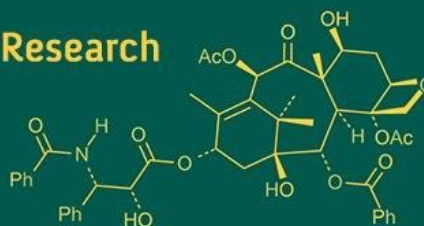


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Population dynamics of major lepidopteran insect pests on cabbage (*Brassica oleracea* var. *capitata*)

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Abstract

An experiment was conducted to observe the population dynamics of cabbage insect pests viz., diamondback moth, cabbage head borer, cabbage leaf webber, cabbage aphid and ladybird beetle on cabbage during *Rabi* season, 2022-23 at Organic Research Farm Kargua ji, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (Uttar Pradesh). The major activity period of the diamondback moth (*Plutella xylostella*) population appeared during the 49th SMW and the peak incidence during the 4th SMW (9.9 larva/plant) and cabbage head borer (*Hellula undalis*) caterpillar population initiated during the 51th SMW and reach its peak incidence 3rd SMW (5.9 larva/plant) respectively while cabbage leaf webber (*Crocidolomia binotalis*) appeared from 48th SMW to 9th SMW with a peak incidence in 1st SMW (4.9 larva/plant). Cabbage aphid (*Brevicoryne brassicae*) were observed from 49th SMW to 9th SMW with peak incidence in 6th SMW (42.7 larva/plant) and ladybird beetle (*Coccinella septempunctata*) appeared from 49th SMW to 9th SMW with peak incidence 5th SMW (2.4 larva/plant) respectively. To determine the efficacy of Eight bio-pesticides viz. Neem oil 0.5%, Garlic extract, *Bacillus thuringiensis* 5%WP, Castor oil 3%, Karanj oil 0.5%, *Beauveria bassiana* 5%WP, NSKE 5%, *Metarizium anisopliae* 5% WP and one untreated control was taken against (*Plutella xylostella* L.) in cabbage.

Keywords: Diamondback moth, leaf webber, aphid, NSKE 5%, neem oil and castor oil

Introduction

The importance of vegetables in human diets is well known among different vegetable cole crops economically important throughout the world. In India, cabbage and cauliflower are two important vegetable crops, grown in different states of the country. In India, it is cultivated in 410.00 thousand ha area with 9869 MT. production and the volume of cabbage production in India is estimated to have an amount of about 9.72 million metric tons. In Uttar Pradesh, the total area of cabbage is 12.2 thousand ha with 348.94 thousand MT. production [1, 2]. Cabbage leaves are low in calories 27 percent, fat 0.1 percent and carbohydrates 4.6 percent also a good source of protein 1.3 percent which contains all essential amino acids Cabbage is an excellent source of minerals such as calcium 39 mg, iron 0.8 mg, magnesium 10 mg, sodium 14.1 mg potassium 114mg and phosphorus 44 mg. It is a rich source of vitamin A 2000 I.U. B1 50 I.U. and C 124 mg/100gm [4]. Insect pests, diseases and weeds are the major constraints limiting agricultural Productivity and growth. It is estimated that herbivorous insects eat about 26 percent of the Potential food Production [6].

Cabbage is attacked by several insect pests due to their succulent nature and year-round availability. More than 27 species of insect pests are reported on cabbage in India(of which 11 belonged to order Lepidoptera, 5 to Orthoptera, 3 each to Heteroptera and Coleoptera, 2 each to Homoptera and Hymenoptera and 1 to Diptera. Among these, fourteen pests have so far been recorded infesting cabbage crops. The insect pests attacking cabbage are diamondback moth (*Plutella xylostella* Linnaeus), cabbage butterfly (*Pieris brassicae* Linnaeus), tobacco caterpillar (*Spodoptera litura* Fabricius), cabbage semi loopier (*Trichoplusia ni*. Hubner), aphid (*Brevicoryne brassicae* Linnaeus), painted bug (*Bagrada cruciferarum* Kirkaldy), cabbage leaf webber (*Crocidolomia binotalis* Zeller), cabbage head borer (*Hellula undalis* Fabricius), cabbage flea beetle (*Phyllotreta cruciferae* Goeze) and bihar hairy caterpillar (*Spilosoma oblique* Walk) are observed commonly on cabbage in different seasons and cause considerable losses. The present studies on population dynamics of major pests of cabbage would give an idea about their peak period of activity and may

help develop pest management strategies against them. Indigenous products viz. Neem products are not only effective against crop pests but also ecologically safe and free from residual problems. Neem oil 1 percent water extract of neem leaves 40 percent and neem kernel extract 2 percent have been found effective against bud fly in linseed [3]. and so, attention is now being focused on the use of biopesticides. *Beauveria bassiana* constitutes an important component to supplement or as an alternative to synthetic chemicals. Keeping these facts in view present study was conducted to evaluate the efficacy of indigenous products and the Entomopathogenic fungus *Beauveria bassiana* against *Plutella xylostella* L. under laboratory conditions. While only 1 percent of the global insecticide market is occupied by the two insecticides (*bt.* based products) and insecticides of plant origin (Pyrethrum and neem-based products) toxicity and development of resistance issues have limited the use of this synthetic insecticide therefore, It is desirable to develop alternative methods for pest management based on biological pesticides, which are safe for both humans and the environment.

Considering the above points the present study entitled "Population dynamics of major lepidopteran insect pests of cabbage and management of diamondback moth (*Plutella xylostella* L.) using different bio-pesticides." was carried out under Bundelkhand region of Jhansi.

Materials and Methods

The Experiment was carried out in an organic research farm at Kargua Ji Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University Jhansi Uttar Pradesh during the *Rabi* season, 2022-2023. It is situated at 78°36^E Longitude and 25°47^N Latitude and is about 178.37 m above mean sea level. The climate is subtropical and semi-arid. The preparation of the field was done by a tractor-drawn cultivator followed by two cross-harrowing to pulverize the soil. Finally, the field was levelled with leveler and then channels were prepared according to the layout three replication and net plot size 2.0 x 2.60 m² of the experiments. The seedlings were sown on raised nursery beds and transplanted after 29 days in the laid-out field. The variety cabbage golden acare used for seed sowing. Seeds were sown on 10.10.2022 in *Rabi* season 2022-2023. Transplanting was done in the field at the spacing of 60 cm x 45 cm on 09.11.2022 in *Rabi* 2022-2023. Protective irrigation was given immediately after transplanting. The observations of major insect pests on cabbage crop were recorded on randomly selected 5 plants, one plot twice in a standard week. Observations on different insects were recorded as follows diamondback moth, aphid, leaf webber, cabbage head borer and ladybird beetle. The observation starts from transplanting and continues till the maturity of the crop. The population of cabbage insect pests was recorded by counting the number of larvae/plant. The population of insects was recorded by counting the number of nymphs and adults per leaf (top, middle and bottom) plant. The data recorded on major insect pests and meteorological parameters were used for statistical analysis. To infer the results of population dynamics was worked out between populations of insect pests.

Method of recording observations: To study the population dynamics of major lepidopteran insect pests of cabbage (*Brassica oleracea* var. *capitata*) the observations of major insect pests on cabbage crop were recorded on 5

plants selected randomly one plot twice in a standard week. Observations on different insects were recorded as follows diamondback moth, aphid, leaf webber, cabbage head borer and ladybird beetle. For DBM (*Plutella xylostella* L.) pre-treatment observation was recorded at the 3rd, 7th, and 14th days after first and second spraying on 5 plants selected randomly. Observation on DBM insects was recorded as follows. The populations of diamondback moth (both larvae as well as adult; alate and apterous) were recorded visually (absolute count.) on leaves, one each from the top, middle and bottom canopy of each tagged plant in the early morning hours.

$$\text{Quantity of Bio-pesticides required} = \frac{\text{Desired strength} \times \text{Quantity of Spray Formulation}}{\% \text{ of Bio-pesticidal formulation material required}}$$

Result and Discussion

***Brassica oleracea* var. *capitata*:** In the present investigation the crop was found infested mainly with diamondback moth (*Plutella xylostella* L. leaf webber *Crocidolomia binotalis* Z. cabbage head borer *Hellula undalis* F. cabbage aphid *Brevicoryne brassica* L. ladybird beetle *Coccinella septempunctata* L. The observations were recorded at weekly intervals during morning hours between 7.00 a.m. to 9.00 a.m. during 2022-23. The data on population dynamics of cabbage insect pests are presented in Table 1.

The diamondback moth, (*Plutella xylostella* L.): The observation regarding the larval population of the diamondback moth (DBM) revealed that the population varied from 0.5 to 9.9/plant during 2022-2023. DBM first appeared during the 49th SMW (3-9 Dec.) with intensity of 0.5/plant. Then the population gradually increased and attained peak during the 4th SMW (22-28 Jan.) when the maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, evaporation, rainfall and wind velocity were 22 °C, 8.2 °C, 94.0%, 62.0%, 1.5 mm, 7.00 mm, and 8.9 Km/hr, respectively. After that, the population decreased up to the 9th SMW (26 Feb- 04 Mar.) at the end of the season. The data on the population dynamics diamondback moth (DBM) is depicted in Fig 1.

Present observations were more or less similar to the results of earlier workers [7]. The larval population of DBM, head borer, leaf webber, cabbage semi looper and tobacco leaf-eating caterpillar ranged from 1.2 to 5.5, 0.45 to 1.8, 2.0 to 7.0, 0.77 to 1.2 and 1.98 to 3.2, respectively. The infestation of DBM, head borer, leaf webber and cabbage semi-looper was initiated during the 47th SMW and of tobacco leaf-eating caterpillar during the 46th SMW. The peak incidence of DBM, head borer, leaf webber, cabbage semi looper and tobacco leaf-eating caterpillar was observed during 51st, 3rd, 48th, 49th and 49th SMW, respectively during 2016-17 [5]. Studies on population dynamics of diamond backmoth, *Plutella xylostella* (Linnaeus) on cabbage revealed that the pest population of (*Plutella xylostella* Linnaeus) appeared from the third week of December which gradually increased and attained a peak of 8.9 larvae per plant during fourth week January. It indicated that the pest was more active during January the peak population of DBM (9.9/plant). First fortnight of January.

Cabbage head borer, (*Hellula undalis* F.): The observation on larval count of cabbage head borer depicted

that the larval population ranged from 2.2 to 5.9/plant during 2022-2023. The activity of cabbage head borer caterpillar initiated during 51st SMW (17-23 Dec.) with gradual increase its population and reach its peak (5.9/plant) 3rd SMW (15-21 Jan.) when the maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, evaporation, rainfall and wind velocity were 26.4 °C 7.0 °C, 90%, 66%, 3.4mm, and 6.9 Km/h, respectively. After that, the larval population decreased up to 9th (26 Feb-04 Mar.) (0.5/plant). The data on population dynamics of cabbage head borer caterpillar is depicted in Fig 1.

Cabbage leaf Webber, (*Crocidolomia binotalis* Z.): The observation on the larval count of cabbage leaf webber depicted that the larval population ranged from 0.3 to 4.9/plant during 2022-2023. The incidence of cabbage leaf webber was noticed from the 48th SMW (26 Nov-02 Dec.)

to the 9th SMW (26 Feb-04 Mar.). The peak incidence was observed in 1st SMW when the maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, evaporation, rainfall and wind velocity were 20.0 °C, 3.2 °C, 100%, 78%, 0.0mm, 0.00mm, 6.5 Km/hr respectively. After that, the larval population decreased up to the 9th SMW (26 Feb-04 Mar.) (0.2/plant). The data on population dynamics in cabbage leaf webber is depicted in Fig 1.

Present observations were more or less similar to the results of earlier workers^[7]. have reported leaf webber *C. binotalis* (maximum 3.00 larvae/plant in 2nd SMW). (Pawar *et al.*,) have reported leaf webber on mustard revealed that the pest was active from the 3rd week of November to the 4th week of December the pest population ranged between 1.10 to 9.0 larvae per plant throughout the season^[3]. peak population of leaf webber (3.07/leaf). Second fortnight of January.

Table 1: Population dynamics of cabbage insect pest with meteorological data during *Rabi* season 2022-23.

SMW	No of Insects /Plant					Temperature (°C)		RH (%)		Wind Velocity	Rain all	No. of Rainy days	Evaporation
	Diamondback moth	Cabbage Head Borer	Cabbage Leaf Webber	Cabbage Aphid	Ladybird beetle	Max.	Man.	Max.	Man.	(Km/h)	(mm)	hrs./day	(mm)
41	0.0	0.0	0.0	0.0	0.0	33	19	93	56	9.4	48.4	5	5.4
42	0.0	0.0	0.0	0.0	0.0	34	18	80	60	6.4	0	0	0.0
43	0.0	0.0	0.0	0.0	0.0	35	17	72	50	8.8	0	0	0.0
44	0.0	0.0	0.0	0.0	0.0	35.5	15	84	42	5.6	0	0	0.0
45	0.0	0.0	0.0	0.0	0.0	35.5	16	71	33	4.8	0	0	0.0
46	0.0	0.0	0.0	0.0	0.0	32	12	84	60	7.8	0	0	0.0
47	0.0	0.0	0.0	0.0	0.0	29.5	10.8	98	57	6.2	0	0	0.0
48	0.0	0.0	0.3	0.0	0.0	28.5	10	73	61	5.2	0	0	0.1
49	0.5	0.0	0.7	4.7	0.1	27	12.6	87	60	5.9	0	0	0.1
50	0.7	0.0	2.0	7.4	0.4	29.5	12.4	59	37	6.6	0	0	0.0
51	2.3	2.2	2.3	15.7	0.5	26.5	6.6	68	59	5.3	0	0	0.0
52	3.1	2.6	3.7	18.8	0.7	22	5	56	36	7.9	0	0	2.2
1	5.3	4.3	4.9	19.4	0.7	20	3.2	100	78	6.5	0	0	0.0
2	7.2	5.0	2.0	20.5	0.7	26.5	3.8	75	62	5.9	0	0	4.1
3	9.0	5.9	1.7	26.7	0.8	26.4	7	90	66	6.9	0	0	3.4
4	9.9	2.3	1.1	33.1	1.0	22	8.2	94	62	8.9	7	1	1.5
5	8.5	2.1	1.1	41.0	2.4	28.4	10	100	67	9.8	0	0	5.2
6	7.5	1.3	1.0	42.7	0.8	32	13.5	98	48	7.9	0	0	1.7
7	5.0	1.3	0.9	11.9	0.7	32	10	75	51	6.5	0	0	0.0
8	3.1	0.9	0.5	9.1	0.7	35	15	80	46	7.6	0	0	0.0
9	2.5	0.5	0.2	7.1	0.5	35	14	66	53	8.6	0	0	0.2

Source of meteorological data KVK Jhansi, (U. P)

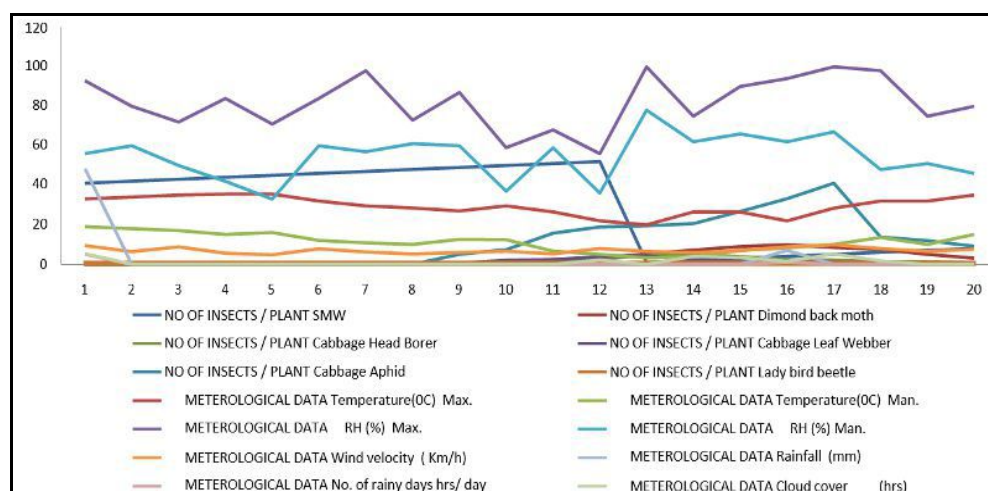


Fig 1: Population dynamics of cabbage insect pests with meteorological data during *Rabi* season 2022-23.

Cabbage aphid, (*Brevicoryne brassica* L.): Trend of incidence of aphids on cabbage, aphid population ranged from 4.7 to 42.7/plant during 2022-2023. The incidence of cabbage aphids was noticed from 49th SMW (03-09 Dec.) to 9th SMW (26 Feb-03 Mar.). The peak incidence was observed in the 6th SMW when the maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, evaporation, rainfall and wind velocity were 32.0 °C, 13.5 °C, 98%, 48%, 1.7mm, 0.00mm, and 7.9Km/hr respectively. After that, the cabbage aphid population decreased up to 9th SMW (26 Feb-04 Mar.) (7.1/plant). The data on the population dynamics of cabbage aphid is depicted in Fig 1.

Ladybird beetle, (*Coccinella septempunctata* L.): The observation of ladybird beetle (Grub and adult) on cabbage indicated that the population ranged from (0.1 to 2.4/plant) during 2022-23. Ladybird beetle appeared with the intensity of (0.1/plant) and increased gradually attaining a peak (2.4/plant) 5th SMW when the maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, evaporation, rainfall and wind velocity were 28.4 °C, 10.0 °C, 100%, 67%, 1.6mm, 5.2mm, and 9.8 Km/hr, respectively. After that, the population declined and sustained up to 9th SMW (26 Feb-04 Mar.) the data on the population dynamics occurrence of the ladybird beetle is depicted in Fig 1.

Present observations were more or less similar to the results of earlier workers^[8]. the incidence of ladybird beetle initiated in the second fortnight of December (0.30/leaf) with a gradual increase and attained its peak in the second fortnight of January (2.13/leaf). The population gradually decreased and reached its minimum during the second fortnight of Feb (0.78/leaf).

Conclusion

Based on number of populations per infestation. DBM, Cabbage Head Borer, Cabbage Leaf Webber, Cabbage Aphids and Cabbage Ladybird beetle were recorded as major insect pests in cabbage crop and noticed from 49th SMW, 51th SMW, 48th SMW, 49th SMW and 49th SMW or peak level presence 9th, 3rd, 1st, 6th and 5th SMW.

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Competing Interests

The authors have declared that no competing interests exist.

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