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Seasonal abundance of diamondback moth *Plutella Xylostella* (Lepidoptera: Plutellidae) On cabbage crop (*Brassica oleracea* var. *capitata* L.)

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Abstract
Field experiment was conducted to determine Seasonal Abundance of Diamondback Moth *Plutella Xylostella* (Lepidoptera: Plutellidae) On Cabbage Crop (*Brassica oleracea* var. *capitata* L.), in Jabalpur, Madhya Pradesh during the *Rabi* season from Sept., 2017 to March, 2018.First appearance of the *P. xylostella* was observed when the crop age was about 82 days *i.e.* first week of December (49th SW). Pest was present on the crop during the vegetative stage and remained available up to harvesting of the crop *i.e.* 11th standard week. Temperature maximum, temperature minimum and temperature average showed significant positive correlation (r= 0.58*, 0.58*, 0.63** respectively) and morning and average relative humidity showed significant negative correlation (r=-0.63**, -0.57*) with larval population.

Keywords: Seasonal abundance, *Plutella xylostella*, diamond back moth, cabbage

Introduction
Cole crops are one of the most widely consumed vegetables throughout the world. These belong to family brassicaceae and genus Brassica. This group includes various types of vegetable crops. The two major crops of this group are cauliflower (*Brassica oleraceae* L. vor botrytis) and cabbage (*Brassica oleraceae* L. var capitata) (Anonymous., 2014). In India, a total of 37 insect pests have been reported to feed on cabbage (Lal 1976).Though an important vegetable crop, cabbage is known to be infested by several insect pests viz., tobacco caterpillar, *Spodoptera litura*Fabricius; diamondback moth, *Plutella xylostella* Linnaeus; cabbage leaf webber, *Crocodolomia binotalis* Zeller; aphids, *Brevicornye brassicae* Linnaeus and *Lipaphis erysimi* Kalt; painted bug, *Bagrada cruciferum* Kirk.; and flea beetle, *Phyllotreta cruciferae* Goeze (Rao and Lal, 2005) [13]. Out of these, diamondback moth, *Plutella xylostella* (L.) is the most destructive pest (Mahla *et al*., 2005; Kumar *et al*., 2007) [12, 9]. Throughout the world diamondback moth is considered the main insect pest of brassica crops, particularly cabbages, kales, broccoli and cauliflowers.
The diamondback moth (*Plutella xylostella* L.) is a major pest insect in more than 100 countries across the globe; it affects cruciferous plants, especially Brassica oleracea crops such as cabbage, cauliflower, broccoli, Brussels sprout and turnip (Mojan *et al*,2003).The economic impact of diamondback moth is difficult to assess since it occurs in diverse small scale and large-scale production areas, but it has been known to completely destroy cabbage and kale crops. In India the estimated annual crop losses due to this pest amount to 16 million USD. In India, diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield (Devjani and Singh, 1999 and Ayalew, 2006) [1].

Method and material
Studies on Seasonal Abundance of Diamondback Moth *Plutella Xylostella* (Lepidoptera: Plutellidae) On Cabbage Crop (*Brassica oleracea* var. *capitata* L.) were conducted at Vegetable seed production farm, Maharajpur, JNKVV, Jabalpur (M.P.) during the *Rabi* season from Sept., 2017 to March, 2018.Population of DBM larvae was recorded from untreated plant having plot size of 10m × 40m with spacing 60cm × 50cm (Row × plant).
Observations of *Plutella xylostella* were recorded on 20 randomly selected plants in a week. It was initiated after germination and was taken up to the harvesting of the crop. Correlation and

regression of the abiotic factors on *P. xylostella*were worked out by using the formula as suggested by Snedecor and Cochran (1967).

Correlation 'r' $= \Sigma XY - \Sigma X\Sigma Yn\sqrt{\{\Sigma X2 - (\Sigma X)2\}n\{\Sigma Y2 - (\Sigma Y)2\}n}$

Regression Y $= a + b\,x\,(R2)$

Result and discussion

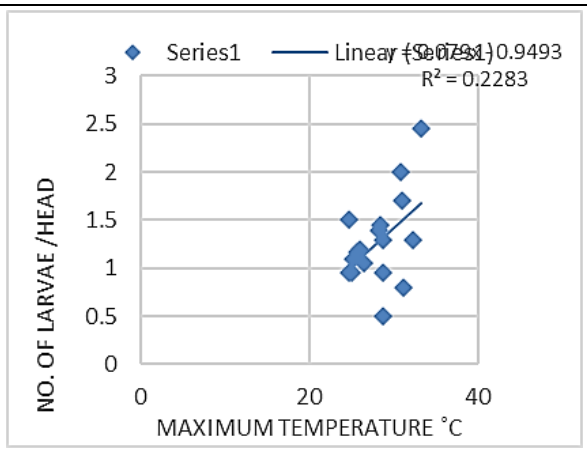
The larva of *Plutella xylostella* L. attacked on head formation stage of crop. The newly hatched larvae had been fed on green matter of the leaves. The grow larvae fed from the lower surface of leaves resulting in irregular patches. Mature larvae often bored into the edible parts of cabbage and make it unfit for consumption.

Table 1 shows the fluctuation in *Plutella xylostella* population throughout the season in different weeks. First incidence of *Plutella xylostella was* recorded on first week of December when the crop age was about 82 days' (0.5 larvae/Head) and was present till harvesting of the crop. The *P. xylostella* incidence, however, was found maximum during third week of March with population 1.95 larvae/head when maximum, minimum and average temperatures were 33.32˚C, 15.44˚C and 24.38 ˚C, respectively, whereas morning, evening and average relative humidity were 74.42%, 29.57% and 51.99%, respectively and rainfall was 0.11mm (Table 1.).

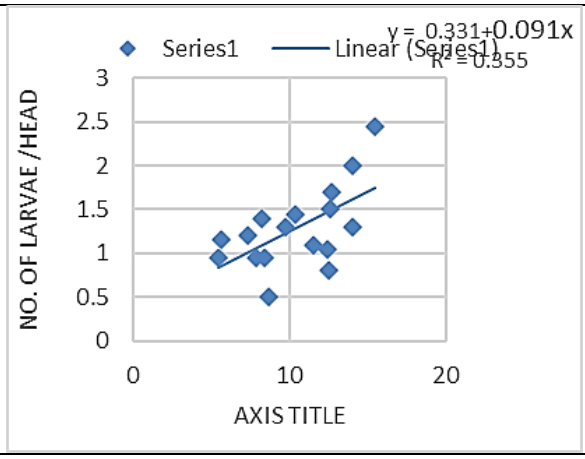
Table 1: Seasonal abundance of *Plutella xylostella* on cabbage crop with weather parameter

Standard Week	Duration	Diamond back moth (*Plutella xylostella*) Average Larval population/		Weather factors					
		Per Plant	Per 20 Plant	tem. Max	tem. Min.	sunshine	rainfall	Rh morning	Rh. Evening
Nursery									
37	11Sep.to 17 Sep.	0.00	0.00	31.7	23.6	1.9	18	89	65
38	18 Sep. to 24 Sep.	0.00	0.00	33	23.9	6.7	3.8	92	64
39	25 Sep. to 1 Oct.	0.00	0.00	29.9	23.5	4.6	52.4	94	83
40	2 Oct. to 8 Oct.	0.00	0.00	31.9	23.9	7.3	24.2	93	64
Transplanting									
41	09 to 15 Oct.	0.00	0.00	31.5	21.3	8	0	88	51
42	16 to 22 Oct.	0.00	0.00	31.5	15.4	9.3	0	91	32
43	23 to 29 Oct.	0.00	0.00	31.7	15.6	8.8	0	82	29
44	30 Oct.to 05 Nov.	0.00	0.00	29.7	12.3	8.7	0	87	34
45	06 to 12 Nov.	0.00	0.00	29.7	10.6	8.1	0	91	24
46	13 to 19 Nov.	0.00	0.00	28.3	8.1	8.1	0	88	24
47	20 to 26 Nov.	0.00	0.00	28.8	8.4	8.3	0	87	22
48	27 Nov.to 03 Dec.	0.00	0.00	28.8	8.7	8.7	0	89	27
49	04 to 10 Dec.	0.50	10.00	25.1	7.9	6.2	0	93	43
50	11 to 17 Dec.	0.00	0.00	26.1	7.3	7.8	0	91	28
51	18 to 24 Dec.	0.45	9.00	24.7	5.5	7.4	0	91	30
52	25 to 31 Dec.	0.66	13.20	25.7	5.6	8.6	0	88	29
1	01 to 07 Jan.	0.80	16.00	28.75	9.7	7.81	0	79.6	29.5
2	08 to 14 Jan.	1.00	20.00	24.67	12.6	9.11	0	88.2	29.2
3	15 to 21 Jan.	0.95	19.00	28.4	10.4	9.32	0	87.57	30
4	22 to 28 Jan.	1.20	24.00	31	12.7	9.15	0	74.7	24.7
5	29 Jan.to 04 Feb.	0.90	18.00	28.3	8.2	9.9	0	85.2	30.2
6	05 to 11 Feb.	0.55	11.00	26.6	12.4	5.4	0	81	51.85
7	12 to 18 Feb.	0.60	12.00	25.2	11.5	6.4	2.6	91.28	44.85
8	19 to 25 Feb.	0.30	6.00	31.2	12.5	9.8	0	80.28	28.42
9	26 Feb.to 04 march	0.80	16.00	32.4	14	8.9	2.1	79	26.14
10	05 to 11 march	1.50	30.00	30.88	14.07	6.87	0	75	32.85
11	12 to 18 march	1.95	39.00	33.32	15.44	7.41	0.11	74.42	29.57

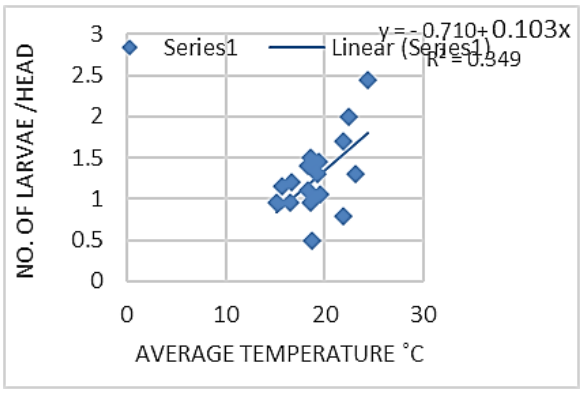
Table 2: Regression analysis of larval population with metereological data



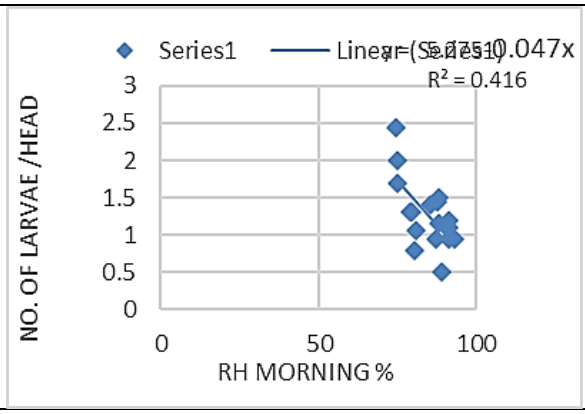
Regression of maximum temperature on *P. xylostella* infesting cabbage



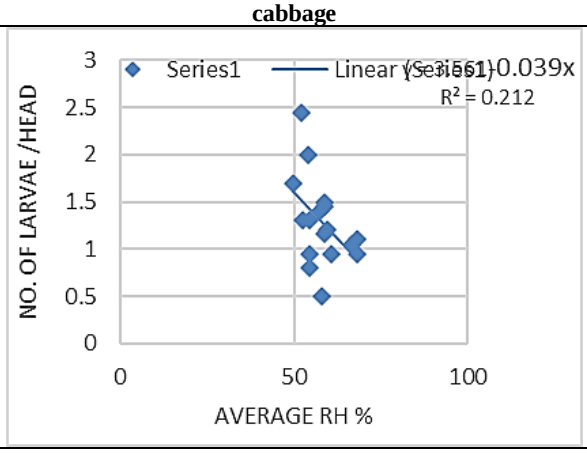
Regression of minimum temperature on *P. xylostella* infesting cabbage



Regression of average temperature on *P. xylostella* infesting cabbage



Regression of morning relative humidity on larva population of *P. xylostella*



Regression of average relative humidity on population of *P. xylostella* infesting cabbage

Temperature maximum, temperature minimum and temperature average showed positive correlation (r= 0.58*, 0.58*, 0.63** respectively) and morning and average relative humidity showed negative correlation (r=-0.63**, -0.57*). All of these were found statically significant (Table 3).

Table 3: Correlation (r) and regression coefficient (byx) of abiotic factors on *Plutella xylostella* infesting cabbage 2017-2018.

Weather factor	*Plutella xylostella*	
	r	Byx
Max. temp.(°C)	0.58*	-0.07
Min. temp.(°C)	0.58*	0.09
Average temp.(°C)	0.63**	0.10
Rainfall (mm)	-0.13NS	-
Morning RH (%)	-0.63**	-0.04
Evening RH (%)	-0.31NS	-
Average RH (%)	-0.574*	-0.03

NS – Non significant, * - significant at 1%, ** - significant at 5%

The regression equation being (Table 2):

y = - 0.94 + 0.07x (R^2 = 0.22)
y = 0.33+0.09x R^2 = 0.35)
y = - 0.71+ 0.10x (R^2 = 0.34)
y = 5.27 -0.04x (R^2 = 0.41)
y = 3.56 -0.03x (R^2 = 0.21)

From the above equations, it may be expressed that with every unit increase in maximum, minimum and average temperature there was an increase of 0.07, 0.09, 0.10 larvae*P. xylostella* per head and average 1.4, 1.8 and 2 larvae per 20 plants respectively. With every unit increase in morning and average relative humidity there was decrease in 0.04 and 0.03 larvae of *P. xylostella* respectively.

First appearance of the *P. xylostella* was observed when the crop age was about 82 days'*i.e.* first week of December (49th SW) and remained available up to harvesting of the crop *i.e.* 11th standard week and its population peaked in mid-March. Similar findings have been reported by Sachan and Srivastava (1972) [6], Barrantes A. *et al.* (1996) [2], Bhagat *et.al.* (2018) [8]. Lee (1986) [5] and Patel, (2002) also reported similar findings that the *Plutella xylostella* was abundant in December to March with a population peak in February, which are more or less in accordance with the finding of the present investigation. Devi *et al.* (2004) [4] reported *Plutella xylostella* appeared in February end and its population peaked in mid-April. This supports the finding of the present investigation.

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