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SHORT NOTE

FIELD EVALUATION OF INDOXACARB 14.5% SC AGAINST DIAMOND BACK MOTH, *Plutella xylostella* Linn. ON CABBAGE AND IT'S PHYTOTOXICITY

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Cabbage, *Brassica oleracea* var. *capitata* (Linn.) is an important vegetable crop of cruciferous group and is widely grown all over the country. In India, cabbage and cauliflower are important cole crops grown on about 0.438 million hectares, producing about 6.335 million tonnes per annum (Mohan and Gujar, 2003). The cabbage crop was cultivated in India on 0.27 million hectares with an annual production of 5.7 million tonnes (Kumar *et al*., 1983). The crop is attacked by a number of insect pests at various stages of crop growth and among them the diamondback moth, *Plutella xylostella* Linn. (Lepidoptera: Plutellidae) is the most serious pest. Larvae of the diamondback moth cause damage to leaves and head of the crop, by feeding on them. Its control is very difficult as it is an internal feeder. This insect causes an average of 52 percent loss to marketable yields of cabbage (Kumar *et al*., 1983) and can even destroy the entire crop (Gujar, 1999). Mohan and Gujar (2003) estimated that the diamondback moth could cause an annual loss of about $16 million on the basis of 2.5% damage even on the protected crop. In recent past, several studies revealed the development of pest resistance to various commonly used insecticides. Therefore, the present work was carried out for evaluating the efficacy of various doses of indoxacarb 14.5 SC, synthetic pyrethroid (cypermethrin 25 EC) and quinalphos 25% EC in order to evolve optional need based insecticidal schedule without causing any deleterious effect on the environment.

Field trials were conducted for testing the efficacy of different doses of indoxacarb 14.5% SC and other insecticides during *Rabi* season of 2004-05 at Horticulture Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) for control of diamondback moth, *P. xylostella* on cabbage. The experiment was laid out in simple Randomized Block Design (RBD) with eight treatments including control, each replicated three times. The one month old seedlings of cabbage variety, "Golden acre" were transplanted in plots measuring 5.4 X 4.2 m with 60cm X 45cm spacing. Knapsack sprayer (spray fluid 350 litres ha^{-1} during early stage and 500 litres ha^{-1} during latter stage of the crop growth) was used for spraying the insecticides on the crop. The treatments included were indoxacarb 14.5% SC @ 30, 40, 50 and 75 g a.i. ha^{-1}, indoxacarb 14.5% SC (Avaunt) @ 30 g a.i. ha^{-1}, one synthetic pyrethroid cypermethrin 25% EC @ 75 g a.i. ha^{-1} and

quinalphos 25% EC @ 500 g a.i. ha^{-1}. Three sprays of above treatments were given during crop season, first insecticidal spraying was done one month after transplanting and continued thereafter at 15 days interval. Pre treatment larval population was recorded one day before the sprays scheduled and post treatment observations were recorded on larval population of *P. xylostella* from ten randomly selected plants from each plot on 3rd, 7th, 10th and 14th days after application of each spray. For recording yield data, only marketable head were taken into account, actual yield from net plot was recorded and then qt ha^{-1} yield was calculated. For interpretation, the data on larval population of *P. xylostella* at definite time intervals thus collected were transformed ($\sqrt{x}$ + 0.50) and subjected to analysis of variance. The mean population of larvae in all the treatments and sprays was compared after calculating the critical difference.

To study phytotoxicity, the cabbage plants were also grown in pots with five replications. Different doses of indoxacarb 14.5% SC @ 40, 50, 75, 100, 150 and 200 g a.i. ha^{-1} were sprayed on plant and burning symptoms such as lesion on leaves, dryness of plants/cabbage head etc. were recorded and classified in four categories as described by Kavadia and Gupta (1986).

1. Mild (+) : Few lesions on leaflet or less than 20 per cent leaflets of plants showing burning symptoms.
2. Moderate (++) : Between 20-50 per cent leaflets of the plants showing burning symptoms.
3. Severe (+++) : More or less all the leaflets and head of the cabbage plants showing burning symptoms (50-100%).
4. Most severe (++++) : Complete mortality of the plant

The eight treatments (including control) were evaluated against diamondback moth, *P. xylostella* on cabbage and the efficacy of treatments were assessed on the basis vegetative parts and cabbage head damage, yield obtained and phytotoxicity.

The data presented in Table 1 revealed that the pre count larval population of *P. xylostella* ranged from 23 to 26 larvae 10 $plants^{-1}$ at one day before spraying. In the experimental trials all the treatments were found significantly superior in reducing DBM population over untreated control. In the first spray, the treatment indoxacarb 14.5% SC @ 75 g a.i. ha^{-1} recorded the lowest population of *P. xylostella* (10.33 larvae 10 $plants^{-1}$) which was followed by indoxacarb 14.5% SC @ 50 g a.i. ha^{-1} (11.30 larvae 10 $plants^{-1}$) and indoxacarb 14.5% SC @ 40 g a.i. ha^{-1} (12.33 larvae 10 $plants^{-1}$) at seven days after application. These three treatments were at par with other. The next effective treatments were indoxacarb 14.5% SC (Avaunt) @ 30 g a.i. ha^{-1} (14.63 larvae 10 $plants^{-1}$) and indoxacarb 14.5% SC @ 30 g a.i. ha^{-1} (15.67 larvae 10 $plants^{-1}$) and were at par with each other. The maximum larval population was recorded in untreated control (35.77 larvae 10 $plants^{-1}$).

In second spray the lowest population was also recorded at seven days after application in all the treatments. Indoxacarb 14.5% SC @ 75 g a.i. ha^{-1} recorded significantly lowest population (7.61 larvae 10 $plants^{-1}$) followed by indoxacarb 14.5% SC @ 50 g a.i. ha^{-1} (8.24 larvae 10 $plants^{-1}$) and indoxacarb 14.5% SC @ 40 g a.i. ha^{-1} (9.14 larvae 10 $plants^{-1}$) which were found at par with it at seven days after treatment.

The third spray was found most effective in reducing the DBM population in all treatments which were significantly superior over untreated control (Table 1). The treatment indoxacarb 14.5% SC @ 75 g a.i. ha^{-1} recorded lowest population

Table 1. Efficacy of different doses of indoxacarb 14.5% SC against diamondback moth, *Plutella xylostella* Linn. on cabbage

Treatment	Dose (g a.i. ha^{-1})	Mean DBM larval population at different interval (days) after spray													Yield (q ha.$^{-1}$)
		Pre count	1st Spray				2nd Spray				3rd Spray				
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1 Indoxacarb 14.5% SC	30	24.60 (5.01)	17.82 (4.27)	15.67 (4.01)	18.10 (4.30)	25.24 (5.07)	12.72 (3.64)	12.03 (3.54)	15.47 (4.00)	21.00 (4.63)	10.35 (3.29)	10.45 (3.31)	13.55 (3.74)	17.04 (4.19)	180.00
T_2 Indoxacarb 14.5% SC	40	25.20 (5.07)	14.20 (3.83)	12.33 (3.58)	14.96 (3.93)	23.58 (4.90)	9.26 (3.12)	9.14 (3.10)	12.06 (3.54)	17.34 (4.22)	3.96 (2.10)	2.71 (2.05)	5.53 (2.45)	10.39 (3.29)	208.90
T_3 Indoxacarb 14.5% SC	50	25.00 (5.05)	13.23 (3.70)	11.30 (3.43)	14.47 (3.87)	21.82 (4.70)	9.76 (3.20)	8.24 (2.95)	11.22 (3.42)	16.43 (4.10)	3.24 (1.93)	2.37 (1.69)	4.25 (2.18)	8.76 (3.03)	209.20
T_4 Indoxacarb 14.5% SC	75	23.00 (4.84)	12.82 (3.65)	10.33 (3.29)	13.62 (3.75)	19.95 (4.47)	8.92 (3.07)	7.61 (2.84)	10.20 (3.27)	15.39 (3.98)	2.69 (1.79)	2.04 (1.59)	3.96 (2.11)	7.53 (2.83)	211.80
T_5 Indoxacarb 14.5%SC (Avaunt)	30	24.40 (4.99)	17.53 (4.25)	14.63 (3.87)	17.23 (4.21)	24.60 (5.01)	11.46 (3.46)	11.40 (3.45)	14.55 (3.86)	20.41 (4.57)	9.58 (3.17)	8.47 (2.99)	12.35 (3.58)	15.72 (4.02)	190.50
T_6 Quinalphos 25% EC	500	26.00 (5.15)	21.76 (4.71)	19.62 (4.48)	22.00 (4.74)	28.47 (5.36)	17.22 (4.21)	17.00 (4.18)	20.18 (4.55)	26.00 (5.14)	15.62 (4.01)	16.00 (4.06)	19.76 (4.50)	28.33 (5.37)	168.00
T_7 Cypermethrin 25% EC	75	23.40 (4.88)	20.94 (4.63)	19.00 (4.41)	21.22 (4.41)	27.96 (5.33)	16.78 (4.12)	15.06 (3.94)	18.88 (4.35)	24.98 (5.05)	14.55 (3.88)	14.36 (3.85)	18.56 (4.35)	27.12 (5.25)	174.00
T_8 Untreated control	-	26.00 (4.94)	31.12 (5.49)	35.77 (5.86)	37.00 (6.12)	41.78 (6.43)	43.10 (6.46)	48.12 (6.87)	52.23 (7.20)	54.37 (7.27)	61.42 (7.81)	64.33 (7.95)	72.46 (8.38)	76.22 (8.60)	140.40
Sem ±		0.37	0.33	0.35	0.36	0.38	0.38	0.31	0.31	0.38	0.28	0.32	0.41	0.42	1.01
CD (P=0.05)		1.092	0.991	1.046	1.082	1.124	1.126	0.907	0.934	1.126	0.821	0.952	1.231	1.249	3.02

*Figures in parentheses are sqrt X + 0.5 transformation values; DAS: days after spray

**Mean DBM larvae per 10 plants average of 30 plants per treatment of three replication

of *P. xylostella* (2.04 larvae 10 plants^{-1}) which was found at par with indoxacarb 14.5% SC @ 50 g a.i. ha^{-1} (2.37 larvae 10 plants^{-1}) and indoxacarb 14.5% SC @ 40 g a.i. ha^{-1} (2.71 larvae 10 plants^{-1}) at seven days after treatment. The next effective treatments were indoxacarb 14.5% SC (Avaunt) @ 30 g a.i. ha^{-1} (8.47 larvae 10 plants^{-1}) and indoxacarb14.5% SC @ 30 g a.i. ha^{-1} (10.45 larvae 10 plants^{-1}). This was followed by cypermethrin 25% EC @ 75 g a.i. ha^{-1} (14.36 larvae 10 plants^{-1}) and quinalphos 25% EC @ 500 g a.i. ha^{-1} (16 larvae 10 plants^{-1}). The maximum larval population of DBM was recorded in untreated control (64.33 larvae 10 plants^{-1}). In the present study, indoxacarb 14.5% SC @ 75 g a.i. ha^{-1} was the most effective treatment against *P. xylostella.* Similar observations were earlier reported by Sable *et al*. (2007) and Rajagopal babu *et al*. (2002). Satpathy *et al*. (2007) reported that cypermethrin 10 EC and quinalphos 25 EC were effective against DBM in cabbage get support to present findings.

The data pertaining to the effect of different insecticides on yield of cabbage are presented in Table 1 and revealed that all the insecticidal treatments gave significantly superior yield over untreated control. The yield of cabbage varied from 168 q ha^{-1} to 211.80 q ha^{-1} in the treated plots as against 140.40 q ha^{-1} in untreated plots. The highest yield of cabbage head was obtained (211.80 q ha^{-1}) in the plot treated with indoxacarb 14.5% SC @ 75 g a.i. ha^{-1} which was found significantly superior over rest of the treatments except indoxacarb 14.5% SC @ 50 and 40 g a.i. ha^{-1} with cabbage yield was 209.20 and 208.90 q ha^{-1}, respectively and it was followed by indoxacarb 14.5% SC (Avaunt) @ 30 g a.i. ha^{-1} (190.50 q ha^{-1}), indoxacarb14.5% SC @ 30 g a.i. ha^{-1} (180 q ha^{-1}), cypermethrin 25% EC @ 75 g a.i. ha^{-1} (174.90 q ha^{-1}) and quinalphos 25% EC @ 500 g a.i. ha^{-1} (168 q ha^{-1}). The lowest yield was recorded in untreated control (140.40 q ha^{-1}).

The treatment indoxacarb 14.5% SC @ 40, 50 and 75 g a.i. ha^{-1} caused no phytotoxic symptoms on the plants, whereas, indoxacarb 14.5% SC @ 100 g a.i. ha^{-1} showed mild phytotoxic symptoms (some lesions on the leaves) on the plants while, it's higher doses, indoxacarb 14.5% SC @ 200 and 150 g a.i. ha^{-1} recorded moderately phytotoxic symptoms on leaves as well as on the cabbage head, as given in Table 2.

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Table 2. Phytotoxic effects of different doses of indoxacarb 14.5% SC against diamondback moth, *Plutella xylostella* Linn. on cabbage plants.

Treatment	Dose (g a.i. ha^{-1})	Intensity of phytotoxicity	Indication marks
Indoxacarb 14.5% SC	40	No phytotoxicity	-
Indoxacarb 14.5% SC	50	No phytotoxicity	-
Indoxacarb 14.5% SC	75	No phytotoxicity	-
Indoxacarb 14.5% SC	100	Mild	+
Indoxacarb 14.5% SC	150	Moderate	++
Indoxacarb 14.5% SC	200	Moderate	++

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