Evaluating the efficacy of selected insecticides on diamondback moth (*Plutellaxylostella*) damagingcabbage (*Brassica oleracea*)

ABSTRACT:

A field investigation was carried out in *Rabi* season of 2022-2023 at the Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India to evaluate the efficacy of some selected pesticides on controlling diamondback moth that causes yield loss of cabbage. The experiment was laid in Randomized Block Design (RBD) with eight treatments each replicated thrice using a single variety Green Soccer. The treatments *viz.* NSKE 5% @50 ml/L, Spinosad 45% SC @0.35 ml/L, Emamectin Benzoate 5% SG @0.5 g/L, Neem oil 5% @50 ml/L, Dimethoate 30% EC @1 ml/L, Indoxacarb 14.5% SC @ 0.5 g/L,Cartap Hydrochloride 50% SP @0.5ml/L, and along with an untreated control was used against *Plutellaxylostella*in Cabbage. The overall mean data on larval population of diamond back moth over control on first and second spray revealed that all treatments were significantly superior over control. Among all the treatments Spinosad 45% SC showed the lowest mean larval population (2.04 %), (0.93 %) followed by Emamectin benzoate 5% SG (2.22 %) (1.06 %),Indoxacarb 14.5% SC (2.66 %) (1.37 %),Cartap Hydrochloride 50% SP (3.20 %) (1.86 %),Dimethoate 30% EC (3.48 %) (2.02 %), and NSKE 5% (4.08 %) (2.33 %), Neem oil 5% (3.82 %), (2.37 %) and highest population was recorded in control (8.13 %), (7.73 %). The highest yield and cost benefit ratio recorded in Spinosad 45% SC (296 q/ha) (1:5.7) followed by Emamectin benzoate 5% SG (264 q/ha) (1:6.2), Indoxacarb 14.5% SC (249 q/ha) (1:5.0), Cartap Hydrochloride 50% SP (215 q/ha) (1:4.8) followed by Dimethoate 30% EC (194 q/ha) (1:4.4), Neem oil 5% (178 q/ha), (1:3.9) and NSKE 5% (170 q/ha) (1:3.8) and control (102 q/ha) (1:2.5). The information obtained in this study has the potential application for controlling diamondback moth and will be useful to the farmers and researchers.

Key word: Cabbage, Efficacy, Emamectin Benzoate, Indoxacarb, *Plutellaxylostella*, Spinosad.

INTRODUCTION

"Following cauliflower in importance, cabbage is the second most important crop that originated in Europe and the Mediterranean area. In India, cabbage is one of the most widely consumed winter veggies. *Brassica oleraceavarcapitata L.* is the Latin name for cabbage in vegetation.Following cauliflower in importance, cabbage is the second most important crop that originated in Europe and the Mediterranean area. In India, cabbage is one of the most widely consumed winter veggies. *Brassica oleraceavarcapitata L.* is the Latin name for cabbage in vegetation". [18]

The word "caboche," which in French refers to the vegetable's circular appearance, is where the English word "cabbage" originates. Wounds and sores were covered with cabbage leaves. It is claimed to be beneficial for those with diabetes and to aid with dyspepsia.**(Maity*et al.*, 2018).**

"Widespread usage of cabbage in traditional medicine includes treating minor cuts and wounds, mastitis, and symptoms related to gastrointestinal disorders (peptic and duodenal ulcers, gastritis, irritable bowel syndrome)".**(Rokayya*et al.*, 2013).**

Bowel cancer is prevented by cabbage because it contains indole-3-carbinol, which has anti-cancer properties. According to Kumar and Kumar (2020), this plant is recognised for its therapeutic qualities and has larger terminal buds that are a great source of calcium, phosphorus, sodium, potassium, sulphur, vitamin C, and dietary fibre. "In 100 grammes of cabbage, there are 25 grammes of calories, 0 grammes of fat, 18 mg of sodium, 0 mg of cholesterol, 170 grammes of potassium, 6 grammes of carbohydrates, 1.3 grammes of protein, 1% of vitamin A, 60% of vitamin C, 4% of calcium, 2% of iron, 5% of vitamin B6, and 3% of potassium".**(Alexandra *et al.*, 2020).**

With a production share of 25.32 percent, West Bengal leads India in the production of cabbage globally with 2288.50 tonnes, followed by Orissa with 1058.78 tonnes, Madhya Pradesh with 686.91 tonnes, Bihar with 673.44 tonnes, and Uttar Pradesh with 302.97 tonnes **(National Horticultural Board, 2017-2018)**.

"The insect-pests *viz*., diamond back moth (*Plutellaxylostella*Linnaeus), cabbage butterfly (*Pierisbrassicae*Linnaeus), tobacco caterpillar (*Spodopteralitura*Fabricius), cabbage semilooper (*Trichoplusiani*Hubner), aphid (*Brevicorynebrassicae*Linnaeus), painted bug (*Bagradacruciferarum*Kirkaldy), cabbage leaf webber (*Crocidolomiabinotalis*Zeller), cabbage head borer (*Hellulaundalis*Fabricius), cabbage flea beetle (*Phyllotretacruciferae*Goeze) and Bihar hairy caterpillar (*Spilosomaobliqua*Walk)are frequently found on cabbage during various seasons and result in significant losses".**(Patait*et al.*, 2008).**

"There is a two- to four-day range for the egg period (incubation time). The larva went through four distinct stages of development. With a total larval period of 7 to 12 days, the first, second, third, and fourth instar larvae lived for 2 to 3 days, 2 days, 1 to 3 days, and 2 to 4 days, respectively. One to two days and three to five days, respectively, were spent in the pre-pupal and pupal stages. Under laboratory conditions, the adults' lifespan ranged from 3 to 7 days, while the overall duration varied between 13 and 22 days". **(Harika*et al*., 2019).** Estimated that the diamond back moth caused losses in commercial output of almost 52%. In the event of a significant diamondback moth infestation on cabbage, losses could exceed 80%. According to **(Kumar and Kumar 2020),** cabbage semiloopers caused 70.63 percent of the damage, with yield losses of up to 64–78 percent. *H. undalis* is a pest that causes havoc with cauliflower and cabbage. It is available all over India and around the world. Usually, reports of it concern mustard, radish, cauliflower, cabbage, and turnips.

Materials and Methods:

The experiment was conducted during *Rabi* season 2022-23 at the Central Research Farm (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India, in a Randomized Block Design with eight treatments replicated three times using a local variety in a plot size of (2m×1m) at a spacing of (45×30 cm) with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. The treatments used in this experiment were *viz.*, NSKE 5% (50 ml/lit), Spinosad 45% SC (0.35 ml/lit), Emamectin benzoate 5% SG (0.5 g/lit), Neem oil 5% (50 ml/lit), Dimethoate 30% EC (1 ml/lit), Indoxacarb 14.5% SC (0.5 g/lit), cartap hydrochloride 50% SP (0.5 ml/lit) and control. These treatments were applied in two sprays at a 15 days interval.

Five plants from each plot were randomly chosen and tagged to record the caterpillar population. Subsequently, the average of three replications was determined for every treatment, and the untreated plot underwent the same process. One day prior to spraying, as well as three, seven, and fourteen days following the application of insecticidal treatment, the *Plutellaxylostella* population was measured**.**

Benefit Cost Ratio:

Net returns were used to evaluate each treatment's cost-effectiveness. The entire cost of the therapy was subtracted from the gross returns to get the net return for each treatment. Plant protection fees and cultivation are included in the total cost of production..

Gross return = Marketable Yield x Market price

Net return = Gross return – Total cost

$$\text{B: C Ratio} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

(Harika*et al.*, 2019)

Result and Discussion:

Following the first and second sprays, the results (Table 1) showed that every treatment outperformed the control by a significant margin. Data on the larval population of *Plutellaxylostella*, the cabbage diamond back moth, after three, seven, and fourteen days following the initial spray showed that all treatments were significantly better than control.Out of all the treatments, the plot treated with Spinosad 45% SC (2.04) recorded least larval population as compared to the remaining treatments followed byEmamectin Benzoate 5% SG (2.22) and Indoxacarb 14.5% SC (2.66). Similarly,Cartap Hydrochloride 50% SP (3.20) recorded larval population followed by Dimethoate 30% EC (3.48), Neem oil 5% (3.82) and NSKE 5% (4.08).

Data on the larval population of *Plutellaxylostella*, the cabbage diamond back moth, at three, seven, and fourteen days following the second spray showed that all treatments were significantly better than control.Out of all the treatments, the plot treated withSpinosad 45% SC (0.93) recorded least larval population as compared to the remaining treatments followed by Emamectin Benzoate 5% SG (1.06) and Indoxacarb 14.5% SC (1.37). Similarly,Cartap Hydrochloride 50% SP (1.37), recorded larval population of followed by Dimethoate 30% EC (2.02), NSKE 5% (2.33) and Neem oil 5% (2.37).

There was a notable difference in yields between the various treatments. Every treatment outperformed the control. It was the largest yield ever recordedin Spinosad 45% SC (296 q/ha) followed by Emamectin Benzoate 5% SG (264 q/ha), Indoxacarb 14.5% SC (249 q/ha),Cartap Hydrochloride 50% SP (215 q/ha), Dimethoate 30% EC (194 q/ha), Neem oil

5% (178 q/ha) and NSKE 5% (170 q/ha) as compared to control plot (102 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Among the all treatments studied, the best and most economical treatment wasSpinosad 45% SC (1:5.7) followed byEmamectinBenzoate 5% SG (1:6.2), Indoxacarb 14.5% SC (1:5.0), Cartap Hydrochloride 50% SP (1:4.8),Dimethoate 30% EC (1:4.4), Neem oil 5% (1:3.9), NSKE 5% (1:3.8) and, as compared to control plot (1:2.5).

All treatments, with the exception of the untreated control, are equally successful, according to data on the mean larval population of the first and second sprays. The lowest diamond back moth larval population across all treatments was found inSpinosad 45% SC (1.48). Similar findingsmadeby**Venugopal*etal.*,(2017**)and**Reddy*etal.*,(2018**)**.**EmamectinBenzoate5%SG(1.645) is found to be the next best treatment which is in line with the findings of **Sujay*et al.*,(2015)andSharma*etal.*,(2017**)theyreportedthatEmamectinBenzoate5%SG(2.023)wasfoundmosteffectiveinreducinglarvalpopulationofdiamondbackmothaswellasincreasingtheyield.Indoxacarb 14.5% SC (2.534) is found to be the next best treatment which is in line with thefindingsof**StanikziandThakur(2016)andSharma*etal.*,(2017)**.CartapHydrochloride50%SP(2.756)isfoundtobethenexteffectivetreatmentwhichisinlinewiththefindings of **Lal *et al.*,(2021) and Bajpai*et al.*,(2014).** Dimethoate 30% EC (3.100) is found to bethe next effective treatment which is in line with the findings of **Thil*et al.*,(2017)**.

The yields among the different treatments were significant. All the treatments were superiorovercontrol.ThehighestyieldwasrecordedinSpinosad45%SC(296q/ha) similar findings of **Kumar and Kumar (2020), Harika*et al.*,(2019**), followedbyEmamectinBenzoate5%SG(264q/ha),These findings are supported by **Stanikzi and Thakur (2016), Kommoji and Tayde (2022).**Indoxacarb14.5%SC(249q/ha),similar findings of**Gaddam*et al.*, (2020).**

Conclusion:

The current study's findings demonstrated thatSpinosad 45 SC followed byEmamectin benzoate 5 SG, Indoxacarb 14.5SC, Cartap hydrochloride 50SP and Dimethoate 30 EC, are the most effective treatments against diamond back moth, *Plutellaxylostella*of cabbage andgenerated the highest yield and the highest Cost-Benefit ratio.NSKE 5% and Neem oil 5% found to be the least effective in controlling the diamondback moth, *Plutellaxylostella*in cabbage.

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Details of the AI usage are given below:

1.

2.

3.

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Table: 1 Efficacy of selected chemicals and neem oil against Diamond back moth, *Plutellaxylostella*on cabbage.

S.No	Treatments	Doses	Larvalpopulation of *Plutellaxylostella*										Yield	C:B ratio
			First spray					**Second spray**						
			1DBS	**3 DAS**	**7 DAS**	**14 DAS**	**Mean**	**1DBS**	**3 DAS**	**7 DAS**	**14 DAS**	**Mean**		
T_0	Control	——	4.93	8.00^{a}	8.26^{a}	8.13^{a}	8.13^{a}	8.13^{a}	7.53^{a}	7.93^{a}	7.73^{a}	7.73^{a}	102	1:2.5
T_1	NSKE 5%	50ml/L	5.20	4.53^{a}	3.60^{b}	4.13^{b}	4.08^{b}	4.13^{b}	2.66^{bc}	2.00^{b}	2.33^{bc}	2.33^{bc}	170	1:3.8
T_2	Spinosad 45% SC	0.35ml/L	5.00	2.53^{f}	1.73^{e}	1.86^{e}	2.04^{f}	1.86^{e}	1.20^{f}	0.66^{e}	0.93^{f}	0.93^{f}	296	1:5.7
T_3	Emamectin Benzoate 5% SG	0.5g/L	4.80	2.73^{ef}	1.80^{e}	2.13^{e}	2.22^{f}	2.13^{e}	1.33^{f}	0.80^{e}	1.06^{ef}	1.06^{ef}	264	1:6.2
T_4	Neem oil 5%	50ml/L	5.06	4.20^{bc}	3.33^{b}	3.93^{b}	3.82^{bc}	3.93^{b}	2.73^{b}	1.93^{b}	2.46^{b}	2.37^{b}	178	1:3.9
T_5	Dimethoate 30% EC	1ml/L	5.06	3.93^{cd}	3.00^{c}	3.53^{c}	3.48^{cd}	3.53^{c}	2.40^{cd}	1.60^{c}	2.06^{cd}	2.02^{cd}	194	1:4.4
T_6	Indoxacarb 14.5% SC	0.5g/L	4.53	3.00^{e}	2.26^{d}	2.73^{d}	2.66^{e}	2.73^{d}	1.73^{e}	1.06^{d}	1.33^{e}	1.37^{e}	249	1:5.0
T_7	Cartap Hydrochloride 50% SP	0.5ml/L	4.80	3.60^{d}	2.80^{c}	3.20^{c}	3.20^{d}	3.20^{c}	2.26^{d}	1.46^{c}	1.86^{d}	1.86^{d}	215	1:4.8
	F- test	-	NS	S	S	S	S	S	S	S	S	S		
	CD.at 0.05%		-	0.42	0.32	0.37	0.38	0.37	0.29	0.20	0.28	0.35		
	S. Ed. (+)		1.34	0.62	0.89	0.74	0.72	0.74	0.69	0.81	0.52	0.63		

DBS- Day Before Spraying, DAS- Day After Spraying, NS-Non-significant, S-Significant