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Short Communication

FIELD EFFICACY OF CERTAIN BIO-RATIONAL INSECTICIDES AND *BACILLUS THURINGIENSIS* BASED BIO-INSECTICIDES AGAINST CABBAGE BUTTERFLY, *PIERIS BRASSICAE* LINN.

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Amongst various insect-pest attacking cabbage crop, butterfly, *Pieris brassicae* Linn. (Lepidoptera: Pieridae) is one of the major constraints in commercial cultivation of the crop in hill and plain areas of Uttarakhand (Mishra and Ram, 1997, Singh *et al*., 2003). The early instars larvae feed gregariously by scrapping the under surface of the leaves whereas the subsequent instars disperse as they grow and eat up leaves from the margin inwards, leaving intact the main veins. Survey conducted from time to time under Horticulture Technology Mission in vegetable growing areas of Uttarakhand revealed that intensive and continuous cropping and improper plant protection measures are also major factor contribute to the seriousness of *P. brassicae*. The losses due to this pest have been estimated to range from 8.16 to 31.69 per cent in Uttarakhand (Singh *et al.,* 2003). Although several insecticides have been recommended for the control of *P. brassicae* in cabbage, yet the changing agro-environmental conditions needed to investigate and assess some newly introduced insecticidal molecules for the effective control. On the other hand, there are several *Bacillus thuringiensis* (Bt) based bio-insecticides which need to be evaluated against this pest as they are preferred over insecticides owing to their eco-friendly nature and lack of harmful residue compared to chemical insecticides (Basu, 2000; Mahesh and Men, 2007). Keeping these points in view, presents investigations were undertaken to find out the relative efficacy of some newly introduced insecticidal molecules and to explore the feasibility of utilizing Bt based bio-insecticides for the management of cabbage butterfly.

The investigation was carried out at Aasanbagh near G. B. Pant University of Agriculture and Technology, Krishi Vigyan Kendra, Dhakrani, Dehradun (Uttarakhand) under Horticulture Technology Mission Project (Mini Mission-I) of Govt. of India for two consecutive years (2007-08 and 2008-09). The insecticidal molecules viz. indoxacarb, spinosad, emamectin benzoate, diafenthiuron and four *Bt* based bio-insecticides namely halt, biolep, delfin, dipel with one conventional insecticides (endosulfan) were used in the experiment against cabbage butterfly, *Pieris brassicae*. The F1 hybrid "Varun" was raised at 50 x 45 cm spacing in a randomized block design (RBD) with 10 treatments including control, each replicate thrice. The size of each plot was 20m^2 (5m x 4m) and separated from the other neighbouring plots by 1m. Four weeks old seedlings were transplanted in the second week of October during 2007 and 2008. In all treatments, dhanuvit @ 1ml per litre of insecticidal solution was used as sticker. In each treatment, population counts of larvae were taken one day before and post treatment counts were taken after one, three, seven and ten days after spraying. The first insecticidal application was initiated at 45 and 49 days after transplanting during 2007-08 and 2008-09, respectively coinciding with homogeneous population of cabbage butterfly. The per cent reduction of pest population over control was calculated (Fleming and Retnakaran, 1985).

The pretreatment count for cabbage butterfly larvae varied from 10.96 to 13.06 larvae per plant during 2007-08 and 7.64 to 9.17 larvae per plant during 2008-09 (Table-1). The per cent reduction of larval population in different new insecticidal molecule treatments and *Bacillus thuringiensis* based bio-insecticides resulted in significant reduction of the larvae and demonstrated their superiority over

Table 1: Effect of various bio-rational insecticides and *Bt* based bio-insecticides on field population of *Pieris brassicae* larvae on cabbage in the rabi season of 2007-08 and 2008-09

Treatment	Conc. (%)	Per cent reduction over control												
		Pre treatment 2007-08 (larvae/ plant)	DAS during 2007-08				Mean (2007-08)	Pre treatment 2008-09 (larvae/ plant)	DAS during 2008-09				Mean (2008-09)	Overall mean
			1	3	7	10			1	3	7	10		
Indoxacarb	0.02	12.10	82.30	96.26	98.02	96.81	93.35	8.69	80.30	96.06	97.61	95.09	92.27	92.81
14.5% SC		(3.55)	(9.10)	(9.84)	(9.93)	(9.86)	(9.68)	(3.03)	(8.99)	(9.83)	(9.91)	(9.78)	(9.62)	(9.65)
Spinosad	0.01	11.68	80.13	93.19	95.84	94.16	90.83	8.02	77.80	91.09	94.10	93.10	89.02	89.93
45% SC		(3.49)	(8.98)	(9.68)	(9.82)	(9.73)	(9.550	(2.920	(8.85)	(9.57)	(9.73)	(9.67)	(9.45)	(9.50)
Emamectin	0.01	13.06	71.34	84.71	87.06	84.35	81.87	9.08	71.69	81.68	84.69	81.06	79.78	80.82
Benzoate		(3.68)	(8.480)	(9.23)	(9.36)	(9.21)	(9.07)	(3.10)	(8.50)	(9.07)	(9.23)	(9.03)	(8.96)	(9.01)
Diafenthiuron	0.005	10.96	69.10	81.92	83.54	80.20	78.69	7.84	67.69	80.27	81.82	78.90	77.17	77.93
50% WP		(3.39)	(8.34)	(9.08)	(9.17)	(8.98)	(8.89)	(2.89)	(8.26)	(8.99)	(9.07)	(8.91)	(8.81)	(8.85)
Endosulfan	0.70	11.37	68.45	78.82	81.94	75.69	76.23	8.54	70.26	78.40	82.06	80.01	77.68	76.95
35% EC		(3.45)	(8.30)	(8.91)	(9.08)	(8.73)	(8.75)	(3.01)	(8.41)	(8.88)	(99.09)	(8.97)	(8.84)	(8.80)
Halt (Bt)	0.20	12.25	31.56	46.96	72.08	69.69	55.07	8.01	32.60	50.08	74.01	71.69	57.10	56.08
		(3.57)	(5.66)	(6.89)	(8.52)	(8.38)	(7.36)	(2.92)	(5.75)	(7.11)	(8.630	(8.50)	(7.50)	(7.43)
Biolep (Bt)	0.20	11.39	26.12	44.20	70.12	67.28	51.93	9.17	26.92	45.69	71.29	66.20	52.53	52.23
		(3.45)	(5.16)	(6.69)	(8.40)	(8.23)	(7.12)	(3.11)	(5.24)	(6.80)	(8.47)	(8.17)	(7.17)	(7.14)
Dipel (Bt)	0.20	12.06	23.49	40.82	67.19	63.06	48.64	8.05	24.10	42.80	69.06	64.62	50.15	49.39
		(3.54)	(4.90)	(6.43)	(8.23)	(7.97)	(6.88)	(2.92)	(4.96)	(6.58)	(8.34)	(8.07)	(6.99)	(6.93)
Delfin (Bt)	0.20	10.92	24.76	42.06	68.69	65.04	50.14	7.64	25.61	43.16	70.08	66.84	51.42	50.78
		(3.38)	(5.03)	(6.52)	(8.32)	(8.10)	(6.99)	(2.85)	(5.11)	(6.61)	(8.40)	(8.21)	(7.08)	(7.04)
Control	-	11.36	0.00	0.00	0.00	0.00	0.00	8.99	0.00	0.00	0.00	0.00	0.00	0.00
(water spray)		(3.44)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(3.08)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
S.Em. ±		0.892	1.422	2.288	2.706	2.379	0.759	0.794	0.964	0.997	0.790	0.418	0.481	0.661
C.D. at 5%		1.875	2.987	4.808	5.685	4.998	1.594	1.669	2.025	2.095	1.659	0.879	1.011	1.389

DAS = Days after spraying
Figures in parenthesis are square root transformed values

Table 2: Effect of certain bio-rational insecticides and Bt formulations on yield of cabbage in the rabi season of 2007-08 and 2008-09

Treatment	Conc. (%)	*Mean yield (q/ha) 2007-08	% yield increase over control	Mean yield (q/ha) 2008-09	% yield increased over control	Average yield (q/ha) (Pooled)	% yield increase over control (Pooled)
Indoxacarb	0.02	481.29	59.76 (7.76)	478.89	61.74 (7.89)	480.09	60.74 (7.83)
Spinosad SC	0.01	472.68	56.91 (7.58)	469.2	58.47 (7.68)	470.94	57.68 (7.63)
Emamectin Benzoate	0.01	448.17	48.77 (7.02)	447.19	51.03 (7.18)	447.68	49.89 (7.10)
Diafenthiuron	0.005	441.20	46.46 (6.85)	440.06	48.62 (7.01)	440.63	47.53 (6.93)
Endosulfan	0.70	439.84	46.00 (6.82)	441.09	48.97 (7.03)	440.46	47.47 (6.93)
Halt (Bt)	0.20	389.90	29.43 (5.47)	387.27	30.79 (5.59)	388.58	30.10 (5.53)
Biolep (Bt)	0.20	372.56	23.67 (4.92)	369.85	24.65 (5.01)	371.20	24.28 (4.98)
Dipel (Bt)	0.20	361.90	20.13 (4.54)	356.69	20.47 (4.58)	359.29	20.30 (4.56)
Delfin (Bt)	0.20	366.60	21.69 (4.71)	360.68	21.61 (4.70)	363.64	21.75 (4.72)
Control (water spray		301.24	0.00 (0.71)	296.08	0.00 (0.71)	298.66	0.00 (0.71)
S.Em. (±)		3.21	0.951	13.12	1.027	1.276	1.069
C.D. at 5%		10.89	1.998	4.1	2.158	2.680	2.245

* Mean of three replications
Figures in parenthesis are square root transformed values

untreated control significantly during both the years. The observations recorded after spraying of chemicals revealed that all the molecules showed their effectiveness at seven days after spraying during both the years. The result indicated that maximum mean larval reduction over control was recorded with indoxacarb i.e. 93.35 per cent followed by spinosad 90.83 per cent, emamectin benzoate 81.87 per cent,

diafenthiuron 78.69 and endosulfan 76.23 per cent which were significantly not different from each other during 2007-08 (Table-1). *Bacillus thuringiensis* based bio- insecticides showed larval reduction over control during 2007-08 but they were significantly inferior to all the insecticidal molecules. Amongst various *Bt* formulations, halt was most effective followed by biolep, delfin and dipel during 2007-08. Almost same trend was noticed during 2008-09 also. During this year indoxacarb treated plots received maximum mean larval reduction (92.27) per cent follwed by spinosad, emamectin benzoate, diafenthiuron and endosulfan. Similarly, halt (*Bt*) recorded maximum mean larval reduction (57.10%) followed by biolep, delfin and dipel.

The computation of two years pooled cabbage yield data (Table-2) revealed that maximum yield i.e 480.09 q/ha was recorded with indoxacarb followed by spinosad emamectin benzoate diafenthiuron 440.63 q/ha. Amongst *Bt* formulations, halt registered maximum yield which (388.58 q/ha) followed by biolep, delfin and dipel. The per cent yield increase over control was found maximum in indoxacarb (60.74%) followed by spinosad, emamectin benzoate, diafenthiuron and endosulfan. However, halt showed maximum per cent yield increase over control among *Bt* formulations which was 30.10 followed by biolep, delfin and dipel.

The present investigation revealed that very meager studies have been carried out on newly introduced insecticidal molecules in different parts of the country against cabbage butterfly. Moreover, the studies conducted by Rai, *et al*., (2010) indicated that that application of emamectin benzoate and diafenthiuron was much effective in lowering the incidence of Lepidopterous larvae in vegetable crops including cabbage butterfly. They have further reported that indxacarb and spinosad are very promising against Lepidopterous larvae in vegetable crops. Endosulfan is the most widely used insecticide against this pest which has been reported by many workers (Singh *et el;* 2001). In the present study also endosulfan was found effective against the pest. As far as performance of *Bt* based bio-insecticides was concerned, present findings are in conformity with the findings of Purnik *et al*; 2002 and Mahesh and Men, 2007 who had reported that *Bt* formulations were effective against Lepidopterous larvae including cabbage butterfly and brinjal shoot and fruit borer hence can be rotated with selective and safer insecticides to achieve expected outcome under an IPM programme. The two years study revealed that indoxacarb and spinosad can be used in combination of halt (*Bt*) to keep the pest population below the economic damage level of cabbage butterfly as these molecules are comparatively safer and selective in nature hence their use in cabbage crop will not cause any harmful residue in the produce which is one of the main thrust area of IPM programme in vegetable crops.

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