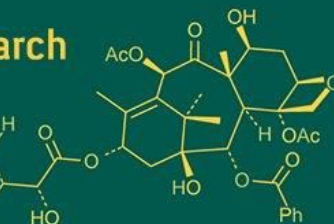
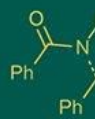
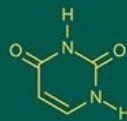
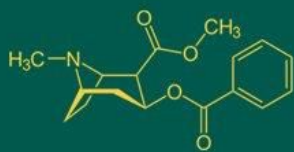


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Bio-efficacy of biorationals and newer insecticides against diamondback moth (*Plutella xylostella* Linn.) in cabbage

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Abstract

The field experiment was conducted during *rabi*, 2024-25 at the research farm of Krishi Vigyan Kendra, Dhule. Evaluated the efficacy of biorationals and newer insecticides against diamondback moth (*Plutella xylostella* Linn.) on cabbage. The eight treatments, Chlorantraniliprole 18.5% SC, Spinetoram 11.7% SC, Spinosad 45% SC, Emamectin benzoate 5% SG, *Beauveria bassiana* 1.15% WP, *Bacillus thuringiensis* var. *kurstaki* 0.50% WP, Neem Arka 10000 ppm and untreated control were used on three replications in randomized block design. The mean survival population of diamondback moth larvae revealed that chlorantraniliprole 18.5% SC @ 150 ml/ha demonstrated superior efficacy, consistently resulting in the lowest larval population. It was however, statistically similar to spinosad 45% SC @ 200 ml/ha. In order of effectiveness, the next was spinetoram 11.7% SC @ 500 ml/ha which was statistically at par with emamectin benzoate 5% SG @ 200 g/ha. Among biorationals *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @500 g/ha was the effective treatment followed by neem arka 10000ppm @1000 ml/ha and *Beauveria bassiana* 1.15% WP @2000 g/ha.

Keywords: Diamondback moth, Cabbage, biorationals, newer insecticides

Introduction

Cruciferous vegetables have an important place among *rabi* crops grown in India. Cabbage (*Brassica oleracea* var *capitata* Linn.) belonging to the family Brassicaceae. It is cultivated extensively in the tropical and temperate regions of the world including India. (Ananda *et al.*, 2017) [1] It is grown for its edible enlarged terminal buds known as head, which is rich in sources of vitamin A (2000 I.U.), B1 (50 I.U.), and C (124 mg/100 gm). Cabbage is an excellent source of minerals such as calcium 39 mg, iron 0.8mg, magnesium 10 mg, sodium 14.1mg potassium 114mg and phosphorus 44 mg. (Kumar *et al.*, 2024) [8] It can be grown in wide range of sandy to heavy soils. The optimum pH of soil for cultivation is between 6.0-6.5.

One of the key problems for the gainful growing of cabbage is insect infestations mainly insect pests, and diseases. The crop is attacked by a number of insects *viz*, tobacco leaf eating caterpillar (*Spodoptera litura* Fab), diamondback moth (*Plutella xylostella* Linn.), cabbage leaf webber (*Crociodolomia bionotalis* Zeller.), aphids (*Brevicornye brassicae* Linn. and *Liphaphis Erysimi* Linn.), painted bug (*Bagrada cruciferarum* Linn.) and crop is affected from sowing to harvest. (Rao and Lal, 2005) [9]

The diamondback moth (*P. xylostella*) called cabbage moth is a major insect pest in more than 100 countries across the globe. In India, diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield also reported that there is 52% loss in yield due to the attack of diamondback moth. (Gautam *et al.*, 2018) [4] The moth has a short life cycle (14 days at 25 °C). The moth is brownish grey in colour, have three pale whitish triangular spots on their hind margins of forewings which form a diamond pattern when the insect is at rest with wings folded along body. Hence, the name “diamondback moth” (Sharma *et al* 2022) [10]. The adult is active at dusk and throughout the night. The caterpillar bores into the head and damages the head thus causing qualitative and quantitative losses. Reliance on chemicals as the control measure has developed resistance to many insecticides in diamondback moth due to ability of the pest to migrate long distances, high

fecundity, short life cycle, absence of effective natural enemies (Gautam *et al.*, 2018)^[4].

This highlights the need for more sustainable and responsible pest management practices. It is therefore, essential to adopt a thoughtful approach using chemicals with new mode of actions. Several insecticides offer novel modes of action, differing from traditional ones, providing the alternative solutions for pest management. Due to the significant pest infestation and consequent damage to cabbage crop, this study was conducted under the title “Bio-efficacy of biorationals and newer insecticides against diamondback moth (*Plutella xylostella* Linn.) on cabbage”

Materials and Methods

The present investigation on bio-efficacy of biorationals and newer insecticides against diamondback moth on cabbage was carried out at the Agricultural farm of Krishi Vigyan Kendra, Dhule (Maharashtra)- 424004 during *rabi* 2024-25. The field was uniform with typical black cotton soil having good drainage. The cabbage crop (variety: Euro 2) was sown on 27th October 2024 and transplanted on 19th November 2024, with a spacing of 90 x 30 cm². The crop was cultivated following the standard agronomic practices in Maharashtra, India. For taking counts of the number of larvae of diamondback moth, five plants were selected randomly in each plot and were tagged. The number of larvae of diamondback moth were counted per plant on tagged plants. The observations were made at one day before spraying as a pre-treatment count and 3, 7 and 14 days after spray as post count. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments replicated three times.

Results and Discussion

Evaluation of biorationals and newer insecticides against diamondback moth on cabbage

Efficacy of biorationals and newer insecticides on survival population of DBM larvae of cabbage after first spray

The data presented in table no. 1 showed that all the

treatments significantly reduced the larval population of diamondback moth as against the untreated control. At 3 DAS the plot treated with chlorantraniliprole 18.5% SC recorded significantly lowest larval population of 2.61 larvae/plant. The next effective treatment was spinosad 45% SC @ 200 ml/ha (3.20 larvae/plant) which was statistically at par with emamectin benzoate 5% SG @ 200 g/ha (3.27 larvae/plant) and spinetoram 11.7% SC @ 500 ml/ha (3.32 larvae/plant). Followed by *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (4.53 larvae/plant), neem arka 10000ppm @ 1000 ml/ha (4.93 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (5.02 larvae/plant). The highest population was recorded in untreated plot (5.16 larvae/plant). At 7 DAS, the plot treated with chlorantraniliprole 18.5% SC @ 150 ml/ha (1.53 larvae/plant) was significantly most effective followed by spinosad 45% SC @ 200 ml/ha (2.25 larvae/plant) which was statistically at par with emamectin benzoate 5% SG @ 200 gm/ha (2.63 larvae/plant) and spinetoram 11.7% SC @ 500 ml/ha (2.77 larvae/plant). Next were *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (3.33 larvae/plant) was statistically at par with neem arka 10000ppm @ 1000 ml/ha (3.67 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (4.00 larvae/plant). And the highest population was recorded in untreated plot (5.58 larvae/plant). At 14 DAS, significantly, lowest population was recorded from chlorantraniliprole 18.5% SC @ 150 ml/ha (2.13 larvae/plant) treated plot and was statistically at par with spinosad 45% SC @ 200 ml/ha (2.77 larvae/plant). Followed by spinetoram 11.7% SC @ @ 500 ml/ha (3.01 larvae/plant) which was statistically at par with emamectin benzoate 5% SG @ 200 g/ha (2.80 larvae/plant) and *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (3.76 larvae/plant), followed by neem arka 10000ppm @ 1000 ml/ha (4.13 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (4.35 larvae/plant). The highest population was recorded in untreated control (6.37 larvae/plant).

Table 1: Efficacy of biorationals and newer insecticides on survival population of DBM larvae of cabbage after first spray

SN	Treatment details	Dose formulated product g-ml/ha	Survival population of DBM larvae per plant at				Mean
			Pre count	3 DAS	7 DAS	14 DAS	
T ₁	Chlorantraniliprole 18.5% SC	150 ml	4.87 (2.32)	2.61 (1.76)	1.53 (1.43)	2.13 (1.62)	2.09 (1.61)
T ₂	Spinetoram 11.7% SC	500 ml	4.92 (2.33)	3.32 (1.95)	2.77 (1.81)	3.01 (1.87)	3.03 (1.88)
T ₃	Spinosad 45% SC	200 ml	5.06 (2.36)	3.20 (1.92)	2.25 (1.66)	2.77 (1.81)	2.74 (1.80)
T ₄	Emamectin benzoate 5% SG	200 g	5.45 (2.44)	3.27 (1.97)	2.63 (1.77)	3.80 (2.07)	3.23 (1.93)
T ₅	<i>Beauveria bassiana</i> 1.15% WP	2000 g	5.00 (2.35)	5.02 (2.35)	4.00 (2.12)	4.35 (2.20)	4.45 (2.22)
T ₆	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> 0.50% WP	500 g	4.89 (2.32)	4.53 (2.24)	3.33 (1.96)	3.76 (2.06)	3.87 (2.09)
T ₇	Neem Arka 10000 ppm	1000 ml	5.11 (2.37)	4.93 (2.33)	3.67 (2.04)	4.13 (2.15)	4.24 (2.18)
T ₈	Untreated control	--	5.19 (2.39)	5.16 (2.38)	5.58 (2.47)	6.37 (2.62)	5.70 (2.49)
	S.Em. ±		0.28	0.05	0.06	0.07	0.05
	C.D. at 5%		NS	0.15	0.21	0.20	0.16

DAS- days after spray

Figures in parenthesis are square root transformed values

Efficacy of biorationals and newer insecticides on survival population of DBM larvae of cabbage after second spray

The data illustrated in table no. 2 showed that all the treatments significantly reduced the larval population of diamondback moth as against the untreated control. At 3 DAS after second application significantly, the lowest larval population was recorded in the treatment with chlorantraniliprole 18.5% SC @ 150 ml/ha (1.18 larvae/plant) and was statistically at par with spinosad 45% SC @ 200 ml/ha (1.53 larvae/plant). Followed by spinetoram 11.7% SC @ 500 ml/ha (1.84 larvae/plant) statistically at par with emamectin benzoate 5% SG @ 200 g/ha (2.14 larvae/plant). Thereafter, *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (3.03 larvae/plant) was statistically at par with neem arka 10000ppm @ 1000 ml/ha (3.35 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (3.73 larvae/plant). The untreated control recorded highest number of larval population (6.60 larvae/plant). At 7 DAS, the treatment with chlorantraniliprole 18.5% SC @ 150 ml/ha (0.44 larvae/plant) recorded significantly lowest number of larval population and was statistically at par with spinosad 45%

SC @ 200 ml/ha (0.68 larvae/plant). Followed by spinetoram 11.7% SC @ 500 ml/ha (1.02 larvae/plant) statistically at par with emamectin benzoate 5% SG @ 200 g/ha (1.10 larvae/plant) and *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (1.22 larvae/plant). The next effective treatment were neem arka 10000ppm @ 1000 ml/ha (1.82 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 gm/ha (2.20 larvae/plant). The untreated control recorded highest number of larval population (7.20 larvae/plant). At 14 DAS, significantly the lowest larval population was recorded in the treatment with chlorantraniliprole 18.5% SC @ 150 ml/ha (0.86 larvae/plant) and was statistically at par with spinosad 45% SC @ 200 ml/ha (1.02 larvae/plant), spinetoram 11.7% SC @ 500 ml/ha (1.14 larvae/plant) and emamectin benzoate 5% SG @ 200 g/ha (1.28 larvae/plant). Followed by *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (1.46 larvae/plant), neem arka 10000ppm @ 1000 ml/ha (1.50 larvae/plant) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (1.54 larvae/plant) which shown significant reduction. The untreated control recorded highest number of larval population (7.80 larvae/plant).

Table 2: Efficacy of biorationals and newer insecticides on survival population of DBM larvae of cabbage after second spray

SN	Treatment details	Dose formulated product g-ml/ha	Survival population of DBM larvae per plant at			Mean
			3 DAS	7 DAS	14 DAS	
T ₁	Chlorantraniliprole 18.5% SC	150 ml	1.18 (1.30)	0.44 (0.99)	0.86 (1.17)	0.83 (1.15)
T ₂	Spinetoram 11.7% SC	500 ml	1.84 (1.53)	1.02 (1.23)	1.14 (1.28)	1.33 (1.35)
T ₃	Spinosad 45% SC	200 ml	1.53 (1.43)	0.68 (1.09)	1.02 (1.23)	1.08 (1.26)
T ₄	Emamectin benzoate 5% SG	200 g	2.14 (1.62)	1.10 (1.26)	1.28 (1.33)	1.51 (1.42)
T ₅	<i>Beauveria bassiana</i> 1.15% WP	2000 g	3.73 (2.06)	2.20 (1.64)	1.54 (1.43)	2.49 (1.73)
T ₆	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> 0.50% WP	500 g	3.03 (1.88)	1.22 (1.31)	1.46 (1.40)	1.90 (1.55)
T ₇	Neem Arka 10000 ppm	1000 ml	3.35 (1.96)	1.82 (1.52)	1.50 (1.41)	2.22 (1.65)
T ₈	Untreated control	--	6.60 (2.66)	7.20 (2.77)	7.80 (2.88)	7.20 (2.77)
	S.E.m. $\pm$		0.06	0.06	0.05	0.09
	C.D. at 5%		0.19	0.20	0.16	0.26

DAS- days after spray

Figures in parenthesis are square root transformed values

Cumulative effect of biorationals and newer insecticides on survival population of DBM larvae of cabbage (average of two sprays)

The mean of observations presented in table no 3 indicated that treatment with chlorantraniliprole 18.5% SC @ 150 ml/ha demonstrated significantly superior efficacy, consistently resulting in the lowest larval population (1.90, 0.99 and 1.37 larvae plant⁻¹) at 3, 7 and 14 days after spray, respectively and was statistically at par with spinosad 45% SC @ 200 ml/ha (2.37, 1.46 and 1.90 larvae plant⁻¹). Followed by spinetoram 11.7% SC @ 500 ml/ha (2.58, 1.86 and 2.08 larvae plant⁻¹) which was statistically at par with emamectin benzoate 5% SG @ 200 g/ha (2.75, 1.86 and 2.64 larvae plant⁻¹). *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @ 500 g/ha (3.97, 2.28 and 2.72 larvae plant⁻¹) was the next effective treatment followed by neem arka

10000ppm @ 1000 ml/ha (4.14, 2.75 and 2.95 larvae plant⁻¹) and *Beauveria bassiana* 1.15% WP @ 2000 g/ha (4.37, 3.10 and 3.13 larvae plant⁻¹). *Beauveria bassiana* 1.15% WP @ 2000 g/ha was the least effective treatment among all the treated plots. Highest larval population was recorded in untreated control.

These results are in agreement with those of Ganesh *et al.*, (2024) [3] who reported that chlorantraniliprole treated plot showed lowest larval population of *Plutella xylostella* and is followed by spinosad. Similar results are in conformity with Verma *et al.*, (2024) [11]. According to Khan *et al.*, (2022), chlorantraniliprole recorded the lowest larval population of diamondback moth which was followed by spinosad, emamectin benzoate, *Bt*. Similar results were also reported by Jyoshna and Yadav (2023) [5], Divekar *et al* (2023) [2], Kommoji and Tayde (2022) [2].

Table 3: Cumulative effect of biorationals and newer insecticides on survival population of DBM larvae of cabbage (average of two sprays)

SN	Treatment details	Dose formulated product g-ml/ha	Survival population of DBM larvae per plant at			Mean
			3 DAS	7 DAS	14 DAS	
T ₁	Chlorantraniliprole 18.5% SC	150 ml	1.90 (1.55)	0.99 (1.22)	1.37 (1.46)	1.42 (1.39)
T ₂	Spinetoram 11.7% SC	500 ml	2.58 (1.75)	1.86 (1.55)	2.08 (1.55)	2.17 (1.64)
T ₃	Spinosad 45% SC	200 ml	2.37 (1.69)	1.46 (1.40)	1.90 (1.50)	1.91 (1.55)
T ₄	Emamectin benzoate 5% SG	200 g	2.75 (1.80)	1.86 (1.54)	2.64 (1.59)	2.42 (1.71)
T ₅	<i>Beauveria bassiana</i> 1.15% WP	2000 g	4.37 (2.21)	3.10 (1.90)	3.13 (1.66)	3.53 (2.01)
T ₆	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> 0.50% WP	500 g	3.79 (2.07)	2.28 (1.67)	2.72 (1.60)	2.93 (1.85)
T ₇	Neem Arka 10000 ppm	1000 ml	4.14 (2.15)	2.75 (1.80)	2.95 (1.66)	3.28 (1.94)
T ₈	Untreated control	--	5.88 (2.53)	6.39 (2.62)	7.08 (2.73)	6.45 (2.64)
S.Em. ±			0.05	0.05	0.04	0.06
C.D. at 5%			0.15	0.14	0.12	0.18

DAS- days after spray

Figures in parenthesis are square root transformed

Yield

The significant cabbage head yield (Table 4) was recorded among different treatments. All the biorationals and newer insecticide treatments produced more yield over the untreated plot. A significant maximum cabbage head yield was recorded in chlorantraniliprole 18.5% SC @150 ml/ha (210.24 q/ha) treated plot. However, it was followed by spinetoram 11.7% SC @500 ml/ha (182.84 q/ha), spinosad 45% SC @200 g/ha (176.44 q/ha) and emamectin benzoate 5% SG @200 g/ha (172.24 q/ha). The treatment with

Bacillus thuringiensis var. *kurstaki* 0.50% WP @500 g/ha (164.44 q/ha), neem arka 10000ppm @1000 ml/ha (151.33 q/ha) and *Beauveria bassiana* 1.15% WP @2000 g/ha (140.88 q/ha) found moderate yield. The untreated control produced only 122.22 q/ha yield.

Similar findings were recorded by Khan *et al.*, (2022) ^[6] who reported that the highest yield was obtained from the chlorantraniliprole 18.5% SC treated plot. Ganesh *et al.*, (2024) ^[3] also recorded highest yield in the treatment chlorantraniliprole 18.5% SC.

Table 4: Effect of different biorationals and newer insecticides on marketable yield of cabbage

Tr. No.	Treatments	Dose formulated product g-ml/ha	Marketable Yield	
			Kg plot-1	q ha ⁻¹
1	Chlorantraniliprole 18.5% SC	150 ml	29.33	210.24
2	Spinetoram 11.7% SC	500 ml	25.51	182.84
3	Spinosad 45% SC	200 ml	24.61	176.44
4	Emamectin benzoate 5% SG	200 g	24.03	172.24
5	<i>Beauveria bassiana</i> 1.15% WP	2000 g	19.65	140.88
6	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> 0.50% WP	500 g	22.94	164.44
7	Neem Arka 10000 ppm	1000 ml	21.11	151.33
8	Control (Untreated)	--	17.05	122.22

Conclusion

Among the tested biorationals and newer insecticides, the treatment with chlorantraniliprole 18.5% SC @ 150 ml/ha demonstrated significantly superior efficacy, consistently resulting in the lowest larval population at 3, 7 and 14 days after spray, respectively. It was however, statistically similar to spinosad 45% SC @ 200 ml/ha. In order of effectiveness, the next was spinetoram 11.7% SC @ 500 ml/ha which was statistically at par with emamectin benzoate 5% SG @ 200 g/ha. Among the biorationals tested, *Bacillus thuringiensis* var. *kurstaki* 0.50% WP @500 g/ha was the effective treatment followed by neem arka 10000ppm @1000 ml/ha and *Beauveria bassiana* 1.15% WP @2000 g/ha. Highest larval population was recorded in untreated control. The highest yield was recorded in chlorantraniliprole 18.5% SC (210.24 q/ha) treated plot.

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References

- Ananda A, Devi AB, Singh A, Barik S, Bairwa MK. Cabbage (*Brassica oleracea* L. var. *capitata*) rare ball introduction with knol khol and broad bean intercropping: yield efficiency under foot hills of Imphal-West. *Pharma Innov J.* 2017;6:339-41.

2. Divekar PA, Patel SK, Manimurugan C, Kushwaha M, Singh V. Bio-efficacy of newer insecticides against the lepidopteran insect-pests in cabbage. *Pharma Innov J*. 2023;12(8):2810-3.
3. Ganesh A, Rajnikant TA. Comparative efficacy of selected insecticides against diamond back moth, *Plutella xylostella* (L.) in cabbage, *Brassica oleracea* var. *capitata* (L.). *Ann Plant Prot Sci*. 2024;32(1):20-4.
4. Gautam MP, Singh H, Kumar S, Kumar V, Singh G, Singh SN. Diamondback moth, *Plutella xylostella* (Linnaeus) (Insecta: Lepidoptera: Plutellidae) a major insect of cabbage in India: a review. *J Entomol Zool Stud*. 2018;6(4):1394-9.
5. Jyoshna M, Yadav U. Efficacy of selected insecticides with botanicals and bio agents against diamondback moth, *Plutella xylostella* (L.) in cabbage, *Brassica oleracea* var. *capitata* (L.). *Int J Environ Clim Change*. 2023;13(9):2129-34.
6. Khan SAR, Mohite PA. Field evaluation of certain chemical insecticides and bioagents against diamondback moth, (*Plutella xylostella* L.) on cabbage (*Brassica oleracea* var. *capitata* L.): an investigational research. *Emerg Issues Agric Sci*. 2022;1:1-10.
7. Kommaji T, Tayde AR. Efficacy of newer selected insecticides, *Beauveria bassiana* and neem oil against diamond back moth (*Plutella xylostella* L.) in cabbage (*Brassica oleracea* var. *capitata*). *Int J Plant Soil Sci*. 2022;34(20):485-91.
8. Kumar R, Yadav K, Gangwar B, Sharma V. Population dynamics of major lepidopteran insect pests on cabbage (*Brassica oleracea* var. *capitata*). *Int J Adv Biochem Res*. 2024;8(8):832-5.
9. Rao SRK, Lal OO. Seasonal incidence of mustard aphid, *Lipaphis erysimi* (Kalt) and diamond back moth, *Plutella xylostella* (L.) on cabbage. *J Insect Sci*. 2005;18(2):106-10.
10. Sharma P, Sharma A, Jat SM, Kumawat KC, Badriprasad. Toxic effect of different insecticides on coccinellid beetle, *Coccinella septempunctata* in cabbage ecosystem. *Pharma Innov J*. 2022;11(1):1383-5.
11. Verma RK, Singh SK, Sharma KR, Chandra U, Yadav PK. Bio-efficacy of chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC and some sole insecticides against lepidopteran borers in cabbage. *Ann Plant Soil Res*. 2024;26(1):136-42.