

# Documentation of the Major Insect Pest of Cabbage and Their Associated Natural Enemies in Bihar, North-eastern India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present investigation was conducted at farm of ICAR-Research Centre for Eastern Region (ICAR-RCER), Patna, Bihar during 2020-21. Geographically, ICAR-RCER, Patna is located at 25°35'30" N latitude, 85°05'03" E longitude, at an altitude 52m above mean sea level. The climate of the region is warm and temperate which is characterized by extremes of the temperature both during summer and winter. During summer, temperature may rise as high as 39°C and in winter it may fall as low as 2-3°C. The total annual average rain fall is 1130mm. This region provides a safe long growing season for most of the crops. Diamond back moth was found to be the most serious insect pest of cabbage. The infestation appeared during first week of January (SMW1) at vegetative stage and remained present up to the harvesting of the crop i.e. 11th SMW. Among the natural enemies, two species of coccinellids (*Coccinella septempunctata*, *C. transversalis*), one larval parasitoid (*Cotesia plutellae*) and one Syrphid fly (*Toxomerus geminatus*) and one unidentified spider was observed during crop period.

**Keywords:** Cabbage aphid; diamondback moth and natural enemies.

## 1. INTRODUCTION

Cole crops are one of the most popular and highly remunerative vegetable crops grown throughout the world. Cole crops are one of the most abundantly consumed vegetables all over the world. Among the various Cole crops, cabbage and cauliflower are most widely grown on commercial scale in India. They belong to the genus *Brassica* of the family Brassicaceae. Cabbage (*Brassica oleracea* var. *capitata*) and cauliflower (*Brassica oleracea* var. *botrytis*) are the most widely grown Cole crops of India. India is the second leading country in producing Colecrops with the production and productivity of 8.5 million tonnes and 19.8 metric tonnes per ha, respectively [1]. Per cent contribution of cabbage and cauliflower production in India from eastern part of India is more than 40%, among them West Bengal (2288.50 thousandtonnes;25.32%), and Bihar and Jharkhand(999.64 tonnes; 11.06%) are on top(NHB, 2018-19). In spite of large scale and in discriminate applications of insecticides, the pests have been found to occur in severe for minallcole crop growing areas, especially diamond backmoth, *Plutella xylostella* (L.); commoncut worm, *Spodoptera litura*(F.); cabbage butterfly, *Pieris brassicae* (L.); cabbage aphids, *Brevicoryne brassicae* L. and *Lipaphis erysimi*; cabbagelooper, *Trichoplusia ni* H.; head borer, *Hellula undalis* (F.); cabbage leaf webber, *Crociodolomia bionotalis*(Zell); paintedbug, *Bagrada cruciferarum*(Kirk.) and fleabeetle, *Phyllotreta cruciferae* (Goeze) etc. [2,3,4]. Out of these, aphid, *L. erysimi* and diamondback moth,*P. xylostella* are reported as major pests insemi-arid region of Rajasthan causing significant losses [5,6]. Cabbage is being cultivated widely in the eastern part of India and subjected to attack by numerous insect pests which act as one of the production constraints. Therefore, knowledge of seasonal incidence of insect pests at different growth stages of cabbage crop will be helpful in evolving proper management schedule for effective control of insect pests. However, the information on seasonal incidence was generated by earlier workers in different regions of India [5,7,8], but scanty information is available from this part of the country. Further, climatic conditions were also changed frequently, therefore, the investigation on seasonal incidence of major insect pests of cabbage and their associated natural enemies was undertaken, which can effectively be utilized in formulating pest management programme. The present studies on incidence of major insect pests of cabbage

would give an idea about their peak period of activity and may be helpful in developing pest management strategy against them.

## 2. MATERIALS AND METHODS

Cabbage seedlings were raised in nursery beds of 2 x 1 m<sup>2</sup> size were prepared by mixing well rotten farms yard manure in the soil @ 10 kg per square meter. To avoid mortality of seedling due to damping off, drenching of the beds was done with carbendazim 50% WP@15 g per litre of water. Prior to sowing, seeds were treated with Thiram @ 2 g per kg of seed. The seed of cabbage variety "Golden Acre" were sown at the rate of 600 g ha<sup>-1</sup> in seed beds on 15<sup>th</sup> November 2020. The experimental field was thoroughly ploughed with the help of mould board plough and cross-harrowing was done with tractor, followed by planking and leveling to bring the good tilth. The recommended dose of NPK for cabbage was applied@120:80:60 kg ha<sup>-1</sup>as per the package and practices developed by Dr RPCAU, Pusa, Samastipur. Nitrogen was applied through urea, half as basal dose and remaining half in two equal splits at 30 days and 50 days of transplanting. Phosphorus and potassium fertilizers were applied through single super phosphate and murate of potash, respectively just before transplanting and well rotten FYM was incorporated in the soil at the time of field preparation @ 20 t ha<sup>-1</sup>. Beds (3.0 x 2.50 m<sup>2</sup>), paths and channels were prepared according to the layout of the experiments. Four weeks old seedlings were transplanted at row to row and plant to plant distance of 40x40 cm, respectively. The transplanting was done on 15<sup>th</sup> December during *Rabi* 2020-21 followed by light irrigation. Other cultural practices, as recommended in package of practices developed by Dr RPCAU, Pusa, Samastipur were adopted during the experimental period as and when needed. To record the observations on succession of different insect pests attacking cabbage crop, ten plants was randomly selected and tagged. The observation on the insect pest population along with their natural enemies was recorded at weekly interval from ten tagged plants with the commencement of insect pests and natural enemies till the harvesting.

## 3. RESULTS AND DISCUSSION

Incidence of insect-pest population and associated natural enemies were observed on cabbage var. "Goldenacre" during 2020-21. During the course of study, seven insect pest

viz., cabbageaphid (*Brevicoryne brassicae*), diamondback moth (*Plutella xylostella* L.), tobacco caterpillar (*Spodoptera litura*), cabbage head borer (*Hellula undalis*), flea beetle (*Phyllotreta cruciferae*), paintedbug, *Bagradaspp.* and Leaf eating caterpillar (*Helicoverpa armigera*) were observed. Among the natural enemies, two species of coccinellids (*Coccinella septempunctata* and *C. transversalis*), one larval parasitoid (*Cotesiaplutellae*), one Syrphid fly (*Toxomerus geminatus*) and one unidentified spider was observed during crop period (Table 1).

### 3.1 The Occurrence of Major Insect Pest Succession is Described Below

#### 1. Cabbage aphid, *Brevicoryne brassicae* (Hemiptera: Aphididae)

Cabbage aphid was observed first time on cabbage during last week of December (SMW 52) at vegetative stage. Observation of present investigation reveals, minimum (2.6) aphids/plant in last week of December and peak population (52.4) aphids/plant during first week of March (SMW 9), thereafter, decline in aphid population was observed and 23.6 aphids/plant was recorded at the time of harvesting i.e., second fortnight of March (Table 2 and Fig. 1). This insect was major pest of cabbage attacking leaves and was found active till the head maturation of crop. However, the maximum activity period of aphid was found during November-December to February and peak in mid-February [9,10,11] whereas in present investigation the peak was recorded in first week of March. This might be due to late sowing of cabbage crop in present investigation.

#### 2. Diamondback moth, *Plutella xylostella* L. (Lepidoptera: Plutellidae)

Diamond back moth first appeared during first week of January (SMW 1) at vegetative stage and remained present up to harvesting of the crop i.e., 11th standard week. The population of diamond back moth varied from 1.3-7.5 larvae/plant, the minimum (1.3 larvae/plant) and maximum (7.5 larvae/plant) population was recorded during first week of January (SMW 1) and second week of February (SMW 6), respectively. Thereafter the population declined reaching 1.7 larvae/plant during head maturation stage (SMW 12) (Table 2 and Fig. 1). Present observations are in accordance of earlier findings

of [12,13] where in they also reported diamond back moth is a serious pest of cabbage throughout the cropping season. Earlier study showed that *P. xylostella* was abundant in December-March with a population peak in February [14], which is more or less in accordance with the present finding. Some earlier worker reported *P. xylostella* appeared in February end and its population peaked in mid-April [15]. These support the finding of the present investigation. The larvae feed on all parts of the plant but prefer places around the bud of a young plant, crevices between loose leaves of a firm head and the undersides of wrapper leaves. Larva often not eats completely the leaf, leaving tiny "windows" of thin foliage. Their feeding may disfigure the bud of a young plant so that the cabbage head will not develop properly.

#### 3. Tobaccocaterpillar, *Spodopteralitura* (Lepidoptera: Noctuidae)

Tobacco caterpillar appeared in first week of January (SMW 1) at vegetative stage having count of 0.10 larvae/plant. The maximum population was (2.2 larvae/plant) in the fourth week of January (SMW 4) (Table 2 and Fig. 1). Thereafter gradual decline in population was recorded. Young larvae initially feed gregariously on leaves and older larvae feed singly, spreading out to other parts of the plant or to neighboring plants makes it one of the major pests of cabbage. In present investigation the incidence and sequence of *S. litura* on cabbage is more or less in accordance with the earlier findings [16,17,18,19].

#### 4. Cabbage head borer, *Hellula undalis* (Lepidoptera: Pyralidae)

First appearance of the cabbage head borer was observed in second week of February (SMW 7) during head formation stage and remained upto the head maturation of the crop (Table 2 and Fig. 1). The overall population of *H. undalis* was very low during entire cropping season.

Caterpillars initially mined the leaves and make it white papery. Later, they fed on leaves and bored into stems and consume its inner content. Similar observation was reported by earlier workers [20, 21]. In Taiwan, Chinese cabbage is more heavily infested by *H. undalis* than common cabbage and the infestation is only seen during the months of June-October [22].

Table 1. Record of insect pest and natural enemies observed in cabbage, *Brassica oleracea* L. var. capitata field during 2020-21

SI. No.	Common Name	Scientific Name	Order	Family	Population level	Period of activity
<b>Insect pest</b>						
1	Cabbage aphid	<i>Brevicoryne brassicae</i> .	Hemiptera	Aphididae	High	December-March
2	Diamondback moth	<i>Plutella xylostella</i> L.	Lepidoptera	Plutellidae	High	January-March
3	Tobacco caterpillar	<i>Spodoptera litura</i>	Lepidoptera	Noctuidae	Medium	December-March
4	Cabbage head borer	<i>Hellula undalis</i>	Lepidoptera	Pyralidae	Low	MidFebruary-March
5	Leaf-eating caterpillar	<i>Helicoverpa armigera</i>	Lepidoptera	Noctuidae	Low	February-March
6	Flea beetle	<i>Phyllotreta cruciferae</i>	Coleoptera	Chrysomelidae	Low	LateJanuary-March
7	Painted bug	<i>Bagrada hilaris</i>	Hemiptera	Pentatomidae	Low	December-March
<b>Natural enemies</b>						
8	Ladybird beetles	<i>Coccinella septempunctata</i> <i>Coccinella transversalis</i>	Coleoptera	Coccinellidae	Low to Medium	December-March
9	Larval endoparasitoid	<i>Cotesia plutellae</i>	Hymenoptera	Braconidae	Medium	January-March
10	Hoverflies	<i>Toxomerus geminatus</i>	Diptera	Syrphidae	Low	February-March
11	Spider	(Unidentified)	Araneae	Arachnidae	Low	LateJanuary-March

Table 2. Occurrence of insect pests on cabbage, *Brassica oleracea* L.var. capitata during 2020-21

Common Name of insects (Scientific Name)	Mean Number of Insect observed during different Standard Meteorological Week (SMW)												
	52	1	2	3	4	5	6	7	8	9	10	11	12
Cabbage aphid ( <i>Brevicoryne brassicae</i> )	2.6	2.9	6.4	12.8	17.4	29.4	36.2	34.4	47.5	52.4	42.8	27.4	23.6
Diamondback moth ( <i>Plutella xylostella</i> )	0	1.3	1.7	2.6	4.9	6.8	7.5	7.2	7.4	6.5	5.3	3.7	1.7
Tobaccocaterpillar( <i>Spodoptera litura</i> )	0.1	0.6	1.8	2.1	2.2	2.0	1.8	1.9	1.5	1.3	1.2	0.7	0.4
Cabbageheadborer( <i>Hellula undalis</i> )	0	0	0	0	0	0	0	0.8	1.2	0.7	0.9	0.6	0.2
Leaf eating caterpillar( <i>Helicoverpa armigera</i> )	0	0	0	0	0	0	0.4	0.7	1.2	1.4	1.0	0.6	0.3
Flea beetle( <i>Phyllotreta cruciferae</i> )	0	0	0	0	0.3	0.7	0.8	1.2	1.6	2.2	2.5	2.1	1.5
Painted bug( <i>Bagrada hilaris</i> )	0.6	0.9	1.4	1.5	1.8	1.5	1.4	1.3	1.7	1.2	0.7	0.3	0.1

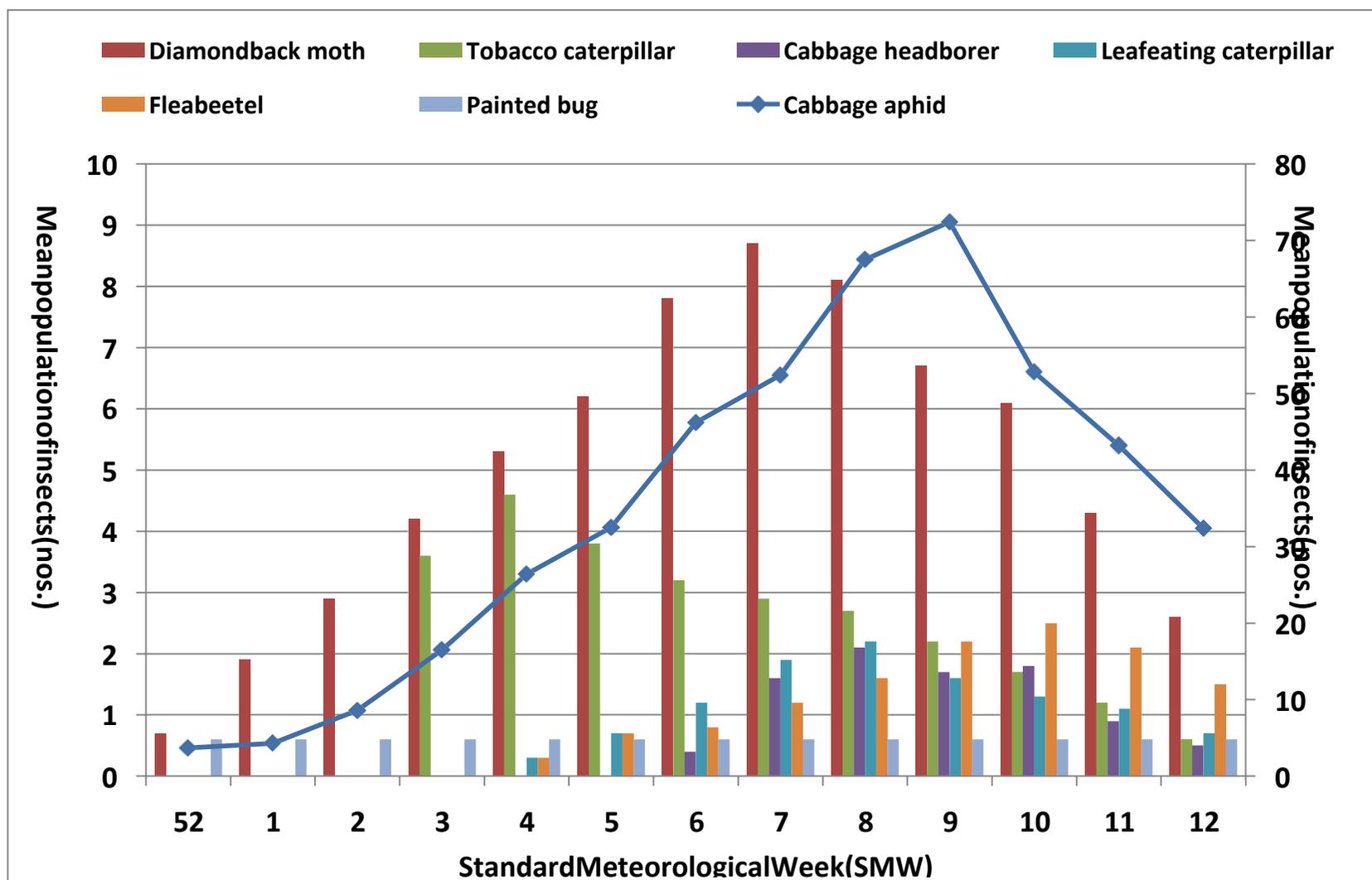


Fig. 1. Occurrence of insect pests on cabbage, *Brassica oleracea* L. var. *capitata* during 2020-21

#### 5. Painted Bug, *Bagrada hilaris* (Hemiptera: Pentatomidae)

First appearance of the *B. hilaris* was observed during second week after transplantation i.e., (MSW52) when the crop age was about 45 days. This pest was present on the crop during the early vegetative stage to the harvesting of the crop, i.e., 3<sup>rd</sup> week of March (MSW 12) (Table 2 and Fig. 1). Damage caused by flea beetle was distinctive in appearance. They chew small hole in leaf, move a short distance and then chew another hole and so on. The result looks like a number of "shot holes" in the leaf. Adults damage the leaves and cut it.

#### 6. Fleabeetle, *Phyllotreta cruciferae* (Coleoptera: Chrysomelidae)

First appearance of the flea beetle was observed in fourth week of January (SMW 4) at vegetative stage (Table 2 and Fig. 1). This insect was found attacking leaves and head of cabbage. It is evident that the pest was present on the crop during vegetative stage and remained active up to the head maturation of the crop. Damage caused by this insect was distinctive in appearance as number of "shot holes" in the leaf. The overall population of flea beetle was very low during entire cropping season. However, it was reported as a serious pest at the seedling stage of cabbage crop in Sri Lanka [23] which inflicts significantly high (71.4%) damage in the seedlings of cabbage.

#### 7. Leaf eating caterpillar, *Helicoverpa armigera* (Lepidoptera: Noctuidae)

First appearance of the *Helicoverpa* was observed in month of early February (SMW 6) during head formation stage of the crop (Table 2 and Fig. 1). The caterpillars initially feed on the outer leaves and subsequently burrowed into the heads. The overall population of *H. armigera* was very low during entire cropping season. Earlier workers also reported that the cabbage heads are attacked by two species of head borers, namely *H. armigera* (Hubner) and *S. litura* Fab. [24].

Among the major predators, only two species of coccinellids namely *Coccinella septempunctata* and *C. transversalis* were observed and their mean population was 0.85 to 1.05 per leaves, respectively. Adults of larval endoparasitoid,

*Cotesia plutellae* were also recorded, causing only 8 per cent parasitization.

#### 4. CONCLUSION

During the course of study, seven insect pest viz., cabbage aphid (*Brevicoryne brassicae*), diamond back moth (*Plutella xylostella* L.), tobacco caterpillar (*Spodoptera litura*), cabbage head borer (*Hellula undalis*), flea beetle (*Phyllotreta cruciferae*), painted bug, *Bagrada* spp. And Leaf eating caterpillar (*Helicoverpa armigera*) were observed (Table 1). Among the natural enemies, two species of coccinellids (*Coccinella septempunctata* and *C. transversalis*), one larval parasitoid (*Cotesia plutellae*), one Syrphid fly (*Toxomerus geminatus*) and one unidentified spider was observed during crop period. Among them, diamond back moth was found to be the most serious pest of cabbage. The infestation appeared during first week of January (SMW 1) at vegetative stage and remained present up to the harvesting of the crop i.e., 11th SMW. The population of diamond back moth varied from 1.3-7.5 larvae/plant, the minimum (1.3 larvae/plant) and maximum (7.5 larvae/plant) population was recorded during first week of January (SMW 1) and second week of February (SMW 6), respectively. Thereafter the population declined reaching (1.7 larvae/plant) during head maturation stage (SMW 12). Whereas, two predatory species of coccinellids, *Coccinella septempunctata* and *C. transversalis* and one endoparasitoid, *Cotesia plutellae* were also recorded, causing only 8 per cent parasitization.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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