



Research Article

EFFICACY OF SOME ORGANIC AND SYNTHETIC PESTICIDE AGAINST MANGO MEALY BUG *Drosicha mangiferae* Green (Hemiptera: Coccidae)

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Abstract- Bio-efficacy of commercial organic and Entomopathogen formulations viz., Azadirachtin 10000 ppm and *Beauveria bassiana*, one modern synthetic formulation viz., Clothianidin 50%WDG, were evaluated against mango mealy bug, *Drosicha mangiferae* Green (Hemiptera: Coccidae) at Regional Research Sub-Station (Terai Zone), UBKV, Kharibari, Darjeeling, West Bengal during 2015 and 2016, as compared to Imidacloprid 17.8% SL, widely used by the mango farmers to keep down the population of the same pest. Both commercial organic formulation Azadirachtin 10000 ppm were used at 0.25 ml, 0.5 ml and 1.0 ml/lit. of water and commercial formulation of Entomopathogen organism *Beauveria bassiana* was used at 1.5 g, 2.5 g and 3.5 g/litre of water and while these were 0.10 g, 0.15 g and 0.25 g/litre of water of Clothianidin 50% WDG and 0.35 ml, 0.55 ml and 0.75 ml/litre of water for Imidacloprid 17.8% SL. Befitting with the pest activity, two sprays with all the formulations were given during end of January of February 2013 and 2014 crop seasons, respectively. All the pesticide formulations tested were found to be more or less equally effective to afford appreciable check against the activity of the pest, reducing aphid in the range from 75.08 to 100% during 2013 and 2014. However, to satisfy organic mango production, which is the global need of the day, Azadirachtin 10000 ppm at 0.5 ml/litre of water, Entomopathogen organism *Beauveria bassiana* at 2.5 g/litre of water and modern synthetic formulation Clothianidin 50% WDG at 0.15 g/litre of water may be good help in the appropriate care against Mealy Bug *Drosicha mangiferae* Green (Hemiptera: Coccidae) the most dreaded pest of mango.

Keywords- Efficacy, Organic, Synthetic pesticide, Mealy bug

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Introduction

Mango (*Mangifera indica* L.) is a major fruit crop cultivated in India with an annual production of about 12 million tonnes [1,2]. West Bengal is the one of the largest state in consideration of the production of mango in India [3]. The Gangetic plain of West Bengal offers a congenial environment for mango production [4]. Out of the all administrative district of West Bengal, Malda ranks first with an annual net production of about 196 metric tons [5]. Most of the mango growers in major mango growing belts are using insecticides of different newer brands in large scale but very often is less effective to check the pest menace [6]. As a result, they are suffering from mango production accounting for huge seasonal loss due to severe insect pests attack. Among all of the mango insect pests, mealy bug, *Drosicha mangiferae* is one of the notorious and destructive pests rendering huge scale of fruit loss [7]. Mealy bug is one of the major pests of mango and ranked 2nd after hopper in causing crop injury. Extent of loss may extend up to 50% [8] in some occasional cases. In general, *D. mangiferae* is found to infest almost all mango cultivars. Incidence of the pest starts from December, gains gradual momentum and attains the peak incidence during the middle of April when it is numerically more abundant. Damage to plants is primarily manifested due to the continuous sucking of 'cell sap' from tender leaves, stem, inflorescence and even from the fruits. Severe infestation often leads to fruit drops [8]. Further the honey dew following the excretion of *D. mangiferae* provides a medium for rapid growth of black and sooty fungi which decolorizes the fruit and makes it non-marketable [9,10]. But there is a remarkable success in the management of crop pests through using organic and synthetic pesticides, boosting up production of different crops including mango, to a marked degree on the one hand but on the other, the use of these pesticides has also created some environmental and health hazards.

Further, the use of synthetic pesticides for a long time to keep the crop pests under control, many of the pests have developed resistance against one or the other pesticides and mango mealy bug is no exception to that. Keeping this view in mind, the present investigation was taken up under Regional Research Sub-Station (Terai Zone) Kharibari farm field conditions to evaluate the bio efficacy of few eco-friendly but effective pesticides namely Azadirachtin -1% (10000 ppm), Entomopathogen organism *Beauveria bassiana* along with new synthetic molecule viz., Clothianidin 50% WDG and Imidacloprid 17.8% SL as standard check against mango mealy bug, *Drosicha mangiferae* Green, with the ultimate aim of developing effective alternatives to synthetic pesticides for management of this most damaging pest of mango.

Materials and Methods

The experiment was conducted during end of December, 2015 and 2016 in mango garden at Regional Research Sub-station (Terai Zone), Uttar Banga Krishi Viswavidyalaya, Kharibari, Darjeeling, West Bengal, following Randomized Block Design (RBD) to evaluate the bio-efficacy of organic formulation and Entomopathogen organism *Beauveria bassiana* and modern synthetic pesticides viz., Clothianidin 50% WDG, against mango mealy bug, *Drosicha mangiferae* Green (Hemiptera: Coccidae).

A synthetic pesticide viz., Imidacloprid 17.8% SL, being used by the standard check, was included in the experiment for comparison of the efficacy of organic formulations and also a no treatment control was included for overall comparison of these formulations. There were three concentrations for each treatment, which were replicated two times.

Table-1 Bio-efficacy of organic and Synthetic pesticide against Mango Mealy Bug *Drosicha mangiferae* Green during 2015 (mean of three replications)

Treatments	Doses (g/ml/lit.)	Before population	Mean No. of population at DAT*						% reduction over control
			1	3	5	7	10	15	
Azadiractin- 1% (10000 ppm)	0.25	95.75(9.81)	85.15(9.25)	75.25(8.70)	63.8(8.02)	50.1(7.11)	30.5(5.57)	25.1(5.06)	81.26
	0.50	94.65(9.75)	75.20(8.70)	55.80(7.50)	38.70(6.26)	20.15(4.54)	10.15(3.26)	1.35(1.36)	98.98
	1.00	98.70(9.96)	70.10(8.40)	45.50(6.78)	30.60(5.58)	18.20(4.32)	9.10(3.10)	0.00(0.71)	100.00
<i>Beauveria bassiana</i>	1.5	94.36(9.74)	84.10(9.20)	75.40(8.71)	60.10(7.78)	55.20(7.46)	40.15(6.38)	32.90(5.78)	75.08
	2.5	94.70(9.76)	80.90(9.02)	72.10(8.52)	56.40(7.54)	41.10(6.45)	34.20(5.89)	28.18(5.36)	78.73
	3.5	96.80(9.86)	77.10(8.81)	62.30(7.92)	48.50(7.00)	32.00(5.70)	26.50(5.20)	18.10(4.31)	86.63
Clothianidin 50% WDG	0.10	96.15(9.83)	84.10(9.20)	70.20(8.41)	61.10(7.85)	42.20(6.53)	38.10(6.21)	18.10(4.31)	86.54
	0.15	94.70(9.76)	77.10(8.81)	55.20(7.46)	38.10(6.21)	22.15(4.76)	10.20(3.27)	0.00(0.71)	100.00
	0.25	93.25(9.68)	72.70(8.56)	50.30(7.13)	31.20(5.63)	18.20(4.32)	9.10(3.10)	0.00(0.71)	100.00
Imidacloprid 17.8% SL	0.35	94.10(9.73)	80.10(8.98)	68.20(8.29)	51.10(9.18)	43.70(6.65)	33.70(5.85)	20.10(4.54)	84.73
	0.55	93.20(9.68)	72.10(8.52)	60.20(7.79)	40.20(6.38)	28.10(5.35)	16.20(4.09)	1.10(1.26)	99.16
	0.75	95.50(9.80)	70.10(8.40)	58.10(7.66)	40.10(6.37)	23.20(4.87)	10.10(3.26)	0.00(0.71)	100.00
Untreated Control	-----	93.25(9.68)	94.70(9.76)	96.25(9.84)	98.15(9.93)	110.15(10.52)	120.35(10.99)	130.45(11.44)	
S.Em±		4.10	2.48	2.19	1.91	1.64	1.52	1.13	
C.D. at 5%		12.13	7.34	6.46	5.65	4.86	4.48	3.32	

*DAT- Days After Treatment, ** Figures in parenthesis are Square root transformed value

Table-2 Bio-efficacy of organic and Synthetic pesticide against Mango Mealy Bug *Drosicha mangiferae* Green during 2016 (mean of three replications)

Treatments	Doses (g/ml/lit.)	Before population	Mean No. of population at DAT*						% reduction over control
			1	3	5	7	10	15	
Azadiractin - 1% (10000 ppm)	0.25	98.75(9.96)	83.95 (9.19)	71.55 (8.49)	60.45 (7.81)	49.4 (7.06)	29.56 (5.48)	22.5 (4.80)**	82.05
	0.50	99.65 (10.01)	72.55 (8.55)	53.80 (7.37)	33.75 (5.85)	18.25 (4.33)	9.65 (3.19)	2.35 (1.69)	98.14
	1.00	105.75(10.31)	85.35 (9.27)	65.70(8.14)	45.50(6.78)	28.20(5.36)	12.50(3.61)	0.00(0.71)	100.00
<i>Beauveria bassiana</i>	1.5	104.36(10.24)	96.55(9.85)	78.45(8.89)	68.40(8.30)	54.25(7.40)	43.15(6.61)	30.30(5.55)	77.12
	2.5	103.70(10.21)	92.45(9.64)	75.15(8.70)	51.40(7.20)	38.90(6.28)	28.25(5.36)	21.15(4.65)	83.93
	3.5	99.80(10.01)	81.15(9.04)	72.35(8.54)	58.55(7.68)	35.40(5.99)	26.50(5.20)	16.40(4.11)	87.05
Clothianidin 50% WDG	0.10	98.15(9.93)	74.50(8.66)	60.60(7.82)	51.15(7.19)	43.25(6.61)	32.85(5.77)	23.40(4.89)	81.21
	0.15	99.70(10.01)	70.75(8.44)	52.25(7.26)	32.80(5.77)	20.15(4.54)	9.25(3.12)	0.00(0.71)	100.00
	0.25	110.25(10.52)	73.56(8.61)	52.35(7.27)	29.25(5.45)	15.25(3.97)	6.10(2.57)	0.00(0.71)	100.00
Imidacloprid 17.8% SL	0.35	107.10(10.37)	90.15(9.52)	78.26(8.87)	61.15(7.85)	41.60(6.49)	30.10(5.53)	22.15(4.76)	83.70
	0.55	102.20(10.13)	82.15(9.09)	72.25(8.53)	42.38(6.55)	25.15(5.06)	15.50(4.00)	2.60(1.76)	98.00
	0.75	98.50(9.95)	65.35(8.11)	53.15(7.32)	41.15(6.45)	20.25(4.56)	9.15(3.11)	0.00(0.71)	100.00
Untreated Control	-----	112.25(10.62)	120.70(11.01)	126.25(11.26)	130.15(11.43)	134.15(11.60)	140.35(11.87)	142.45(11.96)	
S.Em±		2.76	2.44	2.27	1.81	1.79	1.57	1.38	
C.D. at 5%		8.17	7.20	6.70	5.35	5.29	4.64	4.07	

*DAT- Days After Treatment, ** Figures in parenthesis are Square root transformed value

Table-3 Benefit: cost due to treatments with organic and Synthetic pesticide against Mango Mealy Bug *Drosicha mangiferae* Green

Treatments	Dose (g/ml/lit.)	Pesticide used (g/ml/lit.)	Cost of pesticides (Rs.)	Cost of labour/ha (Rs.)	Total cost (Rs.)	Crop yield (kg/ha)	Gross return (Rs.)	Net return (Rs.)	B: C ratio
Azadiractin - 1% (10000 ppm)	0.25	6000x0.5 =3000	1000x 3 =3000.00	250x40 =1000.00*	13,000.00	54,000.00	5,40,000.00**	5,27,000.00	40.54
	0.50	6000x1.0 =6000	1000x6 =6000.00	250x40 =1000.00	16,000.00	58,000.00	5,80,000.00	5,64,000.00	35.25
	1.00	6000x2.0 =12000	1000x12 =12000.00	250x40 =1000.00	22,000.00	62,000.00	6,20,000.00	5,98,000.00	27.18
<i>Beauveria bassiana</i>	1.5	6000x3.0 =18000	750x18 =13500.00	250x40 =1000.00	23,500.00	52,000.00	5,20,000.00	4,96,500.00	21.13
	2.5	6000x5.0 =30000	750x30 =22500.00	250x40 =1000.00	32,500.00	58,000.00	5,80,000.00	5,47,500.00	16.85
	3.5	6000x7.0 =42000	750x42 =31500.00	250x40 =1000.00	41,500.00	61,000.00	6,10,000.00	5,68,500.00	13.70
Clothianidin 50% WDG	0.10	6000x0.20 =1200	14000x1.2 =16800.00	250x40 =1000.00	26,800.00	64,000.00	6,40,000.00	6,13,200.00	22.88
	0.15	6000x0.30 =1800	14000x1.8 =25200.00	250x40 =1000.00	35,200.00	68,000.00	6,80,000.00	6,44,800.00	18.32
	0.25	6000x0.50 =3000	14000x3 =42000.00	250x40 =1000.00	52,000.00	75,000.00	7,50,000.00	6,98,000.00	13.42
Imidacloprid 17.8% SL	0.35	6000x0.70 =4200	1400x 4.2 =5880.00	250x40 =1000.00	15,880.00	63,000.00	6,30,000.00	6,14,120.00	38.67
	0.55	6000x1.10 =6600	1400x6.6 =9240.00	250x40 =1000.00	19,240.00	69,000.00	6,90,000.00	6,70,760.00	34.86
	0.75	6000x1.5 =9000	1400x9 =12600.00	250x40 =1000.00	22,600.00	73,000.00	7,30,000.00	7,07,400.00	31.30

*Charges @ Rs. 250.00/ labour, **Price @ Rs. 10.00/kg.



Fig-1 Spraying Organic, Entomopathogen Organism and Synthetic pesticides



Fig-2 Full recovery of Mealy Bug insects due to spraying with Organic, Entomopathogen Organism and Synthetic pesticides

The three concentrations of Azadirachtin-1% (10000 ppm) included 0.25 ml/lit., 0.50 ml/lit. And 1.00 ml/lit while these were 1.5 gm/lit., 2.5 g/lit., and 3.5 g/lit for *Beauveria bassiana*, Clothianidin 50% WDG was used at concentrations of 0.10 g/lit., 0.15 g/lit. and 0.25 g/lit., and the concentrations for Imidacloprid 17.8% SL included 0.35 ml/lit, 0.55 ml/lit and 0.75 ml/lit. with the help of paddle high volume sprayer, two spraying were given at an interval of 15 days, starting from marble size stage of mango. While working out of the benefit: cost ratio of different pesticidal treatments, only the costs incurred in pesticides and labours were taken into consideration.

Observations on damage an undamaged twig due to different treatments were recorded at one day before treatment and then at 1, 3, 5, 7, 10 and 15 days after treatment (DAT). The results of the three experiments were pooled together to work out the benefit: cost ratio of each treatment.

Results and Discussion

The results obtained through spraying of various doses of the four different types of pesticides on the mortality and population reduction in *Drosicha mangiferae* which causes appreciable damage to mango inflorescence and fruit twigs, have been presented in [Table-1] and [Table-2].

The percent reduction in *Drosicha mangiferae*, as recorded during 2015, ranged from 75.08 to 100% over control, when (Neem) Azadirachtin-1% (10000 ppm), *Beauveria bassiana*, Clothianidin 50% WDG and Imidacloprid 17.8% SL were applied with doses varying from 0.10 to 3.5 ml/g/litre of water [Table-1]. Hence, all the pesticide molecules viz., Azadirachtin-1% (10000 ppm), *Beauveria bassiana* and new synthetic molecule viz., Clothianidin 50% WDG and Imidacloprid 17.8% SL, at

all doses, were found to exert appropriate lethality towards *Drosicha mangiferae*, appreciable reducing.

The results achieved during 2016 with the same pesticidal products against the same pest that all the pesticidal products with their respective doses used, followed more or less the same trend as observed during 2016 [Table-2].

However, neither the pesticide molecules nor the doses were found to differ significantly in regard to expressing their bio-efficacy against the target pest, *Drosicha mangiferae*. Further, the impact of all the pesticide molecules tested, was found to be more pronounced with the passage of time (1- 15 DAT) exhibiting remarkable reduction *Drosicha mangiferae* on 'Amarpali' variety of mango.

It was found that Azadirachtin-1% (10000 ppm), *Beauveria bassiana*, the one organic formulation and one Entomopathogen organism formulations, were equally effective as the two synthetic pesticides like Clothianidin 50% WDG and Imidacloprid 17.8% SL in minimizing inflorescence and fruit to mango *Drosicha mangiferae*.

As regards to economic benefits, the highest economic return of 40.54:1 was found when Azadirachtin-1% (10000 ppm) was used at 0.25 ml/litre, followed by Imidacloprid 17.8% SL (38.67: 10 at 0.35 ml/litre, Clothianidin 50% WDG (22.88 : 1) at 0.10 g/litre and *Beauveria bassiana* (21.13 : 1) at 1.5 g/litre of water [Table-3].

The mango mealy bug has got major status in all India (11) but as of now no information on appropriate management of this pest is available, director of central Institute for subtropical Horticulture published that some synthetic pyrethroids viz., Chlorpyrifos, Carbosulfan and Dimethoate were most effective against mango mealy bug (12)

Conclusion

It may be concluded that even if *Beauveria bassiana* were quite effective in keeping down the intensity of mealy bug infestation in mango to a considerable extent, providing more economic returns to the farmers. Besides, for competing in international fruit markets, emphasis should be given on organic farming and use of organic pesticide formulations like Azadirachtin-1% (10000 ppm) and *Beauveria bassiana*. Both these pesticides at 0.25 ml/lit. and 1.5 g/lit provided appreciable economic returns, protecting mango against mealy bug, *Drosicha mangiferae*, the most dreaded pest of the crop in West Bengal. Obviously, the findings of the present investigation may be useful for control of mango mealy bug, *Drosicha mangiferae*.

Application of research: The research findings from the above investigations on organic pesticides formulations against mango mealy bug were demonstrated in the mango growing areas of West Bengal. Considering the Benefit: Cost ratio (B:C), all the mango growers in locality showed very much interest to adopt these technologies for getting more economic returns.

Research Category: Organic and Synthetic Pesticide

Abbreviations: DAT – Days After Treatments; PPM – Parts Per Million; WDG – Water Dispersible Granule; SL – Soluble Concentrate

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