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DISTRIBUTION PATTERN OF DIAMONDBACK MOTH, *Plutella xylostella* (L.) ON CABBAGE UNDER GANGETIC ALLUVIAL CONDITION OF WEST BENGAL

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ABSTRACT: Distribution pattern of diamondback moth larvae *Plutella xylostella* (L.) on cabbage (*Brassica oleracea* var. *capitata* L.) was studied under Gangetic Alluvial condition of West Bengal in three consecutive cabbage seasons (early cabbage, on season cabbage and late cabbage) during 2009-10. Various indices like dispersion parameter 'K', index of dispersion (Id), reciprocal of the exponent K, Cole's Index, Charlier Coefficient, Lloyd index of mean crowding and Lloyd index of patchiness confirmed that the distribution pattern of the diamondback moth larvae under the study in three crop seasons was aggregative in nature.

Keywords: *Diamondback moth, distribution pattern, cabbage, Gangetic alluvial condition.*

The cabbage, *Brassica oleracea* var *capitata* L. is a plant of the family Brassicaceae (or Cruciferae). It is a herbaceous and dicotyledonous flowering plant with leaves forming a characteristic compact cluster. The cabbage is derived from a leafy wild mustard plant, native to the Mediterranean region. It was known to the ancient Greeks and Romans. Cato the Elder praised this vegetable for its medicinal properties, declaring that "it is first of all the vegetables" (Anon., 1). Cabbage, a leaf vegetable, is an excellent source of vitamin C. It also contains significant amounts of glutamine, an amino acid, which has anti-inflammatory properties. The diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), has become an important pest of cruciferous crops and has got worldwide distribution (Zhang, 12). The pest is most destructive insect of cruciferous plants throughout the world and the annual cost for managing it is estimated to be US $1 billion (Talekar, 10). Spatial distribution is one of the important ecological properties of a species (Taylor, 11). This provides reliable estimation of field population densities, an essential component in pest management programme. A study on distribution pattern of diamondback moth on cabbage is much wanting in West Bengal. Hence distribution pattern of larvae of the pest on cabbage was investigated under Gangetic Alluvial condition, the vegetable belt of West Bengal.

MATERIALS AND METHODS

Cabbage variety 'Green Express' was transplanted in the field at Goyespur C.R. farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal during three consecutive cabbage seasons i.e. early cabbage, on season cabbage and late cabbage in 2009-10. Recommended package of practices were followed throughout the crop seasons except any pesticide application. Fourty plants were randomly selected from the field for larval count of diamondback moth at 5 days interval starting from the 16th days after transplanting. The data on the original counts were arranged in the frequency distribution. Mean ($\overline{X}$) and Variance (s^2) were worked out for the date wise observations following usual statistical procedures. On the basis of mean and variance, statistical tests were then applied to confirm the distribution pattern of diamondback moth. Different indices were calculated as per the procedure suggested by Elliott (3).

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(a) Dispersion parameter (*K*)

$$K \quad \frac{x^{2}}{s^{2} \quad \bar{x}}$$

The value of '*K*' below eight indicates negative binomial aggregated distribution (Southwood, 9).

(b) Index of dispersion (variance-mean ratio)

$$I_{d} \quad S^{2} / \bar{X}$$

This index of dispersion often departs from unity. A value of zero for the index implies maximum regularity and a value greater than one for the aggregative distribution.

(c) Reciprocal of the exponent '*K*'

It was worked out to know the clumping bahaviour of individuals in the population. Calculated value of exponent $K < 8$ and its reciprocal $1/k > 0$ with positive sign indicates contagious nature of distribution.

(d) Cole's index of dispersion

It was worked out by using the formula

$$I_{c} \quad \frac{x^{2}}{(\ x)^{2}}$$

If the value of Cole's index I_c is greater than the value of maximum regularity, 1/n, (*n* = no of samples) then it indicates the aggregative nature of dispersion.

(e) Charlier Coefficient

$$= 100 \quad \sqrt{\ }(S^{2} \quad \bar{X}) \quad 1/\bar{X}$$

If the value of Charlier Coefficient is significantly more than zero then it refers to the contagious nature of population.

(f) Lloyd index (5) of mean crowding (*x*) :

This index was developed by Lloyd in the year 1967. The index is calculated by the formula :

$$x \quad \bar{x} \qquad \frac{s^{2}}{\bar{x}} \quad 1$$

(g) Lloyd index (5) of patchiness:

It is the ratio of mean crowding to mean density (mean population). It is a suitable measure of patchiness of a population. If the ratio (Lloyd index of patchiness) is greater than one then it indicates the contagious nature of distribution.

RESULTS AND DISCUSSION

The values of mean larval population at 5 days interval and the various indices recorded during study are illustrated in the Tables 1 to 3. The count of the diamondback moth larvae were taken from the 15th day after transplanting till it was found on the crop.

The values of dispersion parameter (K) – an index of aggregation were less than eight in all the dates of observations. Reciprocal of the exponent K values were more than zero with positive signs for all the dates of observations in all the three experiments. These indicated the clumping bahaviour of individuals in a population. The findings are in accordance with the statement of Southwood (9) who reported that if K value is <8 it indicates aggregative nature of dispersion.

In all the three crop seasons variance to mean ratio or the index of dispersion (I_d) was more than one which suggested that the larval population of diamondback moth were aggregative nature distribution.

In all the observations of the experiments, the values of the Cole's Index (I_c) were more than the values of maximum regularity (1/n). This was another confirmation of the clumping nature of distribution of DBM. The observations also exposed that the Charlier coefficients were significantly more than zero which referred to the contagious nature of DBM larvae.

Lloyd patchiness index ranged between 1.142-2.756, 1.211-3.937 and 1.174-1.686 in the early cabbage, on season cabbage and late cabbage respectively (Table 1, 2 and 3). The values were greater than one which again established that the distribution pattern of the larvae of diamondback

Table 1: Distribution pattern of diamondback moth, *P. xylostella,* on early cabbage during 5th October, 2009 to 9th November, 2009.

Date of taking observation	Crop age (Days)	No. of samples	Mean $\bar{X}$	Variance S^2	Dispersion Parameter $K \frac{\bar{X}^2}{S^2 \bar{x}}$	Index of Dispersion $I_d = S^2/ X$	Reciprocal of K=(I/K)	Maximum Regularity (1/n)	Cole's Index $I_C = x^2/(\bar{x})^2$	Charlier Coefficient $100 \sqrt{S^2 \bar{X}} 1/\bar{X}$	Lloyd index of mean crowding $x = \bar{x} + [(s^2/\bar{x})] 1$	Lloyd patchiness index
05/10/09	15	40	0.475	0.871	0.570	1.834	1.756	0.025	0.119	132.507	1.309	2.756
10/10/09	20	40	0.875	0.984	7.026	1.125	0.142	0.025	0.056	37.727	1.000	1.142
15/10/09	25	40	1.350	2.900	1.176	2.148	0.850	0.025	0.064	92.221	2.498	1.850
20/10/09	30	40	1.850	3.977	1.609	2.150	0.621	0.025	0.053	78.832	3.000	1.621
25/10/09	35	40	1.750	3.936	1.401	2.249	0.714	0.025	0.056	84.484	2.999	1.714
30/10/09	40	40	1.500	3.333	1.227	2.222	0.815	0.025	0.061	90.267	2.722	1.815
04/11/09	45	40	1.425	2.610	1.714	1.831	0.583	0.025	0.056	76.379	2.256	1.583
09/11/09	50	40	0.900	1.426	1.541	1.584	0.649	0.025	0.068	80.557	1.484	1.649

Table 2: Distribution pattern of diamondback moth, *P. xylostella*, on cabbage during 23rd November, 2009 to 18th December, 2009 (on season cabbage)

Date of taking observation	Crop age (Days)	No of samples	Mean X	Variance S^2	Dispersion Parameter $K \frac{\bar{X}^2}{S^2 \bar{x}}$	Index of Dispersion $I_d = S^2/ X$	Reciprocal of K=(I/K)	Maximum Regularity (1/n)	Cole's Index $I_C = x^2/(\bar{x})^2$	Charlier Coefficient $100 \sqrt{S^2 \bar{X}} 1/\bar{X}$	Lloyd index of mean crowding $x = \bar{x} + [(s^2/\bar{x})] 1$	Lloyd patchiness index
23/11/09	15	40	0.425	0.712	0.629	1.676	1.590	0.025	0.1211	126.092	1.101	2.590
28/11/09	20	40	0.825	0.969	4.740	1.174	0.211	0.025	0.0597	45.931	0.999	1.211
03/12/09	25	40	1.025	1.256	4.553	1.225	0.220	0.025	0.0541	46.867	1.250	1.220
08/12/09	30	40	0.750	0.910	3.510	1.214	0.285	0.025	0.0644	53.376	0.964	1.285
13/12/09	35	40	0.600	0.759	2.265	1.265	0.442	0.025	0.0764	66.453	0.865	1.442
18/12/09	40	40	0.325	0.635	0.340	1.955	2.937	0.025	0.1716	171.387	1.280	3.937

Table 3: Distribution pattern of diamondback moth, *P.xylostella*, on late cabbage during 28th February, 2010 to 2nd April, 2010

Date of taking observa-tion	Crop age (Days)	No of samples	Mean X	Vari-ance S^2	Disper-sion Para-meter $K\ \frac{\bar{X}^2}{S^2\ \bar{x}}$	Index of Disper-sion $I_d = S^2/X$	Recipro-cal of K=(l/K)	Maximum Regul-arity (1/n)	Cole's Index $I_C = x^2/(\bar{x})^2$	Charlier Coefficient $100\ \sqrt{S^2\ \bar{X}}$ / $1/\bar{x}$	Lloyd index of mean crowding $x = \bar{x} + [(s^2/\bar{x})]\ 1$	Lloyd patchiness index
28/02/10	15	40	1.150	1.823	1.965	1.585	0.509	0.025	0.0586	71.340	1.735	1.509
04/03/10	20	40	1.725	3.640	1.554	2.110	0.644	0.025	0.0548	80.230	2.835	1.644
09/03/10	25	40	1.950	2.613	5.737	1.340	0.174	0.025	0.0417	41.751	2.290	1.174
13/03/10	30	40	2.775	6.640	1.992	2.393	0.502	0.025	0.0460	70.849	4.168	1.502
18/03/10	35	40	3.300	10.677	1.476	3.235	0.677	0.025	0.0489	82.305	5.535	1.677
23/03/10	40	40	3.700	13.087	1.458	3.537	0.686	0.025	0.0483	82.807	6.237	1.686
28/03/10	45	40	5.750	20.244	2.281	3.521	0.438	0.025	0.0399	66.209	8.271	1.438
02/04/10	50	40	4.500	16.769	1.650	3.726	0.606	0.025	0.0452	77.839	7.260	1.606

moth was aggregative distribution. The study further indicated that aggregation was species characteristic, as it did not alter even in different cabbage seasons.

Distribution pattern of diamondback moth on cabbage have been studied by various scientists in different parts of India but it is reported by the present author for the first time from West Bengal.

Rai *et al.* (7) studied the spatial distribution of diamondback moth on cabbage and cauliflower at Panipat (Haryana), Jaunpur (Uttar Pradesh) Ranchi (Jharkhand) and Delhi during 1988-89 and they found the aggregative pattern of distribution of the pest on both the crops which corroborates the finding by the present author. Reddy *et al.* (8) reported spatial distribution of DBM larvae on cabbage at Hyderabad during 1994-95. They calculated several indices like variance-mean ratio, Coles Index, K of negative binomial and Lloyds Index of mean crowding which showed aggregative nature of distribution of diamondback moth. The value of these indices in present study also supported the same distribution pattern as reported by Reddy *et al.* (8) and Mishra *et. al.* (6). The findings of the present study also corroborated the distribution pattern as reported by Koteswara Rao and Lal (4) who also reported spatial distribution pattern of DBM larvae on cabbage under Delhi condition.

REFERENCES

1. Anonymous (2005). Cabbage: Cabbage History, Cabbage Facts & Recipes. USDA Nutrient Database. Available from http://www.nal.usda.gov/2005/fnic/food.
2. Cole, L.C. (1946). A theory for analyzing contagiously distributed populations. *Ecology,* **27** : 329-341.
3. Elliott, J.M. (1977). Some methods for statistical analysis of benthic invertebrates. Fresh water biological association. Scientific Publication- 25, P. 156 .
4. Koteswara Rao, S.R. and Lal, O.P. (1999). Distribution pattern of diamondback moth

Plutella xylostella L. on cabbage under Delhi condition. *J. Entomol. Res.,* **23** : (3), 261-265.

5. Lloyd, M. (1967). Mean crowding. *J. Anim. Ecol.,* **36:** 1-30.
6. Mishra, J., Singh, S., Tripathi, A. and Chaube, M.N. (2012). Population dynamics of oriental fruit fly, *Bactrocera dorsolis* (Hendel) in relation to abiotic factors. *HortFlora Res. Spectrum*, **1**(2) : 187-189.
7. Rai, S., Srivastava, K.M., Saxena, J.D. and Sinha, S.R. (1992). Distribution pattern of diamondback moth (*Plutella xylostella*) L. on cabbage and cauliflower. *Indian J. Ento.,* **54**(3) : 262-265.
8. Reddy, C.N., Singh, T.V.K., Reddy, D.D.R. and Goud, T.R. (1996). Distribution pattern of diamondback moth (*Plutella xylostella*) on cabbage at Hyderabad. *Indian J. Entom.*, **58** (4) : 306-309.
9. Southwood, T.R.E. (1978). The sampling programme and the measurement and description of dispersion. In: Ecological Methods. The English language book society and Chapman & Hall University Printing House, Cambridge, Great Britain. pp.7-69.
10. Talekar, N.T. (1992). Management of diamondback moth and other crucifer pests: In: Proceedings of the Second International Workshop. Shanhua, Taiwan: Asian Vegetable Research and Development Center. P. 603.
11. Taylor, L.R. (1984). Assessing and interpreting the spatial distribution of insect population. *Annual Rev. Entom.*, **29** : 321-327.
12. Zhang, B.C. (1994). *Index of Economically Important Lepidoptera.* University Press, Cambridge. P.404