Study the Seasonal Abundance of Diamondback Moth and Natural Enemies in Cauliflower

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Abstract— *The infestation of diamondback moth was started from the 2nd SMW and reached its peak in 8th SMW during the year. The maximum temperature showed significant positive correlation with larval population of diamondback moth. Coccinellid predator, Coccinella septempunctata L. was recorded as a major predator in cauliflower ecosystem which was maximum in the11th SMW of the year. The maximum and minimum temperature significant positive correlation with the population of C. septempunctata.*

Among different newer insecticides tested against diamondback, spinosad was found to be most effective which was found at par with indoxacarb. The insecticides, emamectin benzoate, chlorantraniliprole and fipronil were found moderately effective. The chlorfenapyr, acephate and pyridalyl were found least effective.

The maximum yield of cauliflower heads was registered in the plots treated with Spinosad 45 Sc, which was found at par with indoxacarb 14.5 Sc, the latter treatment was also non-significant with flubendiamide 39.35 Sc. The minimum yield was observed in pyridalyl 10 Ec and acephate 75 Sp. All the treatment were significantly superior over control. The order of yield revealed by different treatments was spinosad= indoxacarb≥ flubendiamide≥ emamectin benzoate≥ chlorantraniliprole≥ fipronil= chlorfenapyr› acephate= pyridalyl› control.

Keywords— Diamondback moth, Insecticides, Cauliflower, Spinosad.

I. INTRODUCTION

Cauliflower, *Brassica oleracea* var. *Botrytis* L. is one of the important cruciferous vegetable crops grown in India. It is grown more or less in all the states and used as salad, boiled vegetable, in curries, pickling as well as dehydrated vegetable. The nutritional value/ 100 g of Cauliflower, consists of carbohydrates 5.3 g, fat 0.2 g, protein 2.4 g, vitamins (thiamine or vitamin $B_1$0.1 mg, riboflavin or B_2 0.1 mg, niacin or vitamin B_3 0.5 mg, pantothenic acid or vitamin B_5 0.7 mg, folate or vitamin B_9 57.0 mg, vitamin C 46.4 mg, and vitamin K 16.0 mg), minerals (Ca 22.0 mg, Fe 0.4 mg, Mg 15.0 mg, Mn 0.2 mg, P 44.0 mg, K 303 mg, Na 30.0 mg, Zn 0.3 mg) (Copyright 2017 Nutrition Value org.). The total area under cultivation of Cauliflower, in India is 372 thousand hectares with an annual production to the tune of 8534 thousand tonnes with productivity of 18.3 metric tonnes (Anonymous-2013). The total area under cultivation of Cauliflower, in Rajasthan is 346 hectares with an annual production to the tune of 7588 tonnes (Anonymous-2010). China is major Cauliflower, producing country with 47 per cent of world followed by India with 12 per cent of world production (FAO-2012).

The yield of Cauliflower is adversely affected by many bottlenecks including insect pest, diseases, environmental stresses, nutritional imbalance etc. Among them insect pests, *viz.,* tobacco caterpillar, *Spodoptera litura* (Fab.); diamondback moth, *Plutella xylostella* (L.); Cauliflower borer, *Hellula undalis* (Fab.); Cauliflower, looper, *Tricoplusiani* (Hub) and aphid, *Lipaphiserysimi* (Kalt.) (Prasad, 1963; Sachan and Srivastav, 1972; Joshi and Sharma, 1973; Mohan *et al*., 1981; Rao and Lal 2005). Out of these, aphid and diamondback moth are major pests causing significant loss in North India. The diamondback moth, *P. xylostella* was first reported on cruciferous vegetables in 1914 (Fletcher. 1914). It is sometimes called Cauliflower, moth, is a European moth believed to be originated in the Mediterranean region that has since spread worldwide. The moth has a short life cycle (14 days at 25 ^{0}C) is highly fecund, capable of migrating long distance, most important pest of cruciferous

crops in the world that produces glucosinolates (Taleker and Shelton, 1993). The moth has a wing span of about 15 mm and body length of 6 mm. The forewings are narrow brownish grey with fine dark speckles. A creamy coloured stripe with a wavy edge of the posterior margin is sometimes constricted to form one or more light coloured diamond shapes, which is the basis of common name of the diamondback moth. The hind wings are narrow, pointed towards the apex and light grey with a wide fringe. Moths are active usually at twilight and at night feeding on cruciferous plants but also fly in the afternoon during mass outbreak.

II. MATERIALS AND METHODS

2.1 Seasonal abundance of diamondback moth and natural enemies in cauliflower:

2.1.1 Layout and design:

In order to study the incidence of Diamondback moth and abundance of natural enemies in cauliflower ecosystem and to work out their relationship with prevailing weather parameters, the experiment was laid out in five plots of 2.25 x 2.25 m^2 size during *Rabi*, 2016-17. These plots were contiguous to each. The observations on the abundance of diamondback moth and natural enemies were recorded from very beginning of their appearance on plants till harvesting of the crop.

2.1.2 Observations:

During the present study, the crop was found to be abundantly infested with diamondback moth, *P. xylostella*. Among the natural enemies of insect pests of cauliflower, the coccinellid predator, *Coccinella septempunctata* L. was found in the field. Other natural enemies like *Cotesia plutellae* and Syrphid flies were present in traces only.

2.2 Diamondback moth, *Plutella xylostella* (L.):

In order to register the larval population of diamondback moth (DBM), direct visual counting method was used (Lal, 1998). Ten plants were selected randomly from each plot and the total larval population of the pest was recorded at weekly interval.

2.3 Natural enemies:

Coccinellid predator *C. septempunctata* was appeared as the major natural enemy in cauliflower ecosystem, its population was recorded on ten randomly selected plants per plot.

2.4 Statistical analysis:

The observations taken on the abundance of diamondback moth and their natural enemies in cauliflower ecosystem were correlated (simple correlation, r) with prevailing weather parameters, *viz*., maximum and minimum temperature.

III. RESULTS AND DISCUSSION

3.1 Seasonal abundance of diamondback moth and natural enemies in cauliflower:

In the present investigation, the seasonal abundance of diamondback moth of cauliflower was studied for the year, 2016-17 which will be helpful in preparing proper schedule for effective management of this pest. The study revealed that the cauliflower crop was infested by a major pest, diamondback moth, *P. xylostella*. This insect pest has also been reported as serious insect pest of cabbage crop by Sachan and Srivastava (1972), Kandoria et al. (1996), and Sharma (2004) who support the present findings. Among the natural enemies of pests only coccinellid predator *Coccinella septempunctata L.* was observed in the cabbage ecosystem which feeds on the aphids.

Diamondback moth was observed as major pest of cauliflower crop attacking throughout the growth stages of the crop. The present finding get support with that of Ahmad et al. (2012) and Meena and Singh (2012) who reported diamondback moth as regular and major pest of cauliflower. The infestation of pest on cauliflower crop was started from first week of January (02nd SMW) and reached to maximum (45.2 larvae /10 plants) in the third week of February (8th SMW) during the year, thereafter, population started declining. Khaire et al. (1987) observed peak population of diamondback moth in the first week of February. The peak population was observed at 28.60C maximum and 13.40C minimum temperature. The present finding is in partial conformity with that of Gera and Bhatnager (1992), Meena and Sharma (2003), Shukla and Kumar (2004) and Goud et al. (2006) who reported that the infestation of pest started from second week of November and reached to peak in the last week of January to first week of February.

The larval population of diamondback moth had significantly positive correlation with maximum temperature (r= 0.51) and non-significant correlation with minimum temperature. The studies showed that the incidence of diamondback moth was only

affected by temperature. The present finding is in conformity by Ahmad et al. who reported that population of diamondback moth was positive correlated with maximum temperature. Contrary results were also reported by Sharma (2004) and Chaudhuri et al. (2001) who reported non-significant positive and significant positive correlation, respectively between the population of diamondback moth and temperature. Ahmad and Ansari (2010) observed that population of diamondback moth started to build up as soon as the cauliflower crop was transplanted. Ahmad et al. (2012) observed that maximum population at 310C which is more as compared to the present study.

Among the natural enemies *Coccinella eptempunctata L.*, a predator of aphid was found in abundance. The population of *C. eptempunctata* was maximum (20.2 /10 plants) in the second week of March (11th SMW). The population of *C. eptempunctata* had significantly positive correlation with maximum (r= 0.71) and minimum temperature (r= 0.66). The present findings are in agreement with that of Bhaskar and Virakatamath (2002), Shukla and Kumar (2003), Bar et al. (2004) observed the parasitisation of diamondback moth by *cotesia plutellae* which was lacking in the present study. Shukla and Kumar (2006) observed parasitisation of diamondback moth by *Tetrastiches Sokolowski* which was not evidence in the present study.

3.2 Seasonal abundance of diamondback moth and natural enemies in cauliflower:

In the present study, conducted during *Rabi*, 2016-17 the cauliflower crop *Brssicaoleracea*var. *Botrytis L* was found to be infested with diamondback moth, *P.xylostella* from 4thJanuary 2017 to 22nd March 2017. Among the natural enemies none of the species was recorded parasitizing the diamondback moth. However, the mynah bird was found predating the larvae. Coccinellid species dominating the cauliflower crop ecosystem was *Coccinella septempunctata* (L.) Other minor populations recorded were of *menochitus sexma culatatus*and syrphid fly. The population of diamond back moth and *C. septempunctata* have been registered.

3.3 Diamondback moth, *Plutella xylostella* (L.):

During *Rabi*, 2016-17, the larval population of diamondback moth first appeared in the 2nd standard meteorological week, SMW (2.0 larvae/ 10 plants) and reached to peak (45.2 larvae /10 plants) in the 8th meteorological week, SMW. The population level was at declining trend after 8th SMW and vanished in 13th meteorological week.

TABLE 1
SEASONAL ABUNDANCE OF DIAMONDBACK MOTH, *PLUTELLA XYLOSTELLA* (L.) AND NATURAL ENEMIES IN CAULIFLOWER CROP DURING *RABI*, 2016-17

S. No.	Date of observation	Standard meteorological week (SMW*)	Temperature(^{0}C)		Mean larval population of diamondback moth/ 10 plants	*C.septempunctata* population/10 plants
			Maximum	Minimum		
1	4/1/17	02	22.0	10.4	2.0	0.00
2	11/1/17	03	19.2	5.2	10.0	0.00
3	18/1/17	04	20.8	7.4	21.6	8.6
4	25/1/17	05	22.1	11.8	28.2	10.0
5	1/2/17	06	23.3	11.1	33.6	10.8
6	8/2/17	07	23.7	8.9	40.4	11.8
7	15/2/17	08	28.6	13.4	45.2	14.8
8	22/2/17	09	27.4	12.6	40.2	16.8
9	1/3/17	10	29.3	13.6	37.2	17.2
10	8/3/17	11	26.3	13.0	35.4	20.2
11	15/3/17	12	29.1	13.4	33.6	18.4
12	22/3/17	13	35.6	19.1	28.0	14.8

The peak larval population of diamondback moth, *P. xylostella* (45.2/ ten plants was observed at 28.6^{0}C maximum and 13.4^{0}C minimum temperatures, thereafter population started declining

The correlation analysis revealed that the larval population of diamondback moth had significant positive correlation with maximum (r = 0.51). b Whereas, non-significant correlation with minimum temperature.

3.4 Natural enemies:

Among the natural enemies, the ladybird beetle, *Coccinella septempunctata* has been recorded as the major natural enemy-pwhich predates the aphids in cauliflower ecosystem. In the year of experimentation, the population of *C. septempunctata* was first noticed in the 4thSMW (8.6/ ten plants) and reached to maximum in the 11thSMW (20.2/ ten plants) at 26.3^{0}C maximum and 13.0^{0}C minimum temperatures

The correlation studies revealed that during the year, the population of *C. septempunctata* had significant positive correlation with maximum and minimum temperature (r = 0.71 and r = 0.66, respectively). Thepopulation of *C. septempunctata* also had significant positive correlation with population of diamondback moth (r = 0.81).

TABLE 2
CORRELATION COEFFICIENT BETWEEN LARVAL POPULATION OF DIAMONDBACK MOTH, *PLUTELLA XYLOSTELLA* (L.), *COCCINELLA SEPTEMPUNCTATA* L. AND ABIOTIC FACTORS IN *RABI*, 2016-17

S. No.	Insect pests and natural enemy	Temperature (^{0}C)		C. septempunctata
		Maximum	Minimum	
1.	Diamondback moth, *Plutella xylostella* (r)	0.51*	0.43(NS)	0.85*
2.	*Coccinella septempunctata* (r)	0.71*	0.66*	----

**** Significant at the 5 % level of significance***

IV. CONCLUSION

Cauliflower, *Brassica oleracea* var. *Botrytis* L. is one of the important cruciferous vegetable crops grown in India. In the present study, conducted during Rabi, 2016-17 the cauliflower crop Brssica oleracea var. Botrytis L. was found to be infested with diamondback moth, *P.xylostella* from 4thJanuary 2017 to 22ndMarch 2017. Among the natural enemies none of the species was recorded parasitizing the diamondback moth. However, the mynah bird was found predating the larvae. Coccinellid species dominating the cauliflower crop ecosystem was Coccinella septempunctata (L.) Other minor populations recorded were of menochitus sexmacu latatus and syrphid fly. The correlation studies revealed that during the year, the population of C. septempunctata had significant positive correlation with maximum and minimum temperature (r = 0.71 and r = 0.66, respectively). The population of C. septempunctata also had significant positive correlation with population of diamondback moth (r = 0.81).

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