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Seasonal incidence of major insect pests and natural enemies of cabbage

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Abstract

Vegetables play an important role in the balanced diet of human beings by providing not only energy-rich food, but also supplying vitamins and minerals. Among the vegetables, cabbage (*Brassica oleracea* var. *capitata* Linnaeus) is one of the most important winter vegetable grown on five continents. The investigation on “Seasonal incidence and comparative biology of diamondback moth on cabbage and its management through ecofriendly insecticides” were carried out at Sardarkrushinagar Dantiwada Agricultural University. The population dynamics of various insect pests of cabbage viz., *P. xylostella*, *H. armigera*, *S. litura* T. ni and *L. erysimi* and its natural enemies viz., (*Chrysoperla*, Ladybird beetle and Spiders) were observed during this period. *S. litura* appeared at a very low level during 47th standard week and remained up to 10th standard week, The population of *H. armigera* during *H. armigera* made its first appearance during 47th standard week and was active up to 9th standard week, *P. xylostella* first appeared during 48th standard week with a population of 2.04 larvae/plant and remain up to 9th standard week, *chrysoperla* was active on cabbage between fourth week of December to second week of March, ladybird beetle on cabbage from third week of December to second week of March. The correlation between aphid population and its natural enemies indicated that *chrysoperla* showed a highly significant positive correlation with aphids population during 2017-18. However, coccinellids beetle and spider showed a non-significant positive correlation with of aphid population.

Keywords: *Brassica oleracea* var. *capitata*, cabbage, seasonal incidence, *Plutella xylostella*, *Helicoverpa armigera*, *Spodoptera litura*, *Trichoplusia ni*, *Lipaphis erysimi*, natural enemies, *Chrysoperla*, ladybird beetle, spiders, population dynamics, eco-friendly insecticides

Introduction

Vegetables play an important role in the balanced diet of human beings by providing not only energy-rich food, but also supplying vitamins and minerals. Comparatively, vegetables are one of the cheapest sources of natural nutritive foods. In developing countries like India, where the pressure of population on land is continuously increasing, vegetables may play a significant role in supplying balanced diet. Among the vegetables, cabbage (*Brassica oleracea* var. *capitata* Linnaeus) is one of the most important winter vegetable grown on five continents and in more than 90 countries throughout the world. It is a leafy vegetable belong to the family: Brassicaceae (formerly Cruciferae) sometime also referred to as Cole crops, is very closely related to kale, broccoli, cauliflower etc. Cabbage is one of the most nutritious vegetables having many medicinal values. It is an excellent source of vitamins 'C,' 'K,' 'B₁' and 'B₆' and also a very good source of minerals viz., Manganese, Potassium, Zinc, Copper, Phosphorus, Magnesium, Calcium, and Iron beside dietary fibres, cabbage is a unique source of several types of phytonutrients, with antioxidant activity due to high content of phenol, polyphenol and anthocyanin. Being rich in glucosinolates and isothiocyanates, it also has anticancer properties (Mezencev, 2002 and Mehta and John, 2002) [4, 5]. Among the various production constrains, biotic stress mainly by insect pests at various growth stages of the crop is a major concern for not attaining the highest yield. The productivity of cabbage is very low compared to other countries and losses in the yield have been reported to the extent of 57 to 97 per cent due to insect pests alone (Prasad, 1963) [7]. More than 37 insect pests have been reported attacking on cabbage right from the vegetative phase to harvest of the crop (Sachan and Gangwar, 1980) [9]. Among them, diamondback moth (*Plutella xylostella* Linnaeus), Cabbage butterfly (*Pieris brassicae* Linnaeus), Cabbage aphid (*Brevicoryne*

brassicae Linnaeus), Cabbage borer (*Hellula undalis* Fabricius), Leaf eating caterpillar (*Spodoptera litura* Fabricius), Cabbage head borer (*Helicoverpa armigera* (Hubner) Hardwick), Painted bug (*Bagrada hilaris* Kirkaldy), Flea beetle (*Phyllotreta cruciferae* Goeze), Mustard sawfly (*Athalia lugens proxima* Klug.) are most serious causing economical damage (Prasad, 1963; Sachan and Srivastava, 1972 and Rao and Lal, 2005) [7, 8, 10].

Materials and methods

The investigation on “Seasonal incidence and comparative biology of diamondback moth on cabbage and its management through ecofriendly insecticides” were carried out at Department of Entomology, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, during 2017-18. The study covered seasonal incidence of major pests of cabbage (*Spodoptera litura* Fabricius, *Plutella xylostella* Linnaeus, *Helicoverpa armigera* Hubner, *Trichoplusia ni* Hubner and aphid). The seasonal incidence of major pests and its natural enemies on cabbage variety Golden Acre was recorded during 2017-18 and Horticultural Instructional Farm. The observations were taken from 20 randomly selected plants. Observation on number of larvae per plant, number of sucking pests per plant and number of predators (*Chrysoperla*, Coccinellids beetle and spiders) were recorded weekly from twenty randomly selected plants, during 2017-18. Correlation between weather parameters and pests incidence and pests population with natural enemies were computed to find out the abiotic influence on population if any, following the standard statistical procedure.

Results and Discussion

Studies on population dynamics of various insect pests of cabbage viz., *P. xylostella*, *H. armigera*, *S. litura* *T. ni* and *L. erysimi* and its natural enemies viz., (*Chrysoperla*, Ladybird beetle and Spiders) were carried out at Horticulture instructional farm, Chimanbhai Patel College of Agriculture, during 2017-18. Weekly observation during crop period on population of various insect pests and its natural enemies

were carried out as per the detailed methodology described under section.

Cabbage leaf worm: *S. litura*

The young larvae of *S. litura* damaged by scrapping the lower surface of the cabbage leaves. The later instars were voracious feeder, generally feed on outer leaves of the cabbage (Plate I). The incidence of various insects pests appeared during 2017-18 is given in Table 1 and 1. A perusal of the data, clearly indicated that the *S. litura* appeared at a very low level during 47th standard week and remained up to 10th standard week i.e. first week of March during 2017-18. Its population ranged from 0.8 to 5.8 larvae/plant and reached maximum population level during second week of January 2017-18. Patel (2002^b) [6] observed the appearance of *S. litura* in third week of December (50th SW) and its peak activity in 52nd SW, thereafter, population start decreasing and disappeared in the month of January. Observation made by Jat *et al.* (2017) [2, 3] revealed its peak activity in the fourth week of February (8th SW). Mishra *et al.* (2008) reported highest population from 35th to 47th SW. The incidence of *S. litura* and its activity varied greatly as reported by earlier workers. Some area it appeared early and attains its peak population within a short span. In present study observed its activity from November to March. The variation may be due to different climate conditions prevailed in the different geographical region under study.

Cabbage head borer: *H. armigera*

The larvae are destructive and voracious feeder. Larvae generally feed on developing boll of the cabbage. Larvae consume three times of its weight of food material daily. Feeding sites are marked by accumulation of fecal material (Plate II). The population of *H. armigera* during 2017-18 is given in Table 1 and Fig. 1. A perusal of the data, clearly indicate that the *H. armigera* made its first appearance during 47th standard week and was active up to 9th standard week i.e. last week of February. Its population ranged from 1.2 to 6.2 larvae/plant and reached highest population level during third week of January during 2017-18.

Table 1: Seasonal incidence of different insect pests of cabbage during rabi 2017–18

Standard meteorological week	Month	Number of larvae per plant				Number of aphids/plant
		<i>S. litura</i>	<i>H. armigera</i>	<i>P. xylostella</i>	<i>T. ni</i>	
47	November	0.8	1.2	0.0	0.6	2.6
48	December	1.4	1.6	2.4	0.8	5.2
49		1.8	1.8	3.4	1.2	7.0
50		2.8	3.2	2.8	1.6	7.4
51		3.0	2.8	3.6	2.2	12.2
52		3.4	2.6	4.4	2.8	18.3
1	January	4.6	4.8	5.2	3.0	28.6
2		5.8	5.4	5.4	3.2	35.8
3		3.6	6.2	6.8	3.6	40.5
4		3.8	5.2	6.2	2.4	48.0
5		4.2	3.4	6.4	1.2	53.2
6	February	4.0	3.4	5.8	1.0	60.4
7		3.6	3.6	3.4	0.4	69.0
8		3.2	2.4	1.2	0.0	48.6
9		1.4	1.8	0.8	0.0	19.2
10	March	0.8	0.0	0.0	0.0	9.8
11		0.0	0.0	0.0	0.0	2.8

The pest remain active from January to February with peak population of 6.2/plant in 3rd week of January (3rd SW). The

population varied from 1.8 to 5.0 larvae/plant with highest population of 5.0 larvae/plant in second week of January

(2nd SW) during 2018-19. Pest appeared late and also disappeared early as no incidence was observed from 4th week of February (9th SW) onwards. The mean data on the population of *H. armigera* during 2017-18 is presented in the Table 1 revealed that *H. armigera* was active during 47th standard week to 9th standard week. Its population ranged from 0.6 to 5.5 larvae/plant and maximum incidence was observed during third week of January (5.5 larvae/plant). Patel (2002^b) [6] observed the appearance of *H. armigera* in second week of December and its peak in 1st SW. Thereafter population started decreasing and disappeared in the month of February. The present findings are in agreement with earlier reports.

Diamondback moth, *P. xylostella*

Diamondback moth larvae feed on leaf portion between large vein and midribs. The larvae generally feed on lower leaf surface, leaving the upper epidermis intact. In case of severe damage plant growth may be stunted (Plate I). The data, given in Table 1 and Fig. 1 clearly indicated that the *P. xylostella* first appeared during 48th standard week with a population of 2.04 larvae/plant and remain up to 9th standard week i.e. last week of February. Its population ranged from 2.4 to 6.8 larvae/plant during crop period and maximum population was reached during third week of January during 2017-18. The mean data (2017-18) presented in Table 1 indicated that *P. xylostella* appeared during 47th standard week and remain active up to 9th standard week. Its population ranged from 0.4 to 6.9 larvae/plant with highest population during last week of January (6.9 larvae/plant) (5th SW). The data clearly indicated that *P. xylostella* was very active during January to February. Patel (2002^b) observed the appearance of *P. xylostella* in December (50th SW) and highest peak in the 3rd SW. Thereafter, populations start decreasing and disappeared in the month of February. Patel (2002^b) reported its activity in the month of January. Tarivia (2011) also noticed its activity from 5th to 14th standard week at Junagadh. Bana *et al.* (2012) [1] recorded its peak activity in the month of January. In the present study also its peak activity, was observed in the month of January which corroborate the reports of earlier workers.

Cabbage Semilooper : *Trichoplusia ni*

Cabbage semilooper is a leaf feeder and first instar larvae feed on the lower surface of the leaves. The later instars chew and make large holes and usually do not feed on the leaf margin (Plate III). The population of *T. ni* recorded during 2017-18 is given in Table 1 and Fig. 1. A perusal of the data, revealed that the *T. ni* incidence started with a population of 0.6 larva/plant during 47th standard week and remain up to 7th standard week i.e. second week of February. Its population varied from 0.6 to 3.6 larvae/plant and highest population was observed during third week of January (3rd SW). During 2017-18 (Table 1 and Fig. 1), the incidence of *T. ni* appeared in the first week of December (48th SW) and active up to fourth week of February (9th SW). The incidence of pest appeared late and also disappeared early as no incidence was observed after first week of March (10th SW). Patel (2002^b) observed the appearance of *T. ni* in second week of December and its

peak activity in first week of January. In the present study the observation on its peak population in the month of January is in agreement with earlier report by Patel (2002^b).

Cabbage aphid: *L. erysimi*

Aphids feed on the cabbage causes yellowing, wilting and stunted growth of the plants. Aphids produce a sugary waste material is called as honeydew, which encourage the development of shooty mould. In case of severe infestation entire plant covered with small mass of sticky aphids (Plate I). The seasonal incidence of aphids during 2017-18 is given in Table 1 and Fig. 1. The data, clearly indicated that the *L. erysimi* population was very low (2.6 aphids/plant) during 47th standard week and it was active up to 11th standard week i.e. second week of March. Its population ranged from 2.6 to 69.0 aphids/plant and highest incidence was observed during second week of February, indicating its activity during February to March. The mean data (2017-18) indicated that aphids first appeared during 47th standard week and remain active up to 12th standard week. Its population ranged from 1.3 to 73.2 aphids/plant with highest population during second week of February (73.2 aphid/plant) (7th SW). The data clearly indicated that aphids remain active during February to March. Patel (2002^b) [6] observed the appearance of aphid in the month of December and its peak in January (5th SW). Bana *et al.* (2012) [1] also observed its peak activity in January. In the present study it was also observed its activity from November to March. The variation may be attributed to the divergent climatic condition prevailed in the different agro-ecological locations.

Natural enemies

Chrysoperla

Chrysoperla carnea (Stephens) commonly known as green lacewing is an insect in the chrysopidae family. The adults feed on nectar, pollen and honey dew and the larvae are active predators and feed on aphids and other small insects. It has been used in the biological control of insect pests on crops. The results presented in Table 1 and graphically depicted in Fig.1 on occurrence of *chrysoperla* on cabbage revealed that, *chrysoperla* was active on cabbage between fourth week of December to second week of March (2017-18). It first appeared during fourth week of December i.e. 51st SW and its reached peak population level (1.8 adults/plant) on fourth week of February i.e. 9th SW. Subsequently, its population declined during rest of the crop period. However, no scientific information is available to corroborate the present finding.

Coccinellids beetle

Coccinellids beetle are among the most visible and best known beneficial predatory insect. In India 400 species are found. Some are native and some have been introduced from other countries. They feed on small insect like aphids, thrips, mites and leafhopper (Plate X). The results presented in Table 1 and depicted in Fig. 1 on the occurrence of ladybird beetle on cabbage revealed its activity on cabbage from third week of December to second week of March (2017-18).

Table 2: Seasonal incidence of natural enemies on cabbage during rabi 2017–18

Standard meteorological week	Month	Number of natural enemies per plant		
		<i>Chrysoperla</i>	Coccinellids beetle	Spider
47	November	0.0	0.0	0.0
48	December	0.0	0.0	0.0
49		0.0	0.0	0.3
50		0.0	0.2	0.4
51		0.4	0.5	0.3
52		0.3	0.7	0.5
1	January	0.5	1.0	0.6
2		0.9	1.7	0.5
3		1.2	1.9	0.8
4		1.5	1.8	0.5
5		1.4	2.1	0.8
6	February	1.7	2.2	0.6
7		1.6	3.0	1.0
8		1.4	3.1	1.2
9		1.8	3.5	1.1
10	March	1.6	4.0	1.3
11		1.2	4.5	1.0

It first appeared during third week of December (0.2 adult/plant; 49th SW) and reached the peak population level (4.5 adults/plant) during second week of March i.e. 11th SW. The data presented in Table 4.2 showed that ladybird beetle first appeared during third week of December and was active up to third week of March. Its population ranged from 0.1 to 6.3 adults/plant with maximum activity during third week of March i.e. 8th SW. Bana *et al.* (2012) [1] observed that the ladybird beetle was active from last week of December to third week of February with a population of 0.04 to 0.24 adults/plant. In the present study we observed its activity from December to March and the difference in the incidence may be due to divergent agro climatic situations prevailed in the different locations.

Spiders

Spider is the general predator come under order Araneae. Spider generally feed on soft bodied insect like aphid, Jassid, thrips *etc.* (Plate X). The results presented in Table 4.14 and graphically depicted Fig. 1 on occurrence of spider species on cabbage revealed that, spider fauna was active on cabbage from third week of December to second week of March during 2017-18. Its first appearance was observed during second week of December i.e. 49th SW then its population increased and slowly reached the peak level (1.3

spider/plant) on first week of March i.e. 10th SW. Then, its population started decreasing rest of the crop period. Patel (2002^b) [6] observed the spider activity during December to February with an average population of 0.04 to 0.16 spider/plant. In the present study we observed its activity from December to March.

Effect of weather parameter on insect pests of cabbage

Correlation of weather parameter with the pest population was computed during 2017-18. The relationship thus obtained during 2017-18 is presented in Table 3. The data clearly revealed that wind velocity, sunshine hours, evening relative humidity and maximum temperature have no significant correlation between the pest populations under study. However, a highly significant negative correlation was observed between minimum temperature and population of *S. litura* (-0.702**), *H. armigera* (-0.707**) and *P. xylostella* (-0.794**). The incidence of *Trichoplusia ni* have a significant negative correlation with minimum temperature (-0.576*). A highly negative significant correlation was observed between aphid population with morning relative humidity (-0.696**), the same trend was also noticed with *H. armigera* (-0.691**). However, the association was significantly negative with *S. litura* (-0.565*) and *P. xylostella* (-0.571*).

Table 3: Correlation between pest population and weather parameters during 2017–18

Pests	Weather parameter					
	Temperature (°C)		Relative Humidity (%)		Wind speed (km/hr)	Sun-shine (hours/day)
	Max.	Min.	Morn.	Even.		
<i>S. litura</i>	-0.361	-0.702**	-0.565*	0.019	-0.256	0.170
<i>H. armigera</i>	-0.177	-0.707**	-0.691**	-0.153	0.188	0.324
<i>P. xylostella</i>	-0.291	-0.794**	-0.571*	0.000	-0.051	0.150
<i>T. ni</i>	-0.095	-0.576**	-0.418	-0.036	0.161	0.244
<i>L. erysimi</i>	0.005	-0.428	-0.696**	-0.311	-0.181	0.364

Significant at the 5% level of significance ($r = 0.456$).

** Significant at the 1% level of significance ($r = 0.575$).

The relationship was negative and non significant in case of *Trichoplusia ni*. Tarivia (2011) observed that maximum temperature and sun shine hours had significant positive correlation with diamondback moth population. Bana *et al.* (2012) [1] observed that maximum and minimum temperature had significant negative correlation with *P.*

xylostella population. Shalini *et al.* (2016) [11] also observed that the morning and evening relative humidity had negative significant correlation. Jat *et al.* (2017) [2, 3] reported a significant positive correlation with temperature with *P. xylostella*.

Table 4: Correlation between aphid population and its natural enemies during 2017–18

Sr. No.	Pests	Chrysoperla	Coccinellids beetle	Spiders
1	Aphid	0.659**	0.313	0.374
* Significant at 5 per cent level of significance ('r' = 0.444);				
** Significant at 1 per cent level of significance ('r' = 0.561).				

The present findings are more or less similar with earlier workers with slight variation from place to place.

Influence of biotic factors on incidence of aphids

The result in respect to correlation between aphid population and its natural enemies are presented in Table 4. It is evident from the data that *chrysoperla* showed a highly significant positive correlation with aphids population during 2017-18. However, coccinellids beetle and spider showed a non-significant positive correlation with of aphid population.

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