



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2024; 12(2): 07-11

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Received: 08-01-2024

Accepted: 17-02-2024

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Incidence of major insect pests and its natural enemies of Cabbage (*Brassica oleracea var. capitata*) under Polyhouse conditions

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DOI: <https://doi.org/10.22271/j.ento.2024.v12.i2a.9291>

Abstract

The major insect pests of cabbage crop during *rabi*, 2021-22 were aphids, leaf webber, diamondback moth and tobacco caterpillar. Although the incidence of semilooper, painted bugs were noticed, it was low. The peak infestation of aphids was seen in last week of November (48th SMW) while that of the lepidopteran pests (leaf webber, DBM and tobacco caterpillar) occurred in January (4th, 4th 2nd SMW, respectively). The mean population of Coccinellids, syrphids and spiders were 0.45, 1.10 and 0.69 respectively under polyhouse conditions. Correlation studies revealed that aphids alone showed significant negative correlation with morning temperature and significant positive correlation with evening temperature while all the lepidopteran pests showed non-significant negative and positive correlations, respectively. All the three natural enemies (coccinellids, syrphids and spiders) showed significant negative correlation with morning temperature and significant positive correlation with evening temperature.

Keywords: Cabbage, polyhouse, insect pests, correlation, natural enemies, standard meteorological week

1. Introduction

Cabbage originated in the Mediterranean region and was brought to India during the Mughal era (Das, 1992; Khalid, 2006) ^[1, 3]. It is one of the most significant and popular winter vegetable crops farmed in all of India and now grown year-round due to its high commercial value. India produced 9.60 million tonnes of cabbage in 2020-21 from 4.12 lakh ha of land, at an average of 23.27 MT per ha. States that produce the most cabbage include West Bengal, Uttar Pradesh, Orissa, Bihar, Assam, Maharashtra, and Karnataka. Cabbage is grown in 820 ha in Telangana, producing 27,780 tonnes per ha with a productivity of 33.71 tonnes per ha (Indiastat.com, 2020-21). Abhijith *et al.* (2019) ^[14] reported that the main pest is the diamondback moth *Plutella xylostella* (Linnaeus), which has a destructive potential ranging between 14 and 84 per cent. Although other lepidopteran pests like the cabbage butterfly, *Pieris brassicae* (Linnaeus), the cabbage semilooper, *Trichoplusia ni* (Hubner), the tobacco caterpillar, *Spodoptera litura* (Fabricius), the cabbage head borer, *Hellula undalis* (Fabricius), and the cabbage leaf webber, *Crociodolomia binotalis* (Zeller) cause extensive damage and some sucking pests like the cabbage aphid, *Brevicornye brassicae* (Linnaeus), green peach aphid, *Myzus persicae* (Green), and painted bug, *Bagrada cruciferum* (Burmeister) have also been recorded to cause significant harm. In protected conditions, a suitable environment and habitat for insect pest proliferation can, however, occasionally be found because of the warm, humid temperatures and an abundance of food. The natural enemies of these insect pests may be less, causing indoor environments to sustain higher harm than outdoor environments (Dash *et al.*, 2020) ^[15].

2. Materials and Methods

The field experiment on "Incidence of Major insect pests and its natural Enemies of Cabbage (*Brassica oleracea var. capitata*) under Polyhouse conditions" was carried out during *rabi*, 2022-23 at Horticultural Polyhouse, College of Agriculture, Rajendranagar. The experimental site is situated at an altitude of 542.3 m above mean sea level with 17.3850° N latitude and 78.4867°E longitude and it falls under semi-arid tropical climate. The details of materials used and methodology adopted during the course of investigation for conducting the experiments are discussed here.

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2.1 Layout of experiment

For the experiment planned, cabbage seedlings of *var.* INDU SEMINIS were raised in a nursery at the Horticultural Garden. The nursery trays were filled with vermicompost and Farm Yard Manure (FYM). The seeds were sown in nursery trays on 12.10.2022. The trays were watered once in two days. Fertilizer (19:19:19) @ 2g/litre, was applied at every 10 days. Germination was observed within 5-6 days of sowing. The cabbage seedlings were transplanted into the beds at a spacing of 45 cm x 30 cm on 10th and 11th Nov, 2022 in polyhouse.

2.2 Observations

2.2.1 Major insect pests

For recording incidence of insect pests and their natural enemies, 25 plants were selected at weekly intervals. The observations recorded for the various pests are as follows

- Aphids:** Total number of aphids/inch²/ 3 leaves/plant (upper, middle, lower) were counted visually with the help of magnifying lens at weekly interval (Lal 1998) [2].
- Painted bug:** Number of bugs per plant
- Leaf webber, diamondback moth and tobacco caterpillar:** Number of larvae per plant
- Predators (Lady bird beetles/Syrphids/Spiders):** Number per plant

2.2.2 Meteorological data

The temperature and relative humidity in polyhouse were recorded daily from thermo hygrometer by installing the digital Thermo hygrometer in the middle of polyhouse and correlated with the incidence of insect pests and natural enemies.

2.3 Statistical analysis: Population data of major insect pests and natural enemies of cabbage thus obtained were subjected to statistical analysis to find out the coefficient of correlation with mean morning and evening temperature and morning and evening relative humidity. A simple correlation was worked out between the populations of major insect pests (aphids, Leaf webber, tobacco caterpillar and diamond back moth) with abiotic environmental factors using the following formula

$$\text{Correlation } r = \frac{\sum xy - \frac{\sum x \cdot \sum y}{n}}{\sqrt{\frac{\sum x^2 - (\sum x)^2}{n} \cdot \frac{\sum y^2 - (\sum y)^2}{n}}}$$

Where,

r = Simple correlation coefficient

x = Independent variable *i.e.*, abiotic component

y = Dependent variable *i.e.*, mean number of insect pests

n = Number of observations

Test of significance of correlation coefficient

$$t = \frac{r}{\sqrt{(1-r^2)}} \sqrt{n-2}$$

Where,

The value of 't' is based on (n-2) degrees of freedom.

n = the number of sets of observations

r = correlation coefficient

3. Results

In the present study the crop was found to be infested with aphid, cabbage leaf webber, diamondback moth, tobacco caterpillar, green semilooper and painted bug. The observations recorded on the incidence of major insect-pests and natural enemies are presented below.

3.1 Aphids

In 2022-23, the infestation of aphid in polyhouse initiated in the second week of November (45th SMW) wherein 10.23 aphids/inch²/3 leaves/plant were recorded which gradually increased, reaching a peak population of 32.70 aphids/inch²/3 leaves/plant during 48th SMW, thereafter the population decreased till the end of March (10th SMW). The mean aphid incidence was recorded as 9.61 aphids/ inch²/3 leaves/plant (Table.1).

The correlation studies showed that the aphid population had significant negative correlation with morning temperature (r=-0.625) and significant positive correlation with evening temperature (r =0.588), while non-significant negative correlation was observed with morning relative humidity (r=-0.189) and non-significant positive with evening relative humidity (r=0.289) (Table.2).

3.2 Leaf webber, *Crociodomia binotalis* Z.

The leaf webber larvae appeared in November (48th SMW) with a mean population of 2 larvae/plant. The larval population increased gradually and reached a peak of 7.30 larvae/plant in 4th SMW and thereafter slightly decreased till harvest. The mean leaf webber incidence was recorded as 2.47 larva/plant (Table.1).

The correlation studies revealed that the leaf webber population had non-significant negative correlation with morning temperature (r =-0.420) and whereas non-significant positive correlation with evening temperature (r =0.367) and evening relative humidity (r=0.116), non-significant negative correlation with morning relative humidity (r=-0.171) (Table.2).

3.3 Diamondback moth, *Plutella xylostella* L.

The diamondback moth population first appeared in November (47th SMW) with an initial population of 0.13 larvae/plant which increased gradually and reached a peak of 5.20 larvae/plant during 4th SMW and the population slightly decreased until harvest. The mean diamondback moth incidence was recorded as 1.99 larvae/plant (Table.1).

The correlation studies showed that there was non-significant negative correlation of DBM with morning temperature (r=-0.412) and morning relative humidity (r = -0.155) while non-significant positive correlation with evening temperature, respectively (r=0.381) and evening relative humidity (r =0.118) (Table.2).

3.4 Tobacco caterpillar, *Spodoptera litura* F.

Tobacco caterpillar larvae was observed from first week of November (45th SMW) with an incidence 0.12 larvae/plant. The population increased gradually and touched its peak with a mean of 4.00 larvae/plant during second week of January (2nd SMW). Thereafter its population reduced gradually. The mean tobacco caterpillar incidence was recorded as 1.59 larvae/plant (Table.1).

Tobacco caterpillar larval population had non-significant

negative correlation with morning temperature ($r = -0.461$), morning relative humidity ($r = -0.137$) and non-significant positive correlation evening temperature and ($r = 0.442$) and evening relative humidity ($r = 0.130$) (Table.2).

3.5 Other insect pests

The incidence of other pests in polyhouse viz., painted bugs, cabbage semilooper was low. Painted bugs were seen from fourth week of November (47th SMW) with an incidence 0.03 bugs/plant. The population increased gradually and touched its peak with a mean of 2.00 bugs/plant during third week of January (3rd SMW). Thereafter its population reduced gradually. The cabbage semilooper incidence was observed in November (48th SMW) with an incidence 0.20 larvae/plant. The population increased gradually and touched its peak with a mean of 2.20 larvae/plant during first week of January (1st SMW). Thereafter its population reduced gradually (Table.1). The cabbage semilooper larval population had non-significant positive correlation with evening temperature ($r = 0.388$), evening relative humidity ($r = 0.106$). Whereas, it showed non-significant negative correlation with morning relative humidity ($r = -0.030$), morning temperature (-0.460). Painted bug correlation studies revealed that population had non-significant positive correlation with evening temperature ($r = 0.241$), morning relative humidity ($r = 0.033$) and non-significant negative correlation with morning temperature ($r = -0.309$), evening relative humidity ($r = -0.053$) (Table.2).

3.6 Natural Enemies

3.6.1 Ladybird beetle

The population of ladybird beetle (grubs and adults) were first noticed from the second week of November (45th SMW) with mean population of 0.1/plant, and reached peak of 1.50/plant during December (48th and 49th SMW). Thereafter, the population reduced gradually up to the harvest. The mean

ladybird beetle was recorded as 0.45 adult/plant (Table.1). The correlation studies revealed that ladybird beetle population had significant positive correlation with evening temperature ($r = 0.508$) and with aphid population ($r = 0.648$). Whereas non-significant positive correlation evening relative humidity ($r = 0.404$) and non-significant negative correlation morning relative humidity ($r = -0.013$) (Table.2).

3.6.2 Syrphids

The population of syrphids was first noticed in November (48th SMW) with a mean population of 0.30/plant, and the peak incidence during January (4th SMW) with syrphids 3.00/plant. Thereafter, the population reduced gradually up to the harvest. The mean syrphids was recorded as 1.10 larva/plant (Table.1).

The correlation studies revealed that spider population showed non-significant negative correlation with morning temperature ($r = -0.490$) and morning relative humidity ($r = -0.496$), and significant positive correlation with evening temperature ($r = 0.691$), and evening relative humidity ($r = 0.700$) (Table.2).

3.6.3 Spiders

The population of spiders was first noticed in November (45th SMW) with a mean population of 0.21/plant, and the peak incidence during January (1st SMW) with spiders 2.00/plant. Thereafter, the population reduced gradually up to the harvest. The mean spider population was recorded as 0.69/plant (Table.1).

Spider population showed non-significant negative correlation with morning temperature ($r = -0.490$) and morning relative humidity ($r = -0.496$), and significant positive correlation with evening temperature ($r = 0.691$), and evening relative humidity ($r = 0.700$) (Table.2).

Table 1: Incidence of major insect pests of cabbage in polyhouse

Standard meteorological week (SMW)	Month	*Mean insect population						Natural enemies		
		Aphids (inch ² /3 leaves/plant)	Leaf webber (no./plant)	DBM (no./plant)	Tobacco caterpillar	Semilooper (no./plant)	Painted bug (no./plant)	Coccinellids (no./plant)	Syrphids (no./plant)	Spiders (no./plant)
45	05 Nov-11 Nov	10.23	0.00	0.00	0.12	0.00	0.00	0.10	0.00	0.21
46	12 Nov-18 Nov	15.93	0.00	0.00	0.17	0.00	0.00	0.10	0.00	0.23
47	19 Nov- 25 Nov	30.20	0.00	0.13	0.80	0.00	0.03	0.70	0.00	0.10
48	26 Nov- 02 Dec	32.70	2.00	1.00	1.13	0.20	0.03	1.50	0.30	1.00
49	03 Dec- 09 Dec	25.52	2.50	1.50	1.70	0.50	0.07	1.50	0.90	0.50
50	10 Dec- 16 Dec	20.10	2.90	2.00	1.90	1.00	0.10	1.00	1.00	2.00
51	17 Dec- 23 Dec	15.20	3.00	2.80	2.27	1.50	0.03	0.70	1.50	1.50
52	24 Dec- 31 Dec	6.91	3.60	3.20	3.00	2.00	0.30	0.50	1.29	1.00
1	01 Jan- 07 Jan	3.65	4.50	4.00	3.30	2.20	1.00	0.50	2.00	2.00
2	08 Jan- 14 Jan	2.90	5.00	4.60	4.00	1.80	1.50	0.67	2.50	1.00
3	15 Jan- 21 Jan	2.77	6.50	5.00	3.80	2.00	2.00	0.20	2.80	0.50
4	22 Jan- 28 Jan	2.30	7.30	5.20	3.20	1.60	1.25	0.17	3.00	0.30
5	29 Jan- 04 Feb	2.03	3.10	2.90	1.45	0.90	0.80	0.10	2.00	1.00
6	05 Jan- 11 Feb	0.97	2.00	1.68	0.80	0.66	0.60	0.07	1.20	0.30
7	12 Feb- 18 Feb	0.47	1.10	0.90	0.45	0.30	0.33	0.07	0.80	0.50
8	19 Feb- 25 Feb	0.47	0.60	0.50	0.18	0.11	0.11	0.07	0.40	0.20
9	26 Feb- 01 Mar	0.40	0.20	0.22	0.17	0.00	0.00	0.07	0.11	0.00
10	02 Mar- 08 Mar	0.21	0.17	0.11	0.13	0.00	0.00	0.00	0.00	0.00
	Mean	9.61	2.47	1.99	1.59	0.82	0.45	0.45	1.10	0.69

Table 2: Correlation of insect pests in cabbage and natural enemies with abiotic factors in polyhouse

Abiotic/ biotic factors	Insect pest						Natural enemies		
	Aphids	Leaf webber	DBM	Tobacco caterpillar	Semilooper	Painted Bug	Coccinellids Adult & Grubs	Syrphids	Spiders
Temperature (°C) at 9:30 AM	-0.625**	-0.420	-0.412	-0.461	-0.460	-0.309	-0.666*	-0.497*	-0.490*
Temperature (°C) at 3:00 PM	0.588*	0.367	0.381	0.422	0.388	0.241	0.508*	0.564*	0.691**
RH 1 (%) at 9:30 AM	-0.189	-0.171	-0.155	-0.137	-0.030	0.033	-0.013	-0.249	-0.496*
RH 2 (%) at 3:00 PM	0.289	0.116	0.118	0.130	0.106	-0.053	0.404	0.505*	0.700**
Aphids							0.648*	0.371	

* Significant at 5% level

**Significant at 1% level

4. Discussions

The findings of the current study are consistent with observations made by Lal *et al.* (2020) [16] who reported that aphids, painted bugs, and diamondback moth were the most prevalent insect pests on cabbage crops in both years, while tobacco caterpillars were also documented. During the months of February and March, the principal insect pests attained their mean peak populations. Similarly, Aiswarya *et al.* (2018) [10] reported that the larval populations of the tobacco leaf eating caterpillar, leaf webber, cabbage semilooper and DBM ranged from 1.2 to 5.5, 0.45 to 1.8, 0.77 to 1.2 and 1.98 to 3.2, respectively. During the 47th SMW, the DBM, leaf webber and cabbage semilooper incidence initiated, while the tobacco caterpillar incidence during 46th SMW. The 51st, 3rd, 48th, 49th and 50th SMW in 2016- 17, respectively, saw the highest incidence of DBM, leaf webber, cabbage semilooper and tobacco leaf eating caterpillar.

Bhagat *et al.* (2018) [9] reported diamondback moth infestation began at the end of December in 2015-2016 and in the first week of January in 2016-2017 and peak incidence in March for both years. Mane *et al.* (2021) [18] reported the DBM incidence started from second week of February and peaked in the first week of March, then gradually decreased during the following meteorological weeks. Reported that both the lady bird beetle (*Coccinella septempunctata*) and the cabbage aphid (*Brevicoryne brassicae*) were visible from the 49th SMW to the 8th SMW, with the peak incidence occurring in the 5th SMW (41.0 larva/plant) and 4th SMW (1.0 larva/plant), respectively.

As per Bhede (2018) [12], syrphid populations peaked in the first SMW (5.75 /plant) and 52nd SMW (3.55 /plant) in the years 2015-16 and 2016-17, respectively. Syrphids and lowest temperature had a strong inverse relationship during the first season and a substantial inverse relationship with aphids was seen during both seasons.

Mane *et al.* (2021) [18] reported DBM has non-significant negative correlation with maximum temperature, minimum temperature, morning humidity and bright sunshine hours.

While Jemimah (2021) [17] reported that coccinellids and syrphids exhibited a negative correlation with maximum and minimum temperatures and wind speed while showing positive correlation with morning RH and evaporation.

5. Conclusion

Incidence of major insect pests of cabbage under polyhouse conditions was studied that will be helpful in preparing proper schedule for effective management of major insect pests of this crop. During the present study, the incidence of aphids, leaf webber, tobacco caterpillar and diamondback moth were commonly noticed, but higher incidence of pests in polyhouse due to plenty availability of crop and least disturbance by the weather parameters.

Natural enemies (Ladybird beetles, Syrphids, Spiders) were observed and their populations fluctuated throughout the crop growth.

6. Acknowledgements

The authors are highly thankful to the Department of Entomology, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agricultural University Hyderabad.

7. Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors

8. Conflict Of Interest

None declared

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