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Effect of pyridalyl against *Plutella xylostella* (L.) on cabbage and natural enemies

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In India, the Diamond Back Moth (DBM), *Plutella xylostella* (L), has consistently remained the most devastating pest of cruciferous vegetables assumes the pest status of national importance (Yadava, *et. al.*, 1974; Lingappa, *et. al.*, 2000; Shankar and Raju, 2002). The pest is a limiting factors in production of cruciferous vegetables particularly cabbage in the subtropics. The estimated annual crop losses due to the pest are US$ 16 million in India (Mohan and Gujar 2003), US $ 40-70 million for cabbage and US$ 0.4 million for broccoli in Texas (Shelton 2004). DBM outbreaks could cause as much as 90 per cent crop loss in South East Asia (Verkerk and Wright 1996), 52% in India (Krishnamoorthy 2004), 80-90% damage on summer cabbage in China (Zhao *et al.*, 1996) and 12- 48.7 t ha $^{-1}$ in Ethiopia (Ayalew 2006). Efforts to control this pest solely through conventional insecticides led to development resistant to almost all insecticides available in India (Chawla and Joia, 1991; Vastard *et al.*, 2004). It has also developed resistance not only to synthetic insecticides but also to *Bacillus thuringiensis* based pesticides (Balasubramani *et al.*, 2008). Currently, this insect has become resistant to almost all classes of insecticides used against it in South-East Asian countries (Dhaliwal *et al.*, 2010). The injudicious use of pesticides for the control of DBM has generated a number of biological and environmental hazards. Under such situation, an effective new molecule is important which will be less hazardous to environment. The pesticide, pyridalyl belongs to a new class of insecticides with unique mode of action from other existing insecticides (Sakamoto *et al.*, 2004). The present study was initiated for evaluation the bioefficacy of pyridalyl against DBM on cabbage and it's impact on some natural enemies *viz. Apanteles plutellae, Bracon brevicornis, Chrysoperla carnea* and *Trichogramma chilonis*.

Field experiments were conducted at the University experimental farm and under laboratory condition at Kalyani, West Bengal, during two consecutive years 2003-04 and 2004-05. Drum head, variety was selected for the exiperiment with spacing of 60 × 45 cm. The experiment was design through RBD with four replication. The plot size was 50 m^2. The treatments evaluated were an untreated control, pyridalyl 10 EC, indoxacarb 14.5 EC and spinosad 45 SC (Table 1). Two sprayings were scheduled at15 days interval with the help of knapsack sprayer with water volume 500 L ha^{-1}. Ten plants were selected randomly for each replication and no. of larvae/plant were counted 24 hours before as well as 3rd, 7th and 15th day after treatments and transformed into percentage. Fifteen days after spraying, reduction in percentage population was estimated for *A. plutellae*. Pyridalyl 10 EC (0.1-0.5 % concentrations) and some other pesticides (Table 2) were applied against *B. brevicornis* Wesmael, *C. carnea* Stephens and *T. chilonis* Ishii under laboratory condition to calculate the LC_{50} values. Mass culture of natural enemies was maintained under laboratory with controlled temperature and relative humidity. Data were recorded against mortality for LC50 values were subjected to Probit analysis (Finney, 1972).

Table 1 was reflected the data on the efficacy of various treatment schedules of pyridalyl in reducing the infestation of *P. xylostella* (DBM) and its effect on cabbage yield and natural enemy, *A. plutelle*. It was observed from the table that all the treatments showed significant reduction of DBM population with highlighted higher yield over control. In the first crop season, at third day after spraying, pyridalyl @ 75g a.i. ha^{-1} provided cent percent reduction followed by 50 g a.i. ha^{-1} (99.99%), @ 25g a.i. ha^{-1} (96.76%), spinosad @ 25g a.i. ha^{-1} (95.99%) and indoxacarb @ 25g a.i. ha^{-1} (95.92%). The treatments, indoxacarb @ 25g a.i. ha^{-1} and spinosad @25g a.i/ha were statistically at par. On the seventh day after spraying pyridalyl @ 50g a.i. ha^{-1} and 75g a.i. ha^{-1} were best treatments with highest control (99.99%), followed by indoxacarb @ 25g a.i. ha^{-1} (97.99%). At fifteen day after spraying highest mortality was observed in case of pyridalyl @ 75g a.i. ha^{-1} (99.99%) followed by the treatment pyridalyl @ 50g a.i. ha^{-1} (99.85%). The highest yield of cabbage was recorded in the treatment pyridalyl @ 75g a.i. ha^{-1} (272.50 q ha^{-1}). Lowest yield was recorded in control plots (252.75 q ha^{-1}). Highest reduction of population was found in indoxacarb @ 25g a.i ha^{-1} (5.87%) and lowest in case of pyridalyl @ 25g a.i ha^{-1} (1.44%). Similar result was found in case of second crop season.

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Table : 1 Bioefficacy of pyridalyl against DBM infesting cabbage vis-à-vis effect on *A. plutelle*

Treatment with dose (g a.i. ha^{-1})	Pretreatment count (No. head^{-1})		Per cent reduction/ increase (+) of population at various days after insecticides application						Yield (q ha^{-1})		% reduction / increase (+) of *A. plutellae* on 15th day	
			3rd		7th		15th					
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
Pyridalyl 10 EC 25	5.50	4.20	96.76 (79.15)*	97.88 (81.53)	96.48 (79.06)	97.02 (80.26)	96.15 (78.59)	96.54 (79.66)	265.75	266.25	1.44 (6.88)	1.51 (7.01)
Pyridalyl 10 EC 50	4.75	5.25	99.99 (88.27)	99.99 (89.53)	99.99 (88.58)	99.99 (89.90)	99.85 (87.86)	99.99 (89.48)	270.25	271.50	1.76 (7.72)	1.84 (7.85)
Pyridalyl 10 EC 75	5.05	5.05	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	99.99 (89.91)	99.99 (89.99)	272.50	273.25	2.08 (8.24)	3.05 (10.21)
Indoxacarb 14.5 EC 25	4.50	4.50	95.92 (78.24)	97.99 (81.58)	97.99 (81.18)	97.28 (81.06)	96.26 (79.14)	97.02 (80.73)	265.50	266.75	5.87 (14.98)	6.38 (14.75)
Spinosad 45 SC 25	5.00	5.00	95.99 (78.38)	96.81 (79.78)	96.28 (80.20)	96.64 (79.49)	95.75 (78.54)	96.18 (79.28)	265.05	266.05	4.26 (11.92)	5.16 (13.23)
Untreated control (Water spray only)	4.50	4.75	+84.96 (0.00)	+71.26 (0.00)	+174.26 (0.00)	+142.08 (0.00)	+218.37 (0.00)	+194.02 (0.00)	252.75	254.50	+17.98 (0.00)	+18.41 (0.00)
LSD(0.05)	**NS**	**NS**	**1.42**	**1.85**	**1.24**	**1.78**	**1.55**	**1.68**	**2.88**	**2.08**	**2.08**	**2..26**

* *Figures in parentheses are angular transformed values*

Table 2: Relative toxicity of different pesticides to natural enemies

Pesticides	*df*	Heterogenity (x^2)	Regression Equation (Y=)	Fiducial Limit	LC_{50} (%)	Relative Toxicity	Order of relative safety
A) Adult of *Bracon brevicornis*							
Alphacypermethrin 10 EC	4	7.30	3.095+0.79X	0.00008-0.00018	0.00012	5.58	3rd
Spinosad 2.5 EC	4	30.53	2.477+0.67X	0.0005-0.0007	0.00022	3.04	2nd
Indoxacarb 14.5 SC	4	14.12	2.246+0.70X	0.00029-0.0015	0.00067	1.0	1st
B) Larvae of *Chrysoperla carnea*							
Alphacypermethrin 10 EC	4	2.80	1.72+0.47X	0.00011-0.00043	0.0023	8.26	3rd
Spinosad 2.5 EC	4	8.61	1.56+0.55X	0.0003-0.0076	0.0014	1.36	2nd
Indoxacarb 14.5 SC	4	12.20	1.44+0.53X	0.00031-0.0476	0.0019	1.0	1st
C) Pupae of *Trichogramma chilonis*							
Alphacypermethrin 10 EC	4	0.63	1.74+0.43X	0.000007-0.00045	0.00009	2.66	3rd
Spinosad 2.5 EC	4	3.20	1.81+0.48X	0.00006-0.0005	0.00018	1.33	2nd
Indoxacarb 14.5 SC	4	0.55	2.90+0.80X	0.00009-0.00057	0.00024	1.0	1st

The effect of pyridalyl against *P. xylostella* on cabbage during the present investigation are in more or less similar with the work done by Suganthi *et. al.* (2007) and Saito *et al.* (2002).The Relative toxicity of commercial formulations of various modern pesticides *viz.*, alpha-cypermethrin 10EC, spinosad 2.5EC, indoxacarb 14.5SC and pyridalyl 10EC as contact poison to three important natural enemies such as *B. brevicornis*, *C. carnea* and *T. chilonis* were determined on the basis of LC_{50} values. The tables 2 was highlighted the lowest LC_{50} value in case of alpha-cypermethrin, so it was most toxic for above mentioned natural enemies followed by spinosad 2.5 EC and indoxacarb 14.5 SC. Whereas pyridalyl was relatively safe to the natural enemies. Similar type of findings were observed by Nair *et al.* (2008), Isayama *et al.* (2004) and Hamamura *et al.* (2006).

It can be concluded that pyridalyl @ 25 – 50 g a.i ha^{-1} gave sufficient control of the DBM and have a lower impact on *A. plutelle*. So, the present investigation were of the opinion that pyridalyl 10EC @ 25 – 50 g a.i ha^{-1} may prove worthy as a component in IPM to keep down the population build up of DBM, *P. xylostella*, a menacing pest of cabbage.

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