity was determined by standard procedure of AOAC 1975 [5]. Total caretonoids, FRAP and DPPH were analysed in ripen fruits [9]. Experimental data were statistically analysed following the analysis of variance method [10]. Farm gate value of mango fruit was taken INR 20 kg^{-1} as per local market price. Productivity of production was the amount of produce obtained per unit of input cost. Its relationship to benefit cost ratio is direct. Their ratio is the input and output cost of the produce. Productivity was calculated as mango yield divided by production cost. Production value, net return and benefit cost ratio was worked out as per following formula [11].

Results and Discussion

Management of Anthracnose and fruit fly

The field trial studies for the management mango anthracnose using *Pseudomonas fluorescens* (Pf1) liquid formulation were conducted and incidence of anthracnose symptoms on leaf and fruit were recorded and tabulated in the [Table-1]. The lowest incidence of anthracnose (11.9 PDI) was recorded in the fungicide *viz*., Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.75-1 g/l treated plot with the fruit fly incidence of 18.3 per cent. The interesting results were recorded in the treatment comprises of methyl eugenol (ME) pheromonae trap -25 no/ha fixed plot which recorded the minimum fruit fly incidence of 1.8 per cent and the anthracnose incidence of 12.94 PDI on leaf and 5.4 PDI in fruit and statistically different from the chemical methods at 5 per enct level. The ecofriendly approach of fruit fly measures was given effective results against chemical methods such as Malathion (14.6 per cent) and Novaluran (21.3). The maximum incidence of the anthracnose in leaf (61.52 PDI) and in fruit (71.98 PDI) was recorded in the mango plot without spraying of any management measures. The analysis economical parameter is clearly shows that the treatment comprising the *P. fluorescens* and pheromone trap treated plot was found be more benefit (3.53) flowed by chemical management T1 (Mancozueb 2 g/lit + malathion @ 2.0 ml/l.) recorded 2.9 of Benefit Cost Ratio (BCR).

The results of the trail are clearly indicates that bacterial biological control agent *P. fluorescens* and Phromone trap combination was fond the effective to arrest the anthracnose disease and fruitfully incidence in mango.

Quality Analysis

To ascertain the quality of mango pulp grown in eco-friendly approaches-imposed plot, the parameters like TSS, Flavour, Acidity, taste and pH were measured and results are given in the [Table-2]. The fruits from *P. fluorescens* and pheromone trap-imposed plot was shown the excellent flavour (9.3) followed by the control plot (8.9). The maximum TSS (22.10° Brix), pH (3.42), acidity (0.32) and taste (9.0) were recorded in the eco-friendly approaches applied plot. The chemical pesticide Malathion sprayed plot recorded the 17.6 and 19.6 with two different combination fungicide applied plot of Treatment 1 and 2 imposed plots.

The investigation of our management trial on mango anthracnose revealed that the bacterial antagonist of *P. fluorescens* was found to be effective biocontrol agent and producing secondary metabolites like antibiotics and growth hormones which are arrest the latent infection of mango anthracnose caused *Colletotrichum gloeosporioides* in leaf and mango. Vivekananthan, *e al*., (2006) [12] reported that the Pre-harvest application of biocontrol formulations *P. fluorescens* (Pf2) and *Bacillus subtilis* (Bs-1) reduced the anthracnose in mango caused by *C. gloeosporioides*. In addition to that they clearly stated in their findings that the application of PGPR has enhanced the defense enzymes like peroxidase, poly phenol oxidase and increased content of phenol was also recorded. The quality parameter such as TSS and acidity was also enhanced in the ecofriendly management adopted plot. Similarly, Viswanathan and Samiyappan, (2001) [13] reported that application of talc-based formulation of *P. fluorescens* was found to effective to control red rot of sugarcane caused by *C. falucatum*. Application of talc-based formulation of *P. fluorescens* TDK1 + Pf1 strain mixture (amended with or without chitin) through seed, soil and foliar spray effectively reduced the incidence of collar rot in groundnut compared to individual bioformulation both under glasshouse and field conditions [14]. The several reports were found that the foliar application of talc based formulations of *P. fluorescens* grown in chitin amended medium found effective against various plant diseases under greenhouse and field conditions [15-18] observed that *P. fluorescens* and *B. subtilis* were effective in increasing seed germination and seedling vigour and that the mixed bioformulation (*P. fluorescens* + *B. subtilis* + neem + chitin) was the best for reducing fruit rot incidence and increasing plant growth and yield of chilli. The post-harvest treatment of mango fruit with *P. fluorescens* (Pf1) was carried out by Prabakar, *et al*., (2008) [19] and their findings were supported with our results that the antagonistic organisms arresting the spread of the pathogen *C. gloeosporioides* causing the latent infection. The indiscriminate use of insecticide to control the fruit fly in mango poses the residues in mango fruit and changes the texure and flvour of the fruits. In our studies the organoleptic test clearly indicates the enhancement of flavor and TSS. It was supported by Viswanathan and Samiyappan, (2001).

Conclusion

The present investigation was made on the effect of non-chemical methods for the management of pest and disease in mango on fruit pulp quality. The application of antagonist organisms like *Pseudomonas fluorescens* (pf1) liquid formulation

and installing the fruit fly trap reduced the pesticide residue and enhance the mango fragrance in ripening fruit and quality. This kind of strategy is support to prefer the consumers and help for organic farming system. The interesting note was found that the more no of honey bee population was attracted during flowering stage.

Application of research: Research show the eco-friendly adopted plant protection for mango enhances the fruit quality, aroma and taste

Research Category: Plant Pathology

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Study area / Sample Collection: Reddiur village, Katpadi Taluk, Vellore district

Cultivar / Variety / Breed name: Mango (*Mangifera indica* L.)

Conflict of Interest: None declared

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