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Efficacy of entomopathogenic fungi against mango hoppers

RD Tumbada, DS Pokhrkar and RV Datkhile

Abstract
Field experiment was conducted to evaluate efficacy of *M. anisopliae* (1 x 10^9 CFU/ml), *M. anisopliae* (1 x 10^7 CFU/ml), *B. bassiana* (1 x 10^9 CFU/ml), *B. bassiana* (1 x 10^7 CFU/ml), *L. lecanii* (1 x 10^9 CFU/ml), *L. lecanii* (1 x 10^7 CFU/ml), azadirachtin 10,000 ppm and thiamethoxam 25 WG against mango hoppers during 2014-15 and 2015-16 at the central campus of Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri (M.S.). Total four sprays were given with initiation of first spray during pre-flowering season (15 days before flowering) and remaining three sprays were given during flowering season at 15 days interval. The application of thiamethoxam 25 WG was found statistically superior over rest of the treatments in suppressing the hopper population (1.14 hoppers/panicle) and registered highest fruit setting (220.17/100 panicles) at marble stage and fruit yield (10.50 t/ha) at harvest with monetary returns of Rs. 3,15,000/- per ha. The next promising treatments were azadirachtin 10,000 ppm (2.85 hoppers/panicle) and *M. anisopliae* @ 1 x 10^9 CFU per ml (3.27 hoppers/panicle) which recorded fruit yield of 9.25 and 10.02 t per ha with monetary returns of Rs. 2,77,500/- and Rs. 3,00,600/- per ha, respectively. The *L. lecanii* (1 x 10^9 CFU/ml) registered fruit yield of 9.01 t per ha with monetary returns of Rs. 2,70,300/- per ha. However, the treatment with *B. bassiana* (1 x 10^7 CFU/ml) was found least effective against the hoppers. Among all the treatments, the highest ICBR (1:17.2) was recorded with *M. anisopliae* (1 x 10^9 CFU/ml).

Keywords: entomopathogenic, fungi, mango hoppers

Introduction

Mango, *Mangifera indica* (Linnaeus) is one of the ancient fruits of Indian origin grown over large extent in the country and considered as a “King of the fruits”. India is the leading country for mango production in the world, with an area of 2.24 million ha and the annual production of 19.69 million MT fruits (Anonymous, 2016) [5]. The crop is attacked by about 492 species of insects, 17 species of mites and 26 species of nematodes in the world. Of these, 188 species of insects have been reported from India (Tandon and Verghese, 1985) [14]. Srivastava (1997) [13] has reported 20 insect pests inflicting considerable damage to mango trees in India. Amongst the major pests, the cicadellids (Jassids) popularly known as ‘Mango hoppers’ have been recognized as the most notorious insect pest causing damage almost every year throughout the country.

Mango hoppers cause most severe and devastating effects since they are monophagous to mango (Pruthi and Batra, 1960) [8]. They feed on vegetative flush tissue by sucking the sap. They lay eggs into the underside of mid ribs of young leaves. Feeding and egg laying cause curling and distortion of new flush and young leaves. Their numerous egg laying punctures to the flower stems results wither and fail to set fruitlets. They excrete honey dew like substances that covers the inflorescence, leaves and fruits encouraging black sooty mould, *Meliola mangiferae* (Earle) which affects photosynthesis activity of leaves and market quality of fruits (Verghese and Kamala Jayanthi, 2001) [16]. Severe infestation of mango hoppers at flowering and fruiting stages could cause cent per cent yield loss (Rahman and Kuldeep, 2007) [17]. For their control many conventional insecticides have been recommended in past (Rahman and Singh, 2004) [9]. But, the continuous and increased use of chemical insecticides has resulted in many serious consequences on the ecosystem. The present study was, therefore, undertaken to evaluate some biopesticides against mango hoppers.

Material and Methods

A field experiment was conducted at the central campus of MPKV, Rahuri during pre-flowering and flowering seasons of the year 2014-15 and 2015-16. The experiment was laid out in Randomized Block Design and each treatment was replicated thrice. The mango orchard of variety ‘Kesar’ having almost similar age and size and the trees with uniform flowering was selected for the experiment. The set of treatments consisting of *M. anisopliae*

(1 x 10^9 CFU/ml), *M. anisopliae* (1 x 10^7 CFU/ml), *B. bassiana* (1 x 10^9 CFU/ml), *B. bassiana* (1 x 10^7 CFU/ml), *L. lecanii* (1 x 10^9 CFU/ml) and *L. lecanii* (1 x 10^7 CFU/ml), botanical pesticide azadirachtin 10,000 ppm and chemical insecticide thiamethoxam 25 WG as standard check were evaluated against mango hoppers. Total four sprays were given with initiation of first spray during pre-flowering season (15 days before flowering) and remaining three sprays were given during flowering season at 15 days interval with the help of Gator Rocking spray pump (ASPEE make).

The population count of hoppers was taken on 10 panicles (before flower opening) selected randomly during pre-flowering season, while during flowering season the hopper population was recorded on 10 flower panicles selected randomly at four sides on the tree. The observations on number of hoppers per panicle were recorded from selected plants, a day before spraying as pre-count and 3, 7, 10 and 15 days after spraying as post-counts after each spray. The data on fruit set were recorded per inflorescence on each tree when the fruits were of marble size and finally yield data were recorded per tree at harvesting of mature fruits.

The data on surviving population of mango hoppers were recorded from each treatment replications-wise at 3, 7, 10 and 15 days after each spray. The superimposed average survival hopper population was transformed into square root values by Poisson formula $\sqrt{x + 0.5}$ and standard statistical method of analysis of variance was employed for the analysis of data (Panse and Sukhatme, 1985) [7]. The observations on fruit setting were recorded by selecting 100 panicles per tree at marble stage of the fruits on the treated trees. The data of fruit set were analyzed by using analysis of variance method. The total number of fruits per tree exposed to various treatments was recorded at harvest stage (physiologically mature fruits) by counting number of fruits and weighed subsequently. The data were expressed as yield in kilograms per tree during both the years of experimentation and then, subjected to analysis of variance.

The economics of treatments against mango hoppers in terms of Incremental Cost Benefit Ratio (ICBR) was worked out, considering the total cost of treatment which included cost of insecticide per tree for each treatment based on the prevailing market price as well as labour cost involved in treatment application. The average yield of mango fruits per tree for each treatment was calculated on the basis of pooled value of the yield obtained during the experimental years (2014-15 and 2015-16) and considered as total receipt per tree. The additional yield due to use of biopesticides and chemical insecticide for each treatment was worked out by subtracting the yield realized in the control treatment from the total yield for each treatment. Monetary return was calculated by multiplying total yield with the market price of the produce. The additional return also worked out by the subtracting the returns realized in the control treatment from the monetary return.Net gain per rupee cost (ICBR) was worked out based on additional returns after deducting from control divided by total cost of treatment and its application.

Results and Discussion

The mean data of four sprays during 2014-15 showed that the chemical insecticide thiamethoxam 25 WG found significantly superior over other treatments with mean of 1.26 hoppers per panicle (Table 1). In this context, the azadirachtin 10,000 ppm and *M. anisopliae* (1 x 10^9 CFU/ml) noticed the next best treatments with the mean of 3.17 and 3.60 hoppers per panicle respectively, after four sprays. The EPF treatments *viz*., *L. lecanii* (1 x 10^9 CFU/ml) and *M. anisopliae* (1 x 10^7 CFU/ml) were ranked third after these treatments. Though, the *B. bassiana* at higher (1 x 10^9 CFU/ml) as well as lower (1 x 10^7 CFU/ml) dosages found relatively less effective than *M. anisopliae* and *L. lecanii*, but did differ statistically from untreated control in suppressing the hopper population on mango trees.

During 2015-16, the overall performance of various biopesticides treatments after four sprays indicated that the thiamethoxam 25 WG found significantly superior over remaining treatments with mean of 1.01 hoppers per panicle. Moreover, the azadirachtin 10,000 ppm and *M. anisopliae* (1 x 10^9 CFU/ml) were the next promising treatments with 2.53 and 2.93 average hoppers per panicle, respectively. The *L. lecanii* (1 x 10^9 CFU/ml) stood third in rank for suppressing the hopper population after each of the four sprays. However, the lower dose of *M. anisopliae* (1 x 10^7 CFU/ml) found equally effective to higher dose of *L. lecanii* (1 x 10^9 CFU/ml) when computed for cumulative means of four sprays. The treatment with *B. bassiana* (1 x 10^7 CFU/ml) found least effective amongst the biopesticides tested in suppressing the hopper population.

The pooled means of two years data of hopper population worked out at different intervals after four sprays explicitly indicated that the thiamethoxam 25 WG proved its superiority in maintaining the pest population to least extent with average of 1.14 hoppers per panicle (Table 3). Furthermore, the azadirachtin 10,000 ppm and *M. anisopliae* (1 x 10^9 CFU/ml) were the promising treatments amongst the biopesticides tested during the experimentation, which recorded 2.85 and 3.27 average hoppers per panicle, respectively. The EPF treatments *viz*., *L. lecanii* (1 x 10^9 CFU/ml) and *M. anisopliae* (1 x 10^7 CFU/ml) found progressively suppressing the pest population with the record of 4.50 and 5.53 average hoppers per panicle respectively, and ranked after these promising treatments. However, the *B. bassiana* showed relatively low pathogenicity among the hopper population and its lower dose (1 x 10^7 CFU/ml) found least effective against the pest. But, this treatment did differ statistically from untreated control.

The data on fruit setting in mango recorded from various treatments during two consecutive years (2014-15 and 2015-16) are presented in Table 4. It is evident from the data that the trees treated with thiamethoxam 25 WG had maximum (225.00) marble sized fruits per 100 panicles during 2014-15 and it was favourably compared with *M. anisopliae* (1 x 10^9 CFU/ml) which showed bearing of 220.33 fruits per 100 panicles. While, *M. anisopliae* (1 x 10^9 CFU/ml) gave maximum bearing of 216.33 fruits per 100 panicles during 2015-16 and it was statistically comparable with thiamethoxam 25 WG which registered 215.33 fruits per 100 panicles. The treatment with thiamethoxam 25 WG recorded highest (220.17) mean marble sized fruits per 100 panicles, followed by *M. anisopliae* (1 x 10^9 CFU/ml) which showed 218.33 mean fruits per 100 panicles. The next promising treatment in this respect was azadirachtin 10,000 ppm which gave 208.83 mean fruits per 100 panicles, followed by *L. lecanii* (1 x 10^9 CFU/ml), *M. anisopliae* (1 x 10^7 CFU/ml) and *B. bassiana* (1 x 10^9 CFU/ml) during both the years. However, *B. bassiana* found least effective at lower dose of 1 x 10^7 CFU per ml by recording 132.84 mean fruits per 100 panicles.

The yield data (kg/tree) were recorded at harvesting of mango fruits from the respective treatments for both the consecutive years (2014-15 and 2015-16) and the means worked out which were converted into tonnes per ha (Table 5). The data indicated that the chemical insecticide thiamethoxam 25 WG recorded maximum mean fruit yield of 105.04 kg per tree. It was followed by *M. anisopliae* (1 x 10^9 CFU/ml), azadirachtin 10,000 ppm and *L. lecanii* (1 x 10^9 CFU/ml) which registered 100.23, 92.50 and 90.06 kg mean fruit yield per tree, respectively. Whereas, *B. bassiana* (1 x 10^7 CFU/ml) recorded lowest mean fruit yield of 71.40 kg per tree and found least effective treatment amongst the biopesticides. Furthermore, the current results revealed that thiamethoxam 25 WG gave highest estimated yield (10.50 t/ha) with maximum monetary returns of Rs. 3,15,000/- per ha as well as additional returns over control (Rs. 1,53,300/ha). It was followed by *M. anisopliae* (1 x 10^9 CFU/ml), azadirachtin 10,000 ppm and *L. lecanii* (1 x 10^9 CFU/ml) showing fruit yield of 10.02, 9.25 and 9.01 t per ha, respectively. Whereas, the *B. bassiana* (1 x 10^7 CFU/ml) gave lowest fruit yield (7.14 t/ha) and found to be the least economical treatment. Among all the treatments, *M. anisopliae* (1 x 10^9CFU/ml) recorded highest ICBR (1:17.2), followed by thiamethoxam 25 WG (ICBR 1:16.5) and *L. lecanii* (1 x 10^9 CFU/ml) with ICBR 1:13.5.

The present study indicated that thiamethoxam 25 WG was the superior treatment in suppressing the hopper population over all the remaining treatments. The results are favourably compared with the findings of Samanta *et al*. (2009) [12] who reported that thiamethoxam (0.016%) showed minimum hopper population (4.53/10 panicles). Rathod and Borad (2013) [10] evaluated newer and conventional insecticides against the mango hoppers during pre-flowering and flowering season and observed that thiamethoxam (0.005%) was most effective in suppressing the hopper population.

The current observations in respect of azadirachtin are in conformity with the findings of Verghese (2000) [15] who reported that the azadirachtin 3,000 ppm and 10,000 ppm were as effective as the synthetic chemicals at lower pest densities. Murugan *et al*. (2005) [6] and Vijaya Bhaskar (2007) [17] found that neem formulations were effective in suppressing the hopper population. The applications of *M. anisopliae* @ 1 x 10^9 spores per ml during off-season as well as at flowering were found effective in reducing the hopper population (Anonymous, 2010b) [2]. In another study, field evaluation of *M. anisopliae* @ 1 x 10^9 spores per ml with sunflower oil @ 1 ml per litre + Triton-X-100 @ 0.1 ml per litre during off-season as well as flowering season effectively suppressed the hopper population (Anonymous, 2014) [4].

The results of the present field experiment showed that the mango trees treated with thiamethoxam 25 WG had borne highest number of marble sized fruits per 100 panicles. Ray *et al*. (2014) [11] observed that the module-IV consisting thiamethoxam (0.008%) treatment gave maximum of 113.68 fruits per 100 panicles at marble stage and 88.20 kg fruit yield per tree at harvest. Similarly, Samanta *et al*. (2009) [12] recorded highest mango fruit yield (72 kg/tree) as well as cost-benefit ratio in the thiamethoxam (0.016%) treatment.

The maximum fruit yield was obtained from the treatment with higher dose of *M. anisopliae* at the rate of 1 x 10^9 spores per ml (Anonymous, 2010a and 2010b) [1, 2]. In another study, the fruit setting noticed maximum on the mango trees treated with *M. anisopliae* @ 1 x 10^9 spores per ml (Anonymous, 2013 and 2014) [3, 4]. Furthermore, Murugan *et al*. (2005) [6] got highest yield (40.6 and 12.9 kg/tree) from the treatment with NSKE (5%) over control (14.8 and 6.7 kg/tree) of the mango varieties *viz*., Neelum and Bangalora, respectively.

Table 1: Effect of EPF against mango hoppers during pre-flowering and flowering season (Average of four sprays 2014-15)

Tr. No.	Treatment	Dose/ litre	Survival population of mango hoppers/panicle days after spray				
			3	7	10	15	Mean
T_1	*M. anisopliae* (1 x 10^9 CFU/ml)	5 ml	5.20(2.39)	3.58(2.02)	2.71(1.79)	2.91(1.85)	3.60(2.02)
T_2	*M. anisopliae* (1 x 10^7 CFU/ml)	5 ml	7.37(2.80)	6.16(2.58)	5.38(2.42)	5.72(2.49)	6.16(2.58)
T_3	*B. bassiana* (1 x 10^9 CFU/ml)	5 ml	7.72(2.87)	6.49(2.64)	5.74(2.50)	6.26(2.60)	6.55(2.66)
T_4	*B. bassiana* (1 x 10^7 CFU/ml)	5 ml	10.18(3.27)	9.91(3.23)	9.28(3.13)	9.84(3.22)	9.80(3.21)
T_5	*L. lecanii* (1 x 10^9 CFU/ml)	5 ml	6.48(2.64)	5.17(2.38)	4.13(2.15)	4.43(2.22)	5.05(2.36)
T_6	*L. lecanii* (1 x 10^7 CFU/ml)	5 ml	8.65(3.02)	7.83(2.89)	7.18(2.77)	7.61(2.85)	7.82(2.88)
T_7	Azadirachtin 10,000 ppm	3 ml	4.29(2.19)	3.07(1.89)	2.38(1.70)	2.95(1.86)	3.17(1.92)
T_8	Thiamethoxam 25 WG	0.3 g	1.53(1.43)	1.27(1.33)	0.89(1.18)	1.36(1.36)	1.26(1.33)
T_9	Untreated control	_	17.69(4.26)	18.12(4.31)	18.57(4.37)	18.99(4.41)	18.34(4.34)
SE ±			(0.08)	(0.08)	(0.07)	(0.08)	(0.08)
CD at 5%			(0.25)	(0.23)	(0.22)	(0.23)	(0.23)

Figures in the parentheses arex + 0.5 transformed values

Table 2: Effect of EPF against mango hoppers during pre-flowering and flowering season (Average of four sprays: 2015-16)

Tr. No.	Treatment	Dose/ litre	Survival population of mango hoppers/panicle days after spray				
			3	7	10	15	Mean
T_1	*M. anisopliae* (1 x 10^9 CFU/ml)	5 ml	4.12(2.15)	2.98(1.87)	2.21(1.65)	2.42(1.71)	2.93(1.85)
T_2	*M. anisopliae* (1 x 10^7 CFU/ml)	5 ml	5.84(2.52)	4.88(2.32)	4.23(2.17)	4.59(2.26)	4.89(2.32)
T_3	*B. bassiana* (1 x 10^9 CFU/ml)	5 ml	6.12(2.57)	5.23(2.39)	4.64(2.27)	5.09(2.36)	5.27(2.40)
T_4	*B. bassiana* (1 x 10^7 CFU/ml)	5 ml	7.63(2.85)	7.34(2.80)	6.81(2.70)	7.37(2.81)	7.29(2.79)
T_5	*L. lecanii* (1 x 10^9 CFU/ml)	5 ml	5.08(2.36)	4.01(2.12)	3.20(1.92)	3.49(2.00)	3.95(2.11)
T_6	*L. lecanii* (1 x 10^7 CFU/ml)	5 ml	6.97(2.73)	6.39(2.62)	5.81(2.51)	6.33(2.61)	6.37(2.62)
T_7	Azadirachtin 10,000 ppm	3 ml	3.29(1.95)	2.42(1.71)	1.92(1.56)	2.51(1.73)	2.53(1.74)
T_8	Thiamethoxam 25 WG	0.3 g	1.20(1.30)	0.98(1.22)	0.68(1.09)	1.18(1.30)	1.01(1.23)
T_9	Untreated control	_	14.37(3.86)	14.94(3.93)	15.49(4.00)	15.95(4.06)	15.19(3.96)
SE ±			(0.07)	(0.07)	(0.06)	(0.07)	(0.07)
CD at 5%			(0.22)	(0.21)	(0.19)	(0.20)	(0.21)

Figures in the parentheses arex + 0.5 transformed values

Table 3: Effect of EPF against mango hoppers during pre- flowering and flowering season (Pooled mean of 2014-15 and 2015-16)

Tr. No.	Treatment	Dose/ litre	Survival population of mango hoppers/panicle					
			Pre-count	3 DAS	7 DAS	10 DAS	15 DAS	Mean
T_1	*M. anisopliae* (1 x 10^9 CFU/ml)	5 ml	12.70(3.67)	4.66 (2.27)	3.28(1.94)	2.46(1.72)	2.67(1.78)	3.27(1.94)
T_2	*M. anisopliae* (1 x 10^7 CFU/ml)	5 ml	12.02(3.54)	6.61(2.67)	5.52(2.45)	4.81(2.30)	5.16(2.38)	5.53(2.46)
T_3	*B. bassiana* (1 x 10^9 CFU/ml)	5 ml	12.75(3.64)	6.92(2.72)	5.86(2.52)	5.19(2.39)	5.68(2.49)	5.91(2.53)
T_4	*B. bassiana* (1 x 10^7 CFU/ml)	5 ml	12.04(3.54)	8.91(3.07)	8.63(3.02)	8.05(2.92)	8.61(3.02)	8.55(3.01)
T_5	*L. lecanii* (1 x 10^9 CFU/ml)	5 ml	12.45(3.60)	5.78(2.51)	4.59(2.26)	3.67(2.04)	3.96(2.11)	4.50(2.24)
T_6	*L. lecanii* (1 x 10^7 CFU/ml)	5 ml	12.15(3.56)	7.81(2.88)	7.11(2.76)	6.50(2.65)	6.97(2.73)	7.10(2.76)
T_7	Azadirachtin 10,000 ppm	3 ml	12.15(3.56)	3.79(2.07)	2.75(1.80)	2.15(1.63)	2.73(1.80)	2.85(1.83)
T_8	Thiamethoxam 25 WG	0.3 g	12.57(3.62)	1.37(1.37)	1.13(1.27)	0.79(1.14)	1.27(1.33)	1.14(1.28)
T_9	Untreated control	_	12.52(3.60)	16.03(4.07)	16.53(4.13)	17.03(4.19)	17.47(4.24)	16.77(4.16)
SE ±			(0.11)	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)
CD at 5%			(NS)	(0.24)	(0.22)	(0.21)	(0.22)	(0.22)

DAS- Days after spraying; NS- Non-significant;
Figures in the parentheses arex + 0.5 transformed values

Table 4: Effect of application of EPF on fruit setting in mango

Tr. No.	Treatment	Dose/ litre	Av. number of marble sized fruits/100 panicles		Mean
			2014-15	2015-16	
T_1	*M. anisopliae* (1 x 10^9 CFU/ml)	5 ml	220.33	216.33	218.33
T_2	*M. anisopliae* (1 x 10^7 CFU/ml)	5 ml	175.33	178.33	176.83
T_3	*B. bassiana* (1 x 10^9 CFU/ml)	5 ml	170.67	172.00	171.34
T_4	*B. bassiana* (1 x 10^7 CFU/ml)	5 ml	135.67	130.00	132.84
T_5	*L. lecanii* (1 x 10^9 CFU/ml)	5 ml	200.00	197.67	198.84
T_6	*L. lecanii* (1 x 10^7 CFU/ml)	5 ml	150.67	156.33	153.50
T_7	Azadirachtin 10,000 ppm	3 ml	212.33	205.33	208.83
T_8	Thiamethoxam 25 WG	0.3 g	225.00	215.33	220.17
T_9	Untreated control	-	110.67	105.33	108.00
SE ±		-	1.94	1.70	1.98
CD at 5%		-	5.80	5.11	5.94

Table 5: Yield of marketable fruits and economics of the treatments

Tr. No.	Treatment	Yield (kg)/tree			Yield (t)/ha	Additional yield over control (t/ha)	Monetary returns (Rs./ha)	Additional returns over control (Rs.)	Cost of pesticides and application (Rs.)	ICBR
		2014-15	2015-16	Mean						
T_1	*M. anisopliae* (1 x 10^9 CFU/ml)	98.20	102.26	100.23	10.02	4.63	3,00,600	1,38,900	8,060	1:17.2
T_2	*M. anisopliae* (1 x 10^7 CFU/ml)	83.22	80.86	82.04	8.20	2.81	2,46,000	84,300	7,360	1:11.4
T_3	*B. bassiana* (1 x 10^9 CFU/ml)	80.00	81.10	80.55	8.06	2.67	2,41,800	80,100	8,060	1:09.9
T_4	*B. bassiana* (1 x 10^7 CFU/ml)	72.33	70.46	71.40	7.14	1.75	2,14,200	52,500	7,360	1:07.1
T_5	*L. lecanii* (1 x 10^9 CFU/ml)	88.54	91.58	90.06	9.01	3.62	2,70,300	1,08,600	8,060	1:13.5
T_6	*L. lecanii* (1 x 10^7 CFU/ml)	75.42	78.92	77.17	7.72	2.33	2,31,600	69,900	7,360	1:09.5
T_7	Azadirachtin 10,000 ppm	94.36	90.63	92.50	9.25	3.86	2,77,500	1,15,800	20,416	1:05.7
T_8	Thiamethoxam 25 WG	102.60	107.47	105.04	10.50	5.11	3,15,000	1,53,300	9,280	1:16.5
T_9	Untreated control	55.52	52.25	53.89	5.39	--	1,61,700	--	--	--
SE ±		1.59	1.34	1.54	--	--	--	--	--	--
CD at 5%		4.77	4.01	4.61	--	--	--	--	--	--

Where, rates are:
M. anisopliae (1 x 10^9 CFU/ml) @ Rs. 275/l, *M. anisopliae* (1 x 10^7 CFU/ml) @ Rs. 240/l,*B. bassiana* (1 x 10^9 CFU/ml) @ Rs. 275/l, *B. bassiana* (1 x 10^7 CFU/ml) @ Rs. 240/l,*L. lecanii* (1 x 10^9 CFU/ml) @ Rs. 275/l, *L. lecanii* (1 x 10^7 CFU/ml) @ Rs. 240/l, Azadirachtin 10,000 ppm @ Rs. 1,488/l, Thiamethoxam 25 WG @ Rs. 5,600/kg,Labour charges @ Rs. 160/labour,
Market price of mango fruits @ Rs. 30/kg.

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