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Performance of Management of the Red Pumpkin Beetle (*Aulacophora foveicollis*) Lucas on Bottle Gourd by Different Bio-Pesticides

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at Organic Research Farm, Karguaji, Bundelkhand University, Jhansi (U.P.) at *Kharif* season of 2023 to evaluate the bio-pesticide and botanicals effect to population reduction of red pumpkin beetle on bottle gourd crop, the experiment was carried out

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with 9 treatments including control in three replications under randomized block design. To evaluate efficacy three applications of treatments were carried out and data was collected at 3DAS, 7DAS and 14 days after spraying. After the observations at first second and third sprays the best effective treatment that reduced the maximum population of red pumpkin beetle was *Beauveria bassiana* @5gm/L followed by Neem oil @2ml/L and *Bacillus thuringiensis* @5gm/L, remain all botanicals and bio-pesticide found superior over control. The highest yield found with 442.21 qt/hac under *Beauveria bassiana* treated with plot followed by the 4.12.50qt/hac and 400.10qt/hac yield under Neem oil and *Bt* treated plots. The highest cost benefit ratio was found under *Beauveria bassiana* that showed 1:4.64 ratio followed by *Bt* and *Metarrhizium anisopliae*.

Keywords: Red pumpkin beetle; bottle gourd; Beauveria bassiana; Bacillus thuringiensis; neem oil; Metarrhizium anisopliae.

1. INTRODUCTION

Bottle gourd *Lagenaria siceraria* (Molina) Stand. is important vegetable crop belongs to the Cucurbitaceae family, it is crop of tropical and sub-tropical region which grown all region of world and it requires hot and humid climate for good production, India is also good producer of bottle guard and grown in every states. The plant of bottle gourd as vine-like have alternate leaf arrangements with fine hairs on stem and tendrils also consistently found. Due to their nutritious properties raw fruit are consumed as juice or also consumed cooked as vegetable, it is rich in calcium, phosphorus and iron minerals and also Vitamin C and B5, it has also have goof (good) ayurvedic medicinal properties that by it is used as the cardio tonic [1] and have high amount of fiber that make it laxative property it is good for liver and diabetes patient. Production of bottle gourd is affected by various insect pest and diseases among all the red pumpkin beetle is a serious noxious pest that attack on all cucurbitaceous crop, red pumpkin beetle *Aulacophora foveicollis* is small body 6-8 mm long insect start infestation with seedling stage and caused heavy damage the beetles start feeding on emerging cotyledons and make hole in leaves [2]. It can cause 35-75 per cent damage and sometimes also need to re sowing of crop, [3].with keeping to the following fact to evaluate the bio-pesticide and botanicals that field experiment was carried out [4].

2. METHODS AND MATERIALS

The field experiment to evaluate the bio-pesticides against red pumpkin beetle was conducted in *Kharif* season 2023 at Organic Research Farm, karguaji, Bundelkhand University Jhansi (U.P.). The experiment was conducted with nine treatments Neemoil, Garlic bulb exttact, *Bacillus thuringiensis,* Karanj oil, Panchgavya, Neem seed kernel extract(NSKE), *Beauveria bassiana, Metarhizium anisopliae,* and control in three replications under randomized block design. The three applications of treatments were done in total crop period according to population of insect at ETL level. The experimental field was divided in 3 replication with 9 treatment in total 27 plots, pre-prepared seedlings of crop was transplanted in each plot in same manner and subsequent required irrigation and interculture operation were carried out in field [5].

2.1 Observation

the transplanted seedling monitored and the data of red pumpkin beetle collected before and after application of the treatments, in each plot the adult population of beetle was observed per plant bases and after the treatment application to evaluate efficacy of the treatments data were collected3 days, 7 days and 14 days after each treatment application and evaluation were carried based on how much population of beetle was reduced by every spray in different treatments [6].

3. RESULTS AND DISCUSSION

First spray: The data collected before first spray of treatment the population of beetle ranged 5.13-5.90 beetle plant and after the application the mean population at 3DAS, 7DAS and 14 DAS resulted that the minimum population 4.34 was found under *Beauveria bassiana* @ 5gm/L followed by 4.86 and 4.91 under Neem oil @2ml/L and *Bacillus thuringiensis* @5gm/L and remain all treatment resulted 4.95, 5.01, 5.07, 5.15 and 5.21mean adult beetle population under *Metarhizium anisopliae* @5gm/L, NSKE @5ml/L, Garlic bulb extract @5ml/L, Panchgavya @5ml/L, and Karanj oil @5ml/L where the

untreated plot showed highest population 5.97 adult beetle per plant [7].

Second spray: The data reveled in Table 2 represented result after the second application of the treatment showed minimum mean population of the beetle 2.94/plant was found under *Beauveria bassiana* @ 5gm/L followed by3.48 and 3.61 beetle per plant under Neem oil @2ml/L and *Bacillus thuringiensis* @5gm/L respectively, where untreated plot showed maximum population 7.23 beetle per plant. Remain all treatment effective and superior over control (untreated plot) [8].

Third spray: The data collected before third application of treatments 2.79 to 3.79 adult population of beetle was observed in treated plot and 7.82 mean population was found in untreated plot, after the third application of treatments data collected at 3DAS, 7DAS and 14 DAS, minimum mean population of beetle 1.69/plant was found with *Beauveria bassiana* @ 5gm/L as per with 1.82 and 1.91 mean beetle population per plant under Neem oil @2ml/L and *Bacillus thuringiensis* @5gm/L respectively. Remain all treatment was superior over control (untreated plot) but Garlic bulb extract was least effected treatment where untreated plot showed 8.16 beetle/plant highest population among all treatments [9].

Fruit yield and cost benefit ratio: The data collected after the harvesting and treatment application illustrated that the highest yield found with 442.21 qt/hac under *Beauveria bassiana* treated with plot followed by the 4.12.50qt/hac and 400.10qt/hac yield under neem oil and *Bt* treated plots. Rest of all treatments also performed significant yield production with different treated plots. And the highest affordable and economical effective treatment among all that showed maximum C:B ratio was *Beauveria bassiana* that showed 1:4.64 ratio followed by *Bt* and *Metarrhizium anisopliae*, where untreated plot showed 1:1.46 ratio and 182.10qt/hac yield that is lowest among all plots.

Table 1. Effect of treatment on population of red pumpkin beetle after first spray

T.no	Treatments	Doses	Mean population of beetle				Mean
			Before	3DAS	7DAS	14DAS	
T_1	Neem oil	2%	5.69	5.22	4.83	4.54	4.86
T_2	Garlic bulb extract	5%	5.13	5.13	5.10	5.00	5.07
T_3	*Bacillus thuringiensis* var. kurstaki	5gm/liter	5.51	5.12	4.94	4.69	4.91
T_4	Karanj oil	5%	5.54	5.34	5.34	4.96	5.21
T_5	Panchagavya	5%	5.90	5.46	5.10	4.90	5.15
T_6	NSKE	5%	5.23	5.20	5.00	4.83	5.01
T_7	*Beauvaria bassiana*	5gm/liter	5.72	5.03	4.26	3.72	4.34
T_8	*Metarrhizium anisopliae*	5gm/liter	5.53	5.21	4.91	4.74	4.95
T_9	Water control	---------	5.48	5.6	6.00	6.33	5.97
	CD		N/A	N/A	0.807	0.786	0.476
	SE(M)		0.171	0.183	0.267	0.260	0.157

Table 2. Effect of treatment on population of red pumpkin beetle after second spray

T.no	Treatments	Doses	Mean population of beetle				Mean
			Before	3DAS	7DAS	14DAS	
T_1	Neem oil	2%	4.60	3.85	3.50	3.08	3.48
T_2	Garlic bulb extract	5%	5.34	4.85	4.53	4.16	4.51
T_3	*Bacillus thuringiensis* var. kurstaki	5gm/liter	4.98	4.06	3.61	3.18	3.61
T_4	Karanj oil	5%	5.32	4.34	4.28	4.10	4.24
T_5	Panchagavya	5%	5.01	4.58	4.31	3.96	4.28
T_6	NSKE	5%	5.34	4.43	4.10	3.55	4.02
T_7	*Beauvaria bassiana*	5gm/liter	4.10	3.21	3.03	2.58	2.94
T_8	*Metarrhizium anisopliae*	5gm/liter	5.05	4.17	3.99	3.50	3.88
T_9	Water control	---------	6.51	6.76	7.16	7.76	7.23
	CD		0.678	0.829	0.939	0.637	0.520
	SE(m)		0.224	0.274	0.311	0.211	0.172

Table 3. Effect of treatment on population of red pumpkin beetle after third spray

T.no	Treatments	Doses	Mean population of beetle				Mean
			Before	3DAS	7DAS	14DAS	
T_1	Neem oil	2%	3.41	2.40	2.07	1.00	1.82
T_2	Garlic bulb extract	5%	5.56	4.04	3.86	3.86	3.92
T_3	*Bacillus thuringiensis* var. kurstaki	5gm/liter	3.79	2.37	2.16	1.20	1.91
T_4	Karanj oil	5%	4.43	3.84	3.45	2.40	3.23
T_5	Panchagavya	5%	4.29	3.90	3.33	2.80	3.34
T_6	NSKE	5%	3.76	2.95	2.50	2.00	2.48
T_7	*Beauvaria bassiana*	5gm/liter	2.79	2.14	1.96	0.98	1.69
T_8	*Metarrhizium anisopliae*	5gm/liter	3.57	2.53	2.31	1.86	2.23
T_9	Water control	---------	7.82	7.97	8.12	8.39	8.16
	CD		0.706	0.546	0.508	0.389	0.575
	SE(m)		0.233	0.180	0.168	0.129	0.190

Table 4. Economics of cultivation and yields

T.No.	Treatments	Yield Qt/h	Cost of yield(Rs)	Common cost(Rs)	Treatment cost(Rs)	Total cost(Rs)	Net Income (Rs)	C:B ratio
T_1	Neem oil	412.5	495000	88800	16200	105000	390000	1:3.71
T_2	Garlic bulb extract	248.10	297720	88800	3150	91950	205770	1:2.23
T_3	*Bacillus thuringiensis* var. kurstaki	400.10	480120	88800	4950	93750	386370	1:4.12
T_4	Karnaj oil	281.5	337800	88800	21240	110040	227760	1:2.06
T_5	Panchgavya	262.1	314520	88800	10800	99600	214920	1:2.15
T_6	NSKE	362.1	434520	88800	10800	99600	334920	1:3.36
T_7	*Beauvaria bassiana*	442.21	530652	88800	5175	93975	436677	1:4.64
T_8	*Metarrhizium anisopliae*	381.02	457224	88800	4050	92850	364374	1:3.92
T_9	Water control	182.1	218520	88800		88800	129720	1:1.46

4. CONCLUSION

The above field experiment concluded with *Beauvaria bassiana* was found best effective to control red pumpkin beetle population followed by Neem oil and *Bacillus thuringiensis*, so we can use the bio-pesticides as alternative of chemical insecticide to avoid their harmful effect and with eco-friendly manner.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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