Biological Forum – An International Journal **14(1): 234-237(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Field Evaluation and Bio-efficacy of different Bio-pesticides and Botanicals against Mustard Web Worm (*Crocidolomia binotais* Zell.)

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(Received 16 October 2021, Accepted 11 December, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The experiment was carried out at Research farm of BTC CARS, Bilaspur during *Rabi* 2019-20. A field experiment was laid down in randomized block design (RBD) with six bio-pesticides and botanicals one insecticide and an untreated control. Bio-pesticides do not have harmful affect against bio-agents. The insecticide Imidacloprid 17.8 SL @ 0.2ml/liter was found to be most effective treatment against mustard web worm and it was recorded least over all mean population (3.29 larvae/plant) with maximum larval reduction per cent (72.16) followed by Garlic extract 5% @ 50 ml/lit, recorded with 3.61 over all mean population and 69.46 per cent reduction in web worm population whereas *Beauveria bassiana* 10 % WP (1×10^9CFU/gm) @ 10 g/lit. was recorded with 3.83 larvae/plant, 67.59 cent reduction in population while other treatments viz *Metarhizium anisopliae* 10% WP (1×10^9 CFU/gm) @ 10g/lit. , *Lecanicillium lecanii* 10% WP (1×10^9 CFU/gm) @ 10 g/lit, Aak leaf extract 5% @ 50 ml/lit. and Aak flower extract 5% @ 50 ml/lit. were recorded less effective.

Keywords: *Crocidolomia binotais* (Zell.), bio-pesticide and botanical-agents.

INTRODUCTION

Mustard (*Brassica juncea* L.) is the most important oilseed crop grown in *Rabi* season for its valuable edible oil content. The name 'mustard' is derived from the Latin word mustum, or must of old wine mixed with crushed seed makes it one of the most important spice in the world (Hemingway, 1976). Mustard (*Brassica juncea* L.) is the most popular one among different rapeseed and mustard being grown during winter in India . China is the origin and from there it was introduced into Afghanistan via Punjab. In India, it is mainly grown in different states like Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, Assam, Gujarat, Maharashtra, Haryana and West Bengal etc. In India it is grown in an area of 6123.93 thousand hectare with a production of 9256.66 thousand tonnes and productivity is 1511 kg/ha in 2018-19 (Anonymous, 2019; Reddy and Ali, 1977). Thirty eight insect pests are known to be associated with different stages of mustard growth in India. Among these, the leaf webber, *C. binotalis* is a serious pest causing yield loss of 13.2 to 81.8 per cent Damage is caused mainly by the caterpillars. The caterpillars from silken web around the leaves. They feed upon the leaves making them completely skeletonised. They feed on flower buds and bore into pods. In mustard crop production, web worm, *Crocidolomia binotalis* (Zell.) is major constraint infestation is also increasing in mustard agro-ecosystem, proceed the mustard growers to control these menace by the use of huge quantity of pesticides which causes severe problems such as residue, resurgence, resistance, hazardous to human beings ,beneficial insects and ultimately impairs the environment. An eco and user friendly pest control approach against mustard web worm is the necessity of present time to safeguard the natural enemies, pollinators and precious environment as well as human health. Keeping the above facts in mind the present investigation was undertaken to evaluate the eco – friendly bio-products to manage the pest.

MATERIAL AND METHODS

A field experiment was laid out in randomized block design (RBD) with eight treatments including untreated control. Replicated three times (Table 1). The crop was sown in second week of November 2019 in plot size of 4.2m × 3m with 30cm row to row distance and 10cm plant to plant distance. The calculated quantity of each bio-pesticide and botanicals was sprayed with the help

of hand operated knapsack sprayer. The spraying was done two times.

Six different bio-pesticides and botanicals and one insecticide treatments were evaluated for the assessment of their comparative performance against mustard web worm. The observation on the web worm incidence was recorded 1 day before spray as pretreatment count and 3, 7, 10, and 15 days after spraying as the post treatment counts. The population of larvae per plant were counted during early morning and population of natural enemies also recorded.

A. Method of preparation of leaf extract

The fresh leaves and flowers of Aak (*Calotropis* sp. L.) were collected and cleaned with tap water and shade dried. The plant leaf and flower extracts were prepared as suggested by Singh (2004)**.** Thereafter, to make the fine powder of them, the dried leaves were crushed with the help of mixer grinder. The 5 per cent concentration was prepared by adding the 5 gm. fine leaf powder in the 100 ml distilled water.

Method of preparation of garlic cloves extract: garlic cloves extract was prepared as suggested by Ellis and Bradley (1992). Steeped the finally grated garlic for 24 hours in the kerosene oil and the soap was dissolved in the water, garlic and kerosene oil infusion were mixed with stirring together and filtered through a fine cloth. Before use this solution was diluted with 20 parts of water.

Materials: 100 gm garlic cloves, 500ml water, 10 gm soap and 2 teaspoons kerosene oil was used.

Table 1: Details of different bio-pesticide and botanicals.

Treatment	Treatment detail	Formulation	Does/liter
T1	*Lecanicillium lecanii*	10 % WP (1×10^9 CFU/g)	10g
T2	*Beauveria bassiana*	10% WP (1×10^9 CFU/g)	10g
T3	*Metarrhizium anisopliae*	10% WP (1×10^9 CFU/g)	10g
T4	Aak leaves (*Calotropis* sp.L.)	5% Leaf extract	50ml
T5	Aak flower (*Calotropis* sp.L.	5% Flower extract	50ml
T6	Garlic (*Allium sativum* L.	5%Garlic extract	50ml
T7	Imidachloprid	17.8 SL	0.2ml
T8	Untreated Control	-	-

Different photograph of Preparation of garlic (*Allium sativum* L.), Aak (*Calotropis* sp. L.) leaf extract and flower extract

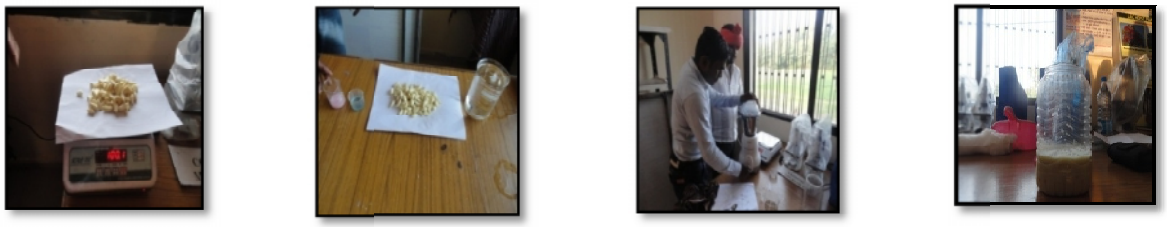

Plate 1. Preparation of garlic (*Allium sativum* L.) extract.

Plate 2. Preparation of Aak (*Calotropis* sp. L.) leaf extract and flower extract.

RESULT AND DISCUSSION

Among the biopesticides, botanicals and insecticide evaluated against mustard web worm, Imidacloprid 17.8 SL @ 0.2 ml/lit. was found to be most effective treatment with lowest 3.29 larvae/plant, maximum 72.16 per cent reduction in larval population of web worm, maximum yield (2309.43kg/ha.) and benefit cost ratio (3.35:1). Garlic extract 5% @ 50 ml/lit. (3.61 larvae/plant) was the next best treatment with 69.46 per cent reduction in larval population, 2143.21kg/ha yield and 2.68:1 benefit cost ratio followed by *Beauveria bassiana* 10 % WP (1×10^9CFU/gm) @ 10 g/lit. (3.83 larvae/ plant) and *Metarhizium anisopliae* 10% WP (1×10^9 CFU/gm) @ 10g/lit. (4.14 larvae/plant) with 67.59 and 64.97 per cent reduction in population, respectively. *Lecanicillium lecanii* 10% WP (1×10^9CFU/gm) @ 10 g/lit (4.82 larvae/plant), Aak leaf extract 5% @ 50 ml/lit. (5.04 larvae/plant) and Aak flower extract 5% @ 50 ml/lit. (5.05 larvae/plant) were recorded with 59.22, 57.36 and 57.27 per cent reduction in larval population, respectively.

Table 2: Efficacy of different bio-pesticides and botanicals against mustard web worm during *rabi* 2019-20.

Sr. No.	Treatment	Dose (g or ml/lit. of water	Mean web worm larval population/plant										Over all mean aphid population/ plant	Per cent reduction in aphid Population over control
			First spray (23/01/2020)					Second spray (10/02/2020)						
			PTO	3 DAS	7 DAS	10 DAS	15 DAS	PTO	3 DAS	7 DAS	10 DAS	15 DAS		
T_1	*Lecanicillium lecanii* 10 % WP (1×10^9 CFU/g)	10g	8.23 (2.95)	6.93 $(2.61)^{b}$	5.13 $(2.25)^{bc}$	4.63 $(2.14)^{bcd}$	3.96 $(1.98)^{bcd}$	5.46 (2.44)	5.46 $(2.34)^{b}$	4.90 $(2.21)^{bc}$	4.90 $(2.21)^{b}$	2.70 $(1.77)^{bc}$	4.82 $(2.20)^{b}$	59.22
T_2	*Beauveria bassiana* 10 % WP (1×10^9 CFU/g)	10g	8.93 (3.07)	6.53 $(2.55)^{b}$	4.56 $(2.13)^{bc}$	3.46 $(1.85)^{de}$	3.00 $(1.73)^{de}$	5.13 (2.38)	4.36 $(2.09)^{b}$	3.93 $(1.98)^{cd}$	3.13 $(1.77)^{c}$	1.73 $(1.48)^{cd}$	3.83 $(1.95)^{bc}$	67.59
T_3	*Metarhizium anisopliae* 10 % WP (1×10^9 CFU/g)	10g	8.63 (3.02)	6.66 $(2.57)^{b}$	4.65 $(2.19)^{bc}$	4.20 $(2.04)^{bcd}$	3.13 $(1.76)^{cde}$	5.36 (2.42)	4.96 $(2.23)^{b}$	4.03 $(2.00)^{bcd}$	3.16 $(1.78)^{c}$	2.36 $(1.69)^{bc}$	4.14 $(2.03)^{bc}$	64.97
T_4	Aak (Calotropis sp.L.) Leaf extract 5%	50ml	9.03 (3.08)	6.73 $(2.59)^{b}$	6.00 $(2.45)^{b}$	4.73 $(2.17)^{bc}$	4.33 $(2.08)^{bc}$	6.03 (2.55)	5.70 $(2.39)^{b}$	5.23 $(2.29)^{b}$	4.23 $(2.06)^{b}$	3.40 (1.97)b	5.04 $(2.24)^{b}$	57.36
T_5	Aak (*Calotropis* sp. L.) Flower extract 5%	50ml	7.43 (2.81)	6.70 $(2.59)^{b}$	5.56 $(2.35)^{bc}$	5.43 $(2.32)^{b}$	4.63 $(2.15)^{b}$	6.13 (2.58)	5.50 $(2.34)^{b}$	5.03 $(2.23)^{bc}$	4.33 $(2.08)^{b}$	3.16 $(1.92)^{b}$	5.05 $(2.24)^{b}$	57.27
T_6	Garlic (*Allium sativam* L.) extract 5%	50ml	8.66 (3.02)	6.46 $(2.52)^{b}$	4.00 $(2.00)^{bc}$	3.56 $(1.89)^{cde}$	2.90 $(1.70)^{de}$	4.83 (2.30)	4.33 $(2.08)^{b}$	3.80 $(1.95)^{cd}$	2.46 $(1.56)^{c}$	1.36 $(1.36)^{cd}$	3.61 $(1.89)^{bc}$	69.46
T_7	Imidacloprid 17.8 SL	0.2ml	8.36 (2.97)	5.83 $(2.41)^{b}$	3.90 $(1.97)^{c}$	3.03 $(1.73)^{e}$	2.63 $(1.62)^{e}$	4.73 (2.29)	4.00 $(2.00)^{b}$	3.60 $(1.89)^{d}$	2.36 $(1.53)^{c}$	1.00 $(1.17)^{d}$	3.29 $(1.81)^{c}$	72.16
T_8	Untreated control	-	7.86 (2.89)	11.00 $(3.30)^{a}$	15.00 $(3.84)^{a}$	16.33 $(4.02)^{a}$	17.00 $(4.10)^{a}$	13.66 (3.77)	11.66 $(3.39)^{a}$	9.66 $(3.10)^{a}$	7.66 $(2.76)^{a}$	6.33 $(2.61)^{a}$	11.82 $(3.41)^{a}$	—
SEm +			0.10	0.15	0.15	0.10	0.11	0.23	0.13	0.10	0.09	0.14	0.13	—
CD (0.05)			NS	0.46	0.45	0.30	0.33	NS	0.39	0.30	0.27	0.42	0.38	—

Note: Figures in parentheses are square root transformed values; Average number of web worm larval / plants; NS = Non significant; DAS = Days after spraying

Table 3: Economics of biopesticides and botanicals applied against mustard web worm.

Sr. No.	Treatment	Mustard seed yield (kg/ha)	Total cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	Benefit over control (Rs./ha)	B:C Ratio
1.	*Lecanicillium lecanii* 10 % WP (1×10^9 CFU/g)	1914.93	24300	84735.65	60435.65	10389.68	2.48:1
2.	*Beauveria bassiana* 10 % WP (1×10^9 CFU/g)	2082.06	24300	92131.15	67831.15	17785.18	2.79:1
3.	*Metarhizium anisopliae* 10 % WP (1×10^9 CFU/g)	1883.06	24300	83325.40	59025.40	8979.43	2.43:1
4.	Aak (*Calotropis* sp. L.) leaf extract 5%	1910.99	23490	84561.30	61071.30	11025.33	2.60:1
5.	Aak (*Calotropis* sp. L.) flower extract 5%	1784.38	23490	78958.81	55468.81	5422.84	2.36:1
6.	Garlic (*Allium sativam* L.) extract 5%	2143.21	25745	94837.04	69092.04	19046.07	2.68:1
7.	Imidachloprid17.8 SL	2309.43	23500	102192.27	78692.27	28646.30	3.35:1
8.	Untreated control	1621.83	21720	71765.97	50045.97	-	2.30:1

Labour rate/day = Rs.295/labour (2 labours required for spraying in one hectare/day); Market price of mustard = Rs 4425 q./ha

CONCLUSION

The results show that biopesticides of mustard crops Imidachloprid, *Beauveria bassiana*, Garlic (*Allium sativam* L.) extracts 5%, and Aak (*Calotropis* sp. L.) Leaf extract 5% web worm control is an effective biopesticides and obtaining a higher yield and economic return. Thus biopesticides of mustard with an effective production in Bilaspur as well as in other developing state that have similar socio-economic backgrounds.

Acknowledgement. We are thankful to the dean, all the professors and colleagues for their help during this study and special thanks to my guide Dr. R.K.S. Tomar sir. This study is a part of M.Sc. thesis of the first author. **Conflict of Interest.** None.

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How to cite this article: Kamal Narayan, R.K.S. Tomar, A.K. Awasthi, Archana Kerketta, Lavkush Salame, Sachin Kumar Jaiswal and Arpit Mishra (2022). Field Evaluation and Bio-efficacy of different bio-pesticides and botanicals against Mustard Web Worm (*Crocidolomia binotais* Zell.). *Biological Forum – An International Journal*, *14*(1): 234-237.