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Evaluation of Management Modules against Hopper Complex in Mango

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ABSTRACT

Among the insect pests causing damage to mango the incidence of hoppers at flowering stage causes considerable yield loss. The farmers mainly rely on combination of chemical insecticides for its management which apart from causing unwarranted issues reduces the chance of export of choice varieties and value products. In this context management modules *viz.,* spraying of *Metarhizium anisopliae* ($1x10^9$ cfu/ml) @ 2 ml/l (M1), azadirachtin 1500ppm @ 4ml/l (M2) and farmers practice of application imidacloprid @ 0.5 ml/l (or other insecticides) (FP) were evaluated through on farm trails in farmers' fields at Dharmapuri district. The mean hopper population / panicle after the first spray in the *M. anisopliae* (M1), zzadirachtin 1500 ppm(M2) and farmers practice (FP) recorded were 16.43, 17.90 and 8.95 respectively. The mean hopper population / panicle after second spray in the *M. anisopliae* (M1), azadirachtin 1500ppm (M2), farmers practice (FP) and control were 14.36, 16.12, 7.07 and 26.57, respectively. The percentage reduction over control in farmers practice was 73.39 per cent which was superior than the other management modules. The application of *M. anisopliae* (M1), azadirachtin 1500ppm (M2) recorded 45.95 and 39.33 per cent reduction of hopper population than the control. The application of *M. anisopliae* (M1) and azadirachtin 1500ppm (M2) recorded 53.8 q/ha and 52.6q/ha with a benefit cost ratio of 1.51 and 1.37, respectively. Based on benefit cost ratio the order of efficacy of different management modules were imidacloprid 17.8SL (FP) > *M. anisopliae* (M1) > azadirachtin 1500ppm (M2).

Keywords

Mango, hoppers, Metarhizium anisopliae, azadirachtin, imidacloprid

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INTRODUCTION

Mango (*Mangifera indica* L.) has been cultivated in Indian subcontinent for the past 4000 years for its preference among consumers. Mango is the national fruit of India and many varieties both traditional and improved are cultivated in different parts of India based upon the preference among local consumers and industries (Verma and Garg, 2021). As per 2019 – 20 estimates mango has been cultivated in 23 lakh area with a 212 lakh MT of production. In Dharmapuri district mango has been cultivated in approximately 15,000 ha. Bangalora, Alphonso, Senthura, Banganapalli, Neelum, Mulgoa, Maliga and Imam Pasand are varieties grown in this region. In Dharmapuri district, more than 50% of the mango has been cultivated under rainfed condtion. Apart from regluar bearing the farmers of this region are practising off season mango cultivation. Among the different constraints in mango cultivation the incidence of insect pests is one of the major concern for the farmers. More than 300 insect pests has been recorded to attack mango crop in different regions of the world (Jacobson *et al*, 1974). The leafhopper, thrips, stemborers, nutweevil and fruitflies are other economically important insect pests encounterd in this region by the farmers.

The incidence of leaf hoppers at early flowering stage has the major influence on yield. Sohi and Sohi (1999) revelaed that the mango leaf hopper has the potential to cause 20-100% yield loss. The leaf hoppers viz., *Idioscopus clypealis* L., *I. niveosparsus* L. and *Amritodus atkinsoni* L. are of major importance, persistent on panicles and leaves, respectively. The nymphs and adults suck the sap from the inflorescence and shoots. During feeding they secrete honeydew which encourages development of sooty mold on the leaf area. The farmers mostly rely on the chemical insecticides for the hopper management. In severe incidence, the farmers are forced to go for two to three rounds of insecticides for the management of hoppers. The predominant insecticides used by the farmers are imidacloprid, dimethoate, dichlorvos and acephate are in combination with fungicides.

The increased reliance on insecticides leads to residue in the fruits and other unwarranted problems. The insecticide residues in the produce may interfere with the prospect of mango export from Dharmapuri. Moreover, the interest of organic farming is increasing among the mango growers and they are searching for the alternate methods for hopper management. Based on the feedback from the progressive farmers, on farm trails were conducted to compare the management modules comprising biopesticide *Metarhizium anisopliae*, botanical azadirachtin along with the farmer's practice

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of insecticide application.

MATERIAL AND METHODS

The on farm trials were conducted at five farmer's field at Palacode and Karimangalam blocks of Dharmapuri district. The Bangalora variety mango gardens of 15 – 20 years were selected to conduct the on farm trial. The farmers were asked to follow the agronomic practice uniformly in their gardens. The following management modules were imposed on the selected trees

- Management module 1 (M1): Spraying of *Metarhizium anisopliae* ($1x10^9$ cfu/ml) @ 2 ml/lt (two times at 21 days interval)
- Management module 2 (M2): Spraying of Azadirachtin 1500ppm @ 4ml/lt (two times at 21 days interval)
- Farmers practice (FP): First spray: Imidacloprid 17.8 SL @ 0.5 ml/lt or Acephate 75 SP (2g/lt) + Dimethoate 25EC (2ml/lt)
- Untreated control (C): No insecticide spray

Each management module was imposed on the selected trees and each tree was considered as one replication. The treatments have been replicated seven times. The spraying of management module components were done at two times viz., first spray at flowering stage and second spray three weeks after first spray. The pretreatment count was taken in all directions of the tree @ 2 influroscens/ direction and expressed as numbers of nymphs / adults per influorescens one day before imposition of treatments.

The post treatment count was taken 5, 10 and 15 days after each spraying. The yield of selected trees was taken at the time of each harvest and cumulative yield was worked out. The benefit cost ratio was calculated by keeping the mango price as Rs.18,000/ quintal. The plant protection cost also worked out to differentiate the effect of management module. The statistical analysis of the effect of management module was done using the statistical package SPSS 16.0.

RESULTS AND DISCUSSION

The results of the on farm trials presented Table 1 and Table 2. The pretreatment hopper count doesn't show any difference among the management modules. The initial hopper population was varied between 25.57 to 29.29 hoppers/panicle (Figure 1). The hopper population was least in the farmers practice of insecticide application (10.00 hoppers/panicle). The management module 1 & 2 recorded 20.57 and 19.29 leafhoppers/panicle, respectively 5 days after treatment (Figure 1).

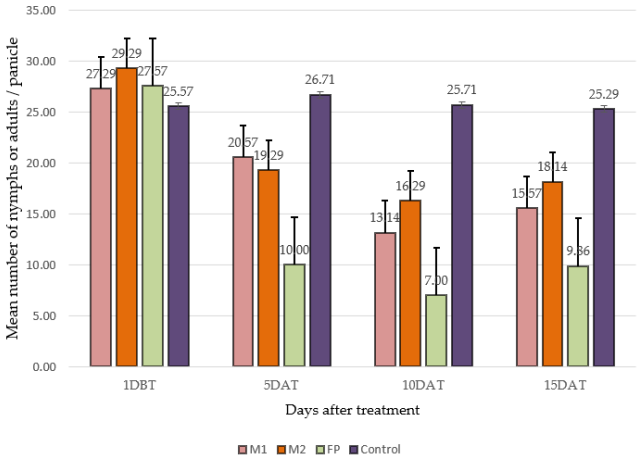

Fig. 1: Effectof different management modules against leaf hopper complex in mango (Firstspray)

The leaf hopper population was 15.57, 18.14 and 9.86 hoppers / panicle in the *Metarhizium anisopliae* ($1x10^9$ cfu/ml) @ 2 ml/l (M1), Azadirachtin 1500ppm @ 4ml/lt. (two times at 21 days interval) (M2) and imidacloprid @ 0.5 ml/l or Acephate 75 SP (2g/l) + Dimethoate 25EC (2ml/l) as first spray and imidacloprid 17.8SL (0.5 ml/l) as second spray (FP) respectively 15 days after the first spraying (Figure 1).

Table 1: Effect different management modules against leafhopper complex in mango

Management modules	No. of leaf hopper nymphs or adults/panicle			Percentage reduction over control
	First spray	Second spray	Mean	
Spraying of *Metarhizium anisopliae* ($1x10^9$ cfu/ml) @ 2 ml/lt. (two times at 21 days interval) (M1)	16.43	12.29	14.36	45.95
Spraying of Azadirachtin 1500ppm @ 4ml/lt. (two times at 21 days interval) (M2)	17.90	14.33	16.12	39.33
First spray imidacloprid @ 0.5 ml/lt. or Acephate 75 SP (2g/lt.) +Dimethoate 25EC (2ml/lt.) – second spray imidacloprid 17.8SL (0.5 ml/lt.) (FP)	8.95	5.19	7.07	73.39
No insecticide spray (Control)	25.90	27.24	26.57	

The mean hopper population per panicle after first spray in the *M. anisopliae* (M1), Azadirachtin 1500 ppm (M2) and farmers practice was 16.43, 17.90 and 8.95, respectively (Table 1). The insecticide application significantly reduced the hopper population than the application of *M. anisopliae* (M1) and Azadirachtin 1500 ppm(M2) application.

The same trend was observed after imposing the treatments second time. The mean hopper population / panicle after second spray in the *M. anisopliae* (M1), azadirachtin 1500ppm (M2), farmers practice (FP) and control were 12.29, 14.33 and 5.19, respectively (Table 1). The population of hoppers increases 10 days after treatment across the management modules and farmers practice of insecticide application (Figure 2).

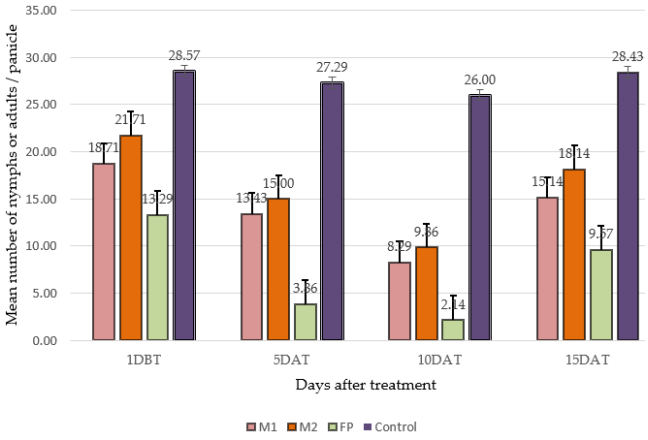

Fig. 2: Effect of different management modules against leaf hopper complex in mango (Second spray)

The percentage reduction over control in farmers practice was 73.39 per cent which was superior to the other management modules. The application of *M. anisopliae* (M1) and azadirachtin 1500ppm (M2) recorded 45.95 and 39.33per cent reduction of hopper population than the control (Table 1).

Girish *et al* (2018) in their study found that imidacloprid 17.5 SL @ 0.25ml/l recorded significantly lower leaf hopper population followed by azadirachtin 5EC and azadirachtin 1EC. The imidacloprid 17.8 SL @ 0.007 per cent recorded maximum mean mortality of 95.35 & 94.06 per cent after first and second spray, respectively (Chaudhari *et al*, 2017). In the present study also the farmers practice of insecticide appliaction reduced the hopper population than microbial and botanical application. Sarode and Mohite (2016) found equal effectiveness of *M. anisopliae* $1x10^8$ cfu/ml @ 0.004 per cent, *Verticillium lecanii* $1x10^8$ cfu/ml @ 0.004 per cent,, *Beuveria bassiana* $1x10^8$ cfu/ml @ 0.004 per cent and NSKE 5 per cent @ 1500ml/ha against mango hopper *Amritodus atkinsoni* Leth. In the present investigation *M. anisopliae* application recorded 45.95 per cent reduction over control whereas azadirachtin 1500 ppm (M2) recorded 39.33 per cent hopper reduction.

The efficacy of neem formulations depends on the density of hopper population. They are effective at lower hopper density (Varghese, 2000). The oil based neem formulations are more effective than the kernal based formulations (Srivastava and Haseeb, 1993) . More number of natural enemies in neem oil treatment than the chemical insecticide spray against mango leaf hopper (Adnan *et al*, 2014). The lower percent reduction in azadirachtin 1500ppm @ 4ml/lt. may be due to the higher hopper population before spraying. In otherway the first and second spraying of management modules were imposed between third week of December to second week of Janaury.

Table 2: Economics of different management modules against leaf hopper complex in mango

Module	Yield (q/ha)	Yield increment over control (%)	Cost of plant protection (Rs./ha)	Total cost of cultivation (Rs./ha)	Net return (Rs./ha)	Benefit Cost Ratio
M1	53.8	31.97	3600	38600	58240	1:1.51
M2	52.6	30.42	5000	40000	54680	1:1.37
FP	57.5	36.35	4000	39000	64500	1:1.65
C	36.6	-	-	35000	30880	1:0.88

The low temperature prevailing during theses months in Dharmapuri district might have favoured the *M. anisopliae* multiplication and resulted in better performance than the azadirachtin. Azadirachtin 1% and Beauveria bassiana 2% recorded highest number of NEs with moderate efficacy against the target pests (Shivamurthy and Anitha, 2019).

The yield attributes and benefit cost ratio implies the economic aspects of management modules imposed aginst the hopper management. The farmers practice of application of insecticde recorded higher yield of 57.5 q/ha with a benefit cost ratio of 1.65 (Table 2). The application of *M. anisopliae* (M1) and azadirachtin 1500ppm (M2) recorded 53.8 q/ha and 52.6q/ha with a benefit cost ratio of 1.51 and 1.37, respectively. The per hectare plant protection cost in the *M. anisopliae* (M1), azadirachtin 1500ppm (M2) and farmers practice (FP) was Rs. 3600, Rs.5000 and Rs.4000, respectively. The plant protection cost was more in azadirachtin 1500ppm (M2) application than the other modules in the on farm trial. Based on benefit

cost ratio the efficacy of different management modules was imidacloprid 17.8SL (FP) > *M. anisopliae* (M1) > azadirachtin 1500ppm (M2). The *M. anisopliae* ($1x10^9$ cfu/ml) @ 2 ml/lt. reduced the hopper population up to 45.95 per cent which indicated that it will be part of Integrated Pest Management programme against leaf hopper complex in Mango.

CONCLUSION

Present study suggests that at the flowering stage of mango crops, hoppers can cause heavy damage and resulting in considerable yield loss. It was concluded that for efficient management, application of *M. anisopliae* (M1) and azadirachtin 1500 ppm (M2) recorded 45.95 and 39.33 per cent reduction of hopper population over control and also produced mango fruits 53.8 q/ha & 52.6q/ha, and benefit cost ratio of 1.51 and 1.37, respectively.

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