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Evaluation of insecticides against diamondback moth *Plutella xylostella* on cabbage during 2016

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Abstract
The experiment was laid out at farmers field Kommanal, Shivamogga, under field condition in a Randomized Block Design (RBD) with three replications consisting of eight treatments. The mean number of larvae in different insecticide at treatment indicated that chlorantraniliprole proved very effective in recording lowest number of larva per plant of 0.44 and was on par with emamectin benzoate (0.53 larvae per plant), flubendiamide(0.60 larvae per plant), and spinosad (0.67 larvae per plant). Further indoxacarb (0.73 larvae per plant) and dichlorvos (0.78 larvae per plant) which were statistically on par with each other and proved to be next best treatments. NSKE (0.91 larvae per plant) was found to be least effective compared to other treatments. While untreated check registered highest number of larvae per plant.

Keywords: Diamond Back moth, chlorantraniliprole, NSKE, Flubendiamide

Introduction
Cabbage, *Brassica oleracea* L. var. *capitata* (Brassicaceae), is of Cyprus and Mediterranean origin. It is an economically important cruciferous vegetable. It is grown for its edible enlarged round terminal buds, which is rich source of Ca, P, Na, K, S, vitamin A, vitamin C, carbohydrates and dietary fiber. Major cabbage growing states are in the country are Uttar Pradesh, Orissa, Bihar, Assam, West Bengal, Maharashtra, Tamil Nadu (Nilgiris) and Karnataka, it is grown on area of 10,490 hectares with a production of 2.212 lakh MT (Anon., 2015) [1] and the major cabbage producing belts are Belgaum, Hassan, Mysore and Dakshin Kannada (Anon., 2015) [1]. Lepidopteron larvae are the most destructive pests of cabbage and are often controlled with insecticide. Cabbage, being a highly payable vegetable crop, intensive plant protection measures involving use of a large quantity of different insecticides is adopted. These applications are calendar-based rather than need-based. In spite of large scale and repeated applications of insecticides, the pest has been found to occur in severe form in all cabbage growing areas. Most of these applications may be unwanted or may not be timely. This practice not only results in increase in production cost but also lead to considerable complications in the ecosystem. Although several insecticides are available in market, the crop failures are very common in cabbage due to severity of the defoliator pests and the resistance developed by them especially diamondback moth. In addition to the development of resistance in pests, indiscriminate and injudicious use of pesticides has grossly poisoned almost each component of the biosphere, caused resurgence of pests and reduction in natural enemies in agro-ecosystems allowing rapid rebound of target and minor pest. Therefore, it is found necessary to evaluate new insecticides for the control of diamond back moth of cabbage.

Materials and Methods
The experiment was laid out at farmers field Kommanal, Shivamogga, under field condition in a Randomized Block Design (RBD) with three replications consisting of eight treatments. Cabbage seeds were sown during first week of July, 2016. When seedlings were of 25 days old, they were transplanted to main field on 27th of July, with experimental plot size of 4 × 3 m^2 and spacing of 60 × 45 cm between rows and plants, respectively. The crop was raised by following all the recommended package of practices except plant protection practices for insect control. Observation on number of larvae and pupa per plant was counted from randomly selected five plants, one day before, 3, 5 and 7 days after imposition of treatments. The statistical analysis of the data obtained from managemental trails was done using analysis of variance (ANOVA) using Web Agri Stat Package (WASP-2) developed by Indian Council

of Agricultural Research, Research Complex, and Goa. Data were transformed by Arc sin transformation before subjecting to ANOVA.

Result

The result revealed that day before spraying of insecticides the larval population varied from 3.53 to 4.93 larvae per plant. However, no significant difference was observed among the treatments Table.1 at three days after spray, from the results it was observed that there was a significant difference among the treatments. The lowest larval population was recorded in the treatment chlorantraniliprole 18.5 SC (0.67 per plant) and was on par with emamectin benzoate 5 SG (0.80 per plant), flubendiamide 480 SC (0.87 per plant) and spinosad 45 SC (0.93 larva/ plant). The treatment indoxacarb 15.8 EC recorded 1.00 larvae per plant found to be next best treatment and was on par with dichlorvos 76 EC with 1.00 larvas per plant. NSKE 5% with 1.13 larvae per plant found to be least effective compared to other treatments. However, all other treatments recorded lower number of larvae per plant and superior over untreated check (4.13 per plant).

At five days after spraying, the difference in the larval population of *P. xylostella* among the treatments were significant. Among the treatments, a significant lower population was observed in chlorantraniliprole 18.5 SC (0.47 larva per plant) along with emamectin benzoate 5 SG (0.53 larva per plant) flubendiamide 480 SC (0.60 larva per plant), spinosad 45 SC (0.67 larva per plant) and indoxacarb 15.8 EC (0.73 larva per plant) are statistically on par with each other. Dichlorvos 76 EC with0.80 larvas per plant stood next best treatment. Further, NSKE 5% with 0.93 larva per plant found to be least effective compared to other treatments. However, all other treatments recorded lower number of larvae per plant and superior over untreated check (4.80 larva per plant).Almost similar trend of results was recorded on seven days after spraying, chlorantraniliprole 18.5 SC (0.20 larva per plant) recorded least number of larva per plant along with emamectin benzoate 5 SG (0.27 larva per plant), flubendiamide 480 SC (0.33), spinosad 45 SC (0.40 larva per plant) and indoxacarb 15.8 EC (0.47 larva per plant). Dichlorvos 76 EC with 0.50 larva per plant was next best treatment. Further, NSKE 5% with 0.67 larvas per plant found to be least effective compared to other treatments. However, untreated control remained inferior by recording highest larval population (5.27 larvae/ plant). The overall mean number of larvae in different insecticide at treatment indicated that chlorantraniliprole proved very effective in recording lowest number of larva per plant of 0.44 and was on par with emamectin benzoate (0.53 larvae per plant), flubendiamide (0.60 larvae per plant), and spinosad (0.67 larvae per plant). Further indoxacarb (0.73 larvae per plant) and dichlorvos (0.78 larvae per plant) which were statistically on par with each other and proved to be next best treatments. NSKE (0.91 larvae per plant) was found to be least effective compared to other treatments. While untreated check registered highest number of larvae per plant (4.73).

Table 1: Evaluation of insecticides against diamondback moth *Plutella xylostella* on cabbage during 2016 (First spray)

Sl. NO.	Treatments	Dosage	Mean number of larvae/plant				Mean
			1DBFS	3DAFS	5DAFS	7DAFS	
T1	Flubendiamide 480 SC	0.20 ml/l	4.40 (2.21)	0.87 (1.17)^{bcd}	0.60 (1.05)^{cd}	0.33 (0.91)^{cd}	0.60 (1.05)^{cd}
T2	Chlorantraniliprole 18.5 SC	0.1 ml/l	4.93 (2.32)	0.67 (1.08)^{d}	0.47 (0.98)^{d}	0.20 (0.84)^{d}	0.44 (0.97)^{d}
T3	Spinosad 45 SC	0.20 ml/l	4.20 (2.15)	0.93 (1.20)^{bcd}	0.67 (1.08)^{bcd}	0.40 (0.94)^{bcd}	0.67 (1.08)^{bcd}
T4	Indoxacarb 15.8 EC	0.54 ml/l	4.07 (2.13)	1.00 (1.22)^{bc}	0.73 (1.11)^{bcd}	0.47 (0.98)^{bcd}	0.73 (1.11)^{bc}
T5	Dichlorvos 76 EC	1.70 ml/l	4.13 (2.14)	1.00 (1.22)^{bc}	0.80 (1.14)^{bc}	0.53 (1.02)^{bc}	0.78 (1.13)^{bc}
T6	Emamectin benzoate 5 SG	0.40 g/l	4.87 (2.32)	0.80 (1.14)^{cd}	0.53 (1.02)^{cd}	0.27 (0.87)^{cd}	0.53 (1.02)^{cd}
T7	NSKE 5%	-	4.20 (2.16)	1.13 (1.28)^{b}	0.93 (1.20)^{b}	0.67 (1.08)^{b}	0.91 (1.19)^{b}
T8	Untreated check	-	3.53 (1.98)	4.13 (2.15)^{a}	4.80 (2.30)^{a}	5.27 (2.40)^{a}	4.73 (2.29)^{a}
S.Em±			0.10	0.03	0.04	0.04	0.03
CD (p=0.05)			0.32	0.11	0.13	0.14	0.10

Observations: 5 plants per plot, Figures in the parentheses are$\sqrt{x+0.5}$ transformed values, Means followed by same letters do not differ significantly by DMRT (P=0.05), DBFS- Day before First Spray, DAFS- Days after First Spray

Discussion

Chlorantraniliprole proved very effective in recording lowest larval population of 0.44 larva per plant being statistically on par with emamectin benzoate (0.53 larva per plant), flubendiamide (0.60 larva per plant), spinosad (0.67 larva per plant), indoxacarb (0.73 larva per plant), when compared to the standard check dichlorvos (0.78 larva per plant). NSKE (0.91 larva per plant) Table.1 larva per plant were found to be least effective compared to other treatments. While untreated check registered highest number of larvae per plant (4.73 larva per plant). Chlorantraniliprole shown excellent control of diamondback moth, *P. xylostella*on cabbage, these studies are in accordance with Deepa (2015) [3] and Alton and David (2009) [2]. Deivendran *et al.* (2007) evaluated the efficacy of new insecticides against *P. xylostella* on cruciferous, and the results revealed that indoxacarb at 90 g a.i. ha^{-1} gave the highest mean larval mortality (67.0 per cent) followed by spinosad at 75 g a.i. ha^{-1} (62.0 per cent). These studies contradictory with present findings. This might be due to DBM has already got resistance to indoxacarb. Suganyakanna *et al.* 2005 [4] reported that emamectin benzoate 5SG (Proclaim) formulation at 10 g a.i ha^{-1} and 8.75 a.i ha^{-1} were more effective against the pest.

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