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Efficacy of Insecticides Against *Pieris brassicae nepalensis* (Doubleday) on Cabbage in Chitwan, Nepal

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Abstract*: A field experiment was conducted to test the efficacy of microbial, botanical, safe chemical insecticide and some other potentially dangerous chemical insecticide against cabbage butterfly *Pieris brassicae nepalensis* (Doubleday) in cabbage under field condition. Six different commercially available pesticide: 1) Spinosad @ 0.2 ml/liter (Tracer 45% SC, semi-microbial), 2) Neemix 300 ppm @ 2ml/liter (Commercial product of neem), 3) Mahashakti @ 2ml/liter (Formulation of *B. thuruingenesis)*, 4) Malathion 50% WP @ 2 ml/liter (safe chemical pesticide), 5) Dichlorvos 76% EC @ 1ml/liter (unsafe chemical pesticide), 6) Emamectin benzoate 5% SG @ 0.2 gm/l (bio- insecticide), and 7) Control were applied comprising 7 treatments and three replications. Cabbage variety Green Coronet was planted in plots of 3m × 3m with spacing of 40 cm × 40 cm in a randomized complete block design. Data collection regarding pests and natural enemies were done at 3, 6 and 9 days after spray. The results obtained from different treatments against cabbage butterfly showed that Diclorovus, Emamectin benzoate and Spinosad were the most effective and consistent in controlling larval population of *Pieris brassicae nepalensis*. Three insecticides [Diclorovus (87.56%), Emamectin benzoate (80.31%) and Spinosad (72.44%)] gave highly significant protection of cabbage butterfly over control all the time in all three sprays. The treatments Malathion (45.38%), B.t (38.08%) and Neemix (48.35%) failed to give significant reduction of larval population after 1st spray; however, after 2nd and 3rd spray all six treatments gave significant protection from cabbage butterfly larvae over control. Besides chemical pesticide Dichlorovus, Bio-Pesticides such as Emamectin benzoate and Spinosad were found to give effecient control over cabbage butterfly thus can be used as substitute of chemical pesticides for management of *Pieris brassicae nepalensis* under Chitwan condition.

***Keywords*: Cabbage butterfly, *Pieris brassicae nepalensis*, Cabbage, Emamectin benzoate, Spinosad.**

1. Introduction

Cabbage, *Brassica oleracea var. capitata* L is an important vegetable crop grown as winter crop as well as off season crop in high hills and mountains. Cabbage suffers from several insects, among which the important pests of cabbage are: Cabbage butterfly (*Pieris brassicae nepalensis* (Doubleday) and other species of *Pieris*), Diamond Back Moth *Plutella xylostella* (Linnaeus), Tobacco caterpillar *Spodoptera litura* (Fabricius), Soyabean hairy caterpillar *Spilarctia casignata* (Kollar), Cutworms *Agrotis ipsilon* (Ashmed), Flea beetle *Phyllotreta cruciferae* (Goeze), Aphids *Brevicoryne brassicae* (Linnaeus) etc. (Thapa, 1986-87; Sachan & Gangwar, 1990; NARC, 1998; Neupane, 2000). Among them Cabbage butterfly is identified as major pest in Nepal (Joshi, 1994; Neupane, 2000)

In Nepal, four species of cabbage butterfly are recorded. These species are *P. Brassicae, P. brassicae nepalensis, P. canidia and P. canidia indica* (Thapa, 1987). In the Terai and inner Terai regions of Nepal, *P. brassicae nepalensis* predominates followed by *P. Candida* (Thapa, 1987). Cabbage butterfly attacks to crops are usually localized and may lead to 100% crop loss (Feltwell, 1982). Due to their robust migratory habit, adults may infest new areas previously free from attack. In India, P. brassicae is estimated to cause over 40% yield loss annually on different vegetable crops (Ali & Rizvi, 2007).

P. brassicae larvae occasionally cause damage to cabbage and cauliflower by boring into the heads of the vegetables (Ali & Rizvi, 2007). In addition, high populations of larvae can skeletonize host plants. Since many of the host crops of P. brassicae are sold for fresh consumption, harm by P. brassicae can cause significant reduction in crop value also (Cartea, Padilla, Vilar & Velasco, 2009).

2. Materials and Methods

A field experiment was conducted to test the efficacy of microbial, botanical and chemical insecticide against cabbage butterfly in cabbage under field condition. The field experiment was laid out in the experimental farm of Department of Entomology, AFU, Rampur, Chitwan (Mangalpur VDC) during winter season. The layout of the field was done in randomized complete block design (RCBD). There were 7 treatments with 3 replications. Plot size was 9m2 (3m × 3 m) and spacing between two blocks and two plots within blocks was 1 m.

Land preparation was done by conventional tillage and

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harrowing. Compost were incorporated with the rate of 20mt/ha and NPK at the rate of 240:180:80 kg/ha. 32 days old seedling of Green Coronet variety was transplanted in the field on 3rd week of January, 2015 with spacing of 40*40. All the pesticide materials were applied on cabbage plants with a hand compression sprayer of 8-liter capacity @ 500-700 liter/ha. Treatments were sprayed with onset of larvae in plants and repeated at 10 days' interval. The insect number was recorded at 3, 6 and 9 days after treatment application after the onset of the insect in the field from randomly selected 10 plants in each plots.

After collecting and summarization, data was tabulated and analyzed by using tools like MSTAST/RSTAT and Excel. All the analyzed data which were significant subjected to DMRT for mean comparison. From the pre and post treatment data, percent reduction over control (PROC) and mean treatment population of larvae was calculated.

3. Results and Discussion

The results of field experiment especially for management of cabbage butterfly (*Pieris brassicae nepalensis*) in the field condition of Rampur, Chitwan showed that the three insecticides (Diclorovus, Emamectin benzoate and Spinosad) gave highly significant protection of cabbage butterfly over control in all three sprays. The treatments Malathion, B.t. and Neemix failed to gave significant reduction of larval population after 1st spray; however, after 2nd and 3rd spray all six treatments gave highly significant protection from cabbage butterfly larvae over control.

The results obtained from different treatments against cabbage butterfly showed that Diclorovus, Emamectin benzoate and Spinosad were most effective and consistent in controlling larval population of *Pieris brassicae nepalensis*. The results showed that Diclorovus proved to be superior to other treatments due to maximum reduction over control all the times except six day and nine day after third spray. After six days of second spray Emamectin benzoate recorded maximum reduction over control and after nine day of second spray, maximum reduction over control was obtained due to Spinosad.

Maximum PROC (87.56%) due to Diclorovus was obtained 3 day after third spray. This finding is supported by findings of Dahiya, Lakra, Dahiya and Singh (1994), where he found 90% reduction of but Devjani, Singh and Goel (2008) claimed less than 50% mortality due to Diclorovus.

Emamectin benzoate was also found nearly as effective as Diclorovus in reducing larval population of cabbage butterfly. Maximum reduction of 80.31% was obtained after 9 days of third spray. The results are supported by Sing, Rai and Singh (2010) and Youha and Hongemi (2009), where they reported 80-90 % reduction over control on lepidopterous pests.

Spinosad was another promising bio-pesticide tested, which obtained maximum reduction over control of 72.44% after 9

Table 1
Effect of different treatments against cabbage butterfly, *Pieris brassicae nepalensis*, after 1st spray (larval population per 10 plants)

Treatments	Pre treatment	3 DAS	Reduction over control (%)	6 DAS	Reduction over control (%)	9 DAS	Reduction over control (%)
Spinosad @ 0.2 ml/liter	25(5.77)	11.00(3.334)^{b}	63.07%	15.67(4.00)^{bcd}	44.08%	17.00(4.16)^{ab}	45.52%
Neemix @2ml/liter	22.5(5.45)	20.33(4.56)^{a}	24.15%	17.67(4.26)^{abcd}	29.93%	19.33(4.41)^{ab}	31.16%
Mahashakti(B.t.)@2ml/liter	21.25(5.26)	19.67(4.472)^{a}	22.32%	20.33(4.56)^{abc}	14.61%	19.67(4.45)^{ab}	25.86%
Malathion @2ml/liter	24.25(5.58)	22.33(4.777)^{a}	22.70%	24.33(4.98)^{ab}	10.45%	25.33(5.04)^{a}	16.31%
Diclorovus @1ml/liter	22.75(5.39)	8.67(3.008)^{b}	68.03%	12.33(3.48)^{d}	51.62%	11.67(3.47)^{b}	58.92%
Emamectin benzoate @0.2gm/l	23(5.26)	9.33(3.091)^{b}	65.94%	13.33(3.71)^{cd}	48.27%	12.33(3.55)^{b}	57.04%
Control	23.5(5.43)	28.00(5.302)^{a}		26.33(5.16)^{a}		29.33(5.42)^{a}	
SEm	0.4178	0.2554		0.3115		0.4099	
CV	13.28%	10.85%		12.52%		16.29%	
LSD	1.288	0.7876		0.9597		1.263	
F-Test (α =0.05)	NS	S		S		S	

PROC: Percentage Reduction over Control; CV: Coefficient of Variation; S: Significant; SEm: Standard Error of mean; LSD: Least Significant Difference; values with the same letters in a column are not significantly different at 5% by DMRT (Duncan's Multiple Range Test) and figure in parenthesis indicate $\sqrt{(x+0.5)}$ transformation.

Table 2
Effect of different treatments against cabbage butterfly, *Pieris brassicae nepalensis*, after 2nd spray (larval population per 10 plants)

Treatments	Pre treatments	3 DAS	Reduction over control (%)	6 DAS	Reduction over control (%)	9 DAS	Reduction over control (%)
Spinosad @ 0.2 ml/liter	17.00(4.16)	9.33(3.12)^{c}	57.24%	9.00(3.05)^{cd}	54.33%	7.67(2.81)^{c}	65.49%
Neemix @2ml/liter	19.33(4.41)	19.33(4.42)^{b}	22.12%	14.67(3.88)^{bc}	34.55%	19.00(4.41)^{b}	24.80%
Mahashakti(B.t.)@2ml/liter	19.67(4.45)	20.33(4.54)^{b}	19.48%	17.67(4.24)^{b}	22.50%	17.33(4.19)^{b}	32.56%
Malathion @2ml/liter	25.33(5.04)	21.67(4.70)^{b}	33.40%	21.00(4.63)^{b}	28.48%	21.33(4.66)^{b}	35.56%
Diclorovus @1ml/liter	11.67(3.47)	5.33(2.40)^{c}	64.40%	7.33(2.78)^{d}	45.77%	9.00(3.02)^{c}	40.97%
Emamectin benzoate @0.2gm/l	12.33(3.55)	6.33(2.51)^{c}	60.01%	5.33(2.36)^{d}	62.69%	7.67(2.80)^{c}	52.43%
Control	29.33(5.42)	37.67(6.16)^{a}		34.00(5.86)^{a}		38.33(6.22)^{a}	
SEm	0.4099	0.3281		0.2938		0.2983	
CV	16.29%	14%		13.3%		12.86%	
LSD	1.263	1.001		0.9054		0.9192	
F-Test (α =0.05)	S	S		S		S	

PROC: Percentage Reduction over Control; CV: Coefficient of Variation; S: Significant; SEm: Standard Error of mean; LSD: Least Significant Difference; values with the same letters in a column are not significantly different at 5% by DMRT (Duncan's Multiple Range Test) and figure in parenthesis indicate $\sqrt{(x+0.5)}$ transformation.

Table 3
Effect of different treatments against cabbage butterfly, *Pieris brassicae nepalensis*, after 3rd spray (larval population per 10 plants)

Treatments	Pre treatments	3 DAS	Reduction over control (%)	6DAS	Reduction over control (%)	9 DAS	Reduction over control (%)
Spinosad @ 0.2 ml/liter	7.67(2.81)	3.33(1.90)^{c}	63.50%	3.33(1.93)^{c}	60.00%	2.33(1.64)^{c}	72.44%
Neemix @2ml/liter	19.00(4.41)	14.33(3.85)^{b}	36.68%	10.67(3.32)^{b}	48.35%	12.33(3.56)^{b}	41.22%
Mahashakti(B.t.)@2ml/liter	17.33(4.19)	16.00(3.94)^{b}	22.52%	11.67(3.47)^{b}	38.08%	13.33(3.72)^{b}	30.35%
Malathion @2ml/liter	21.33(4.66)	16.33(4.06)^{b}	35.73%	12.67(3.58)^{b}	45.38%	18.33(4.33)^{b}	22.18%
Diclorovus @1ml/liter	9.00(3.02)	1.33(1.34)^{c}	87.56%	2.33(1.68)^{c}	76.15%	1.33(1.34)^{c}	86.59%
Emamectin benzoate @0.2gm/l	7.67(2.80)	2.00(1.56)^{c}	78.10%	2.00(1.52)^{c}	76.00%	1.67(1.46)^{c}	80.31%
Control	38.33(6.22)	45.67(6.74)^{a}		41.67(6.46)^{a}		42.33(6.42)^{a}	
SEm	0.2983	0.4382		0.3141		0.3817	
CV	12.86%	22.71%		17.35%		20.58%	
LSD	0.9192	1.350		0.9679		1.176	
F-Test (α =0.05)	S	S		S		S	

PROC: Percentage Reduction over Control; CV: Coefficient of Variation; S: Significant; SEm: Standard Error of mean; LSD: Least Significant Difference; values with the same letters in a column are not significantly different at 5% by DMRT (Duncan's Multiple Range Test) and figure in parenthesis indicate $\sqrt{(x+0.5)}$ transformation.

days of third spray. The effectiveness of Spinosad was also reported by Breet (1997) and Klokoar-Smit *et al.* (2007). Muthkumar, Sharma and Sinha (2007) reported a maximum PROC of 78.7 % against cabbage butterfly by Spinosad.

Malathion failed to give effective control of the butterfly larvae. Maximum reduction over control observed was of only 45.38% after six days of third spray. Low effectiveness of Malathion was also reported by Patil, Basavana Goud and Kulkarni (2010) with 40.74% reduction over control. The ineffectiveness of Malathion was also evidenced by Vastrat (2000) under field condition which corroborates the previous findings.

Neemix also gave poor performance compared to other insecticide giving maximum PROC of 48.35%, 6 days after third spray. Poor performance of Neem based insecticide was also reported by Temurade, Deshmukh and Nemade (1992). However, Sharma and Gupta (2009) reported neem-based pesticides to be effective giving upto 88% reduction over control against *Pieris brassicae.*

Mahasakti, a commercial formulation of *Bacillus thruienginesis* var. *krustaki* was found least effective among the insecticide used giving maximum PROC of only 38.08%. Praveen, Dhandapani and Kenndy (2001) and Satpathy and Panda (1997) reported B.t. products such as Biosap, Delfin, Halt and Biolep to be highly effective against lepedopterous pests. Poor effectiveness of B.t in field condition may be due to high temperature during the experiment. However, the poor performance of B.t related pesticide (Biolep, Biosap and Biobit) was also mentioned by Mahapatro and Gupta (1999) in their report.

4. Conclusion

Field experiment showed that Diclorovus, Emamectin benzoate and Spinosad were the most effective and consistent treatments in controlling larval population of *Pieris brassicae nepalensis*. Three insecticides [Diclorovus (87.56%), Emamectin benzoate (80.31%) and Spinosad (72.44%)] gave highly significant management of cabbage butterfly over control in all three sprays. The treatments Malathion (45.38%), B.t (38.08%) and Neemix (48.35%) failed to give significant reduction of larval population after 1st spray; however, after 2nd and 3rd spray all six treatments gave significant protection from cabbage butterfly larvae over control. Thus, be Besides chemical pesticide Dichlorovus, Bio-Pesticides such as Emamectin benzoate and Spinosad were found to give efficient control over cabbage butterfly thus can be used as substitute of chemical pesticides for management of *Pieris brassicae nepalensis* under Chitwan condition.

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