Field efficacy of selected insecticides against diamond back moth, *Plutellaxylostella*(Linnaeus) on cabbage, *Brassica oleracea* (Linnaeus)

Assessing the Effectiveness of Insecticides on Controlling Diamond Back Moth (*Plutellaxylostella*) Infestations in Cabbage (*Brassica oleracea*): A Field Study

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ABSTRACT:

A field investigation was carried out in *Rabi* season 2022-2023 at Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experiment was laid in Randomized Block Design (RBD) with eight treatments each replicated thrice using a 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, Indoxacarb14.5% 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 data on larval population of diamond back moth over control on first and second spray overall mean revealed that all treatments were significantly superior over control. Among all the treatments Spinosad 45% SC showed 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).

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

INTRODUCTION

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Cabbage is the second most important cole crop, which originated in Europe and in the Mediterranean region after cauliflower. Cabbage is one of the most popular winter vegetables grown in India. The botanical name of cabbage is *Brassica oleraceavarcapitata*L.,

~~Family Crucifera and Chromosome number: 2n=18~~. The English name cabbage comes from the French caboche, meaning head referring to its round form. The cabbage leaves were used to cover ulcers and wounds. It is said to help indigestion and also said to be good for people suffering from diabetes **(Maity *et al.*, 2018).**

Cabbage has wide spread use in traditional medicine, in alleviation of symptoms associated with Gastrointestinal Disorders (gastritis, peptic and duodenal ulcers, irritable bowel syndrome) as well as in treatment of Minor cuts and wounds and Mastitis **(Rokayya*et al.*, 2013; Kumar and Choudhary, 2016).**

Cabbage has an anti-cancer property; it protects against bowel cancer due to presence of indole- 3-carbinol. It is known to possess medicinal properties and its enlarged terminal buds is a rich source of several minerals like Ca, P, Na, K, S, Vitamin A, Vitamin C and dietary fibre(Kumar et al., 2015). 100 gm of cabbage contains 25g of calories, 0 gm of fat, 18mg of sodium, cholesterol 0 mg, 170 gm of potassium, 6g of carbohydrate, 1.3 gm of protein, vitamin A 1%, vitamin C 60%, calcium 4%, iron 2%, vitaminB6 5%, mg 3% **(Alexandra *et al.*, 2020).**

In India, West Bengal accounts highest production of cabbage in the world which is 2288.50 tonnes, which has the share of 25.32 percent followed by Orissa 1058.78 tonnes, Madhya Pradesh 686.91 tonnes, Bihar 673.44 tonnes, and Uttar Pradesh 302.97 **(~~Source:~~ 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~~ Bihar hairy caterpillar (*Spilosomaobliqua*Walk) are observed commonly on cabbage in different seasons and cause considerable losses. **(Pataik*et al.*, 2008).**

The egg period (incubation period) varies from 2 to 4 days. The larva passed through four different instars. The first, second, third and fourth instar larva lived for 2 to 3 days, 2 days,1 to 3 days and 2 to 4 days, respectively with a total larval period of 7 to 12 days. The pre-pupal and pupal stage lasted for 1 - 2 days and 3 to 5 days, respectively. The adults lived for 3 to 7 days and the entire life span under laboratory conditions varied from 13 to 22 days. **(Harika *et al.*, 2019).** Estimated about 52% losses in marketable yield due to diamond back

moth. The losses could be more than 80% under severe infestation of diamondback moth on cabbage. **(Sachan and Srivastava, 1972)** recorded 70.63 % damage to cabbage due to cabbage semilooper with yield loss up to 64 to 78 %. *H. undalis*is a destructive pest of cabbage and cauliflower. Its distribution is worldwide and throughout India. It is usually reported on cabbage, cauliflower, turnip, radish and mustard**.**

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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.

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The population of caterpillars was recorded on 5 plants randomly selected and tagged from each plot. After that mean of three replications was calculated for each treatment and the same was done with the untreated plot. The population of *Plutellaxylostella*was recorded 1 day before spraying and on the 3rd day, 7th day and 14th day after insecticidal application.

Benefit Cost Ratio:

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment was worked out by deducting total cost of the treatment from gross returns. Total cost of production includes both cultivation as well as plant protection charges.

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Gross return = Marketable Yield x Market price

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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:

The results (Table: 1) after 1st and 2nd spray revealed that all the treatments were significantly superior over the control. The data on larval population of cabbage diamond back moth, *Plutellaxylostella*over control at 3rd, 7th and 14th day after first spray revealed that all the treatments were significantly superior over control. Among 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).

The data on larval population of cabbage diamond back moth, *Plutellaxylostella*over control at third, seventh and fourteen days after second spray revealed that all the treatments were significantly superior over control. Among 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).

The yields among the different treatments were significant. All the treatments were superior over control. The highest yield was recorded in 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 byEmamectin Benzoate 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).

Thedataonthemeanlarvalpopulationoffirstsprayandsecondspray,overallmeanrevealedth at all the treatments except untreated control are effective and at par. Among all the treatmentsleast larval population of diamond back moth was recorded in Spinosad 45% SC (1.48).

Similarfindingsmadeby**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)wasfoun

dmosteffectiveinreducinglarvalpopulationofdiamondbackmothaswellasincreasingtheyield.Indoxacarb 14.5% SC (2.534) is found to be the next best treatment which is in line with thefindingsof**StanikziandThakur(2016)andPurushotamSharma*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.Thehighestyieldwasrecordedin Spinosad 45% 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:

From the present study, the results showed that Spinosad 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*on cabbage and produced maximum yield and recorded the highest Cost-Benefit ratio compared to other treatments. NSKE 5% and Neem oil 5% found to be the least effective in managing the pests of diamond back moth, *Plutellaxylostella*on cabbage.

Declare
conflict of Interest:

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

S.No	Treatments	Doses	Larval population 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