Incidence of insect pests and its natural Enemies of Cabbage (*Brassica oleracea var. capitata*) in relation to weather parameters under field conditions

ABSTRACT

The study was carried out in the field at the Horticultural Polyhouse, College of Agriculture, Rajendranagar, during the *rabi* season of 2022–2023. In the field, aphid infestation peaked in the last week of November (48th SMW), while lepidopteran pests (tobacco caterpillar, DBM, and leaf webber) peaked in January (3rd, 2nd, and 1st SMW, respectively).Coccinellids, syrphids, and spiders had average populations of 0.80, 0.21, and 0.03 correspondingly. Aphids were shown to have a non-significant link with weather factors, showing negative correlations with maximum temperature, sunshine, wind, and rainfall and positive correlations with minimum temperature and RH I & II. While leaf webber and DBM showed a non-significant negative connection with sunshine and wind speed, they displayed a non-significant positive correlation with maximum temperature, RH I & II, and rainfall. Additionally, they showed a strong inverse relationship with evaporation. The maximum and minimum temperatures were shown to have a non-significantly positive connection with tobacco caterpillar and semilooper.

Keywords: Cabbage,Tobacco caterpillar, Insect pests, Leaf webber, Natural enemies, Diamondback moth.

1. INTRODUCTION

Cabbage cultivated year-round in India because of its high commercial value. It is one of the most important and popular winter vegetable crops. Over 4.12 lakh hectares of land, or 23.27 MT per ha, India produced 9.60 million tonnes of cabbage in the 2020-21 season. Maharashtra, Karnataka, Orissa, Bihar, West Bengal, Uttar Pradesh, and Assam are some of the states that produce a lot of cabbage.According to Indiastat.com (2020-21), Telangana grows cabbage on 820 hectares of land, producing 27,780 tonnes year and 33.71 tonnes of productivity per hectare. The main pest, *Plutella Xylostella* (Linnaeus) diamondback moth, was identified by Abhijith *et al*. (2019) as having a damaging potential of 14–84%. Many other lepidopteran pests cause a great deal of damage, including the cabbage leaf webber (*Crocidolomiabinotalis* Zeller), tobacco caterpillar (*Spodoptera litura* Fabricius), cabbage head borer (*Hellula undalis* Fabricius), cabbage semilooper (*Trichoplusiani* Hubner), and cabbage butterfly (*Pieris brassicae* Linnaeus). Sucking pests have also been known to inflict serious damage, including the painted insect (*Bagradacruciferum* Burmeister), green peach aphid (*Myzus persicae* Green), and cabbage aphid (*Brevicornyebrassicae* Linnaeus). According to Sachan and Gangwar (1990), there may be seasonal variations in the frequency of insect pests. Weather factors play a major role in determining the frequency, abundance, and damage caused by insect pests.Succeeding in field agriculture is made more difficult by these vegetable's susceptibility to biotic stresses, especially during the winter and wet seasons.

2. MATERIAL AND METHODS

In the Horticultural Garden at the College of Agriculture, Rajendranagar, the field experiment was carried out in the rabi season of 2022–2023. Situated at a height of 542.3 metres above mean sea level, the experimental site is situated inside a semi-arid tropical climate with coordinates of 17.3850° N latitude and 78.4867° E longitude. The materials used and the methodology used for the inquiry throughout the tests are described in the following section.

2.1 Layout of Experiment:

The Horticulture Garden nursery was used to raise cabbage seedlings of the variety INDU SEMINIS for the intended experiment. Farm Yard Manure (FYM) and vermicompost were mixed together and put into the nursery trays. On October 12, 2022, the nursery trays were filled with seeds, and they

were watered once every two days. The fertiliser doses (N: P2O5: K2O: 19:19:19) were sprayed every ten days at a rate of 2 grammes per litre. Within five to six days of seeding, germination was seen. After that, on November 10 and 11, 2022, the cabbage seedlings were moved into beds in the field with a 45 cm 30 cm spacing.

2.2 Observations:

2.2.1 Major insect pests:

Every week, 25 plants were chosen to monitor the population of insect pests and their natural opponents. The following are the notes made about the different pests.

a) **Aphids:** Total number of aphids/inch^2/ 3 leaves/plant (upper, middle, lower) in 30 plants were counted visually with the help of magnifying lens at weekly interval.
b) **Painted bug:**Number of bugs per plant (30 plants)
c) **Leaf webber, diamondback moth and tobacco caterpillar:**Number of larvae per plant (30 plants)
d) **Predators (Lady bird beetles/Syrphids/Spiders):**Number per plant (30 plants)

2.2.2 Meteorological data:

In the open field, the maximum and lowest temperatures (°C), relative humidity (%), rainfall (mm), and sunshine hours were recorded along with the temperature and relative humidity. The seasonal occurrence of insect pests that harm cabbage and the complex of their natural enemies were connected with these meteorological conditions. The Agro-Climatic Research Centre at PJTSAU, Rajendranagar provided the weather parameter data, which were subsequently analysed to look for relationships with the prevalence of insect pests and their natural enemies.

2.3 Statistical analysis:

Statistical analysis was performed on population data of key insect pests and natural enemies of cabbage in order to determine the coefficient of correlation with maximum and minimum temperature, morning and evening relative humidity, rainfall, and sunshine hours. Aphids, leaf webbers, tobacco caterpillars, and diamondback moths are the main insect pests. A simple association was established between these populations and abiotic environmental conditions. Correlation coefficient significance test

3. RESULTS AND DISCUSSION

Aphids, cabbage leaf webbers, diamondback moths, tobacco caterpillars, green semiloopers, and painted bugs were among the pests that were discovered to be infesting the crop during the current investigation. Below are the noted observations regarding the prevalence of the main insect pests and their natural adversaries.

3.1 Aphids:

An infestation of aphids in the field began in the second week of November (45th SMW), when 10.51 aphids/inch2/3 leaves/plant were recorded. The population of aphids then steadily increased, peaking at 29.70 aphids/inch2/3 leaves/plant during the 48th SMW. After that, the population declined until the end of February (8th SMW). As shown in Table1, the average aphid incidence was 8.08 aphids/inch2/3 leaves/plant.

The results of the correlation studies indicated that the aphid population exhibited a non-significant positive correlation with morning relative humidity (r=0.371), a non-significant negative correlation with rainfall (r=-0.147), evaporation (r=-0.195), and sunshine (r=-0.195), as well as a significant negative correlation with maximum temperature (r=-0.543).

3.2 Leaf webber, *Crocidolomiabinotalis Z.*

During the third week of November (47th SMW), a leaf webber infestation was observed, with a mean population of 0.15 larvae/plant. Before steadily declining until harvest, the larval population grew until it peaked at four larvae/plant on the third SMW. A mean incidence of 1.28 larvae/plant was found for leaf webbers (Table.1).

The results of the correlation studies indicated that the population of leaf webbers had a significant negative correlation (r=-0.523) with evaporation, a non-significant negative correlation (r=-0.046) with sunshine, a non-significant negative correlation (r=-0.322), a non-significant negative correlation with wind speed, and a non-significant positive correlation (r =0.200) with maximum temperature, morning and evening relative humidity (r=0.329 and 0.189), rainfall (r =044), and sunshine (Table.2).

3.3 Diamondback moth, *Plutellaxylostella* L.

The diamondback moth first emerged in the fourth week of November (48th SMW), with a mean population of 0.17 larvae/plant. Over time, this population grew, peaking in the second week of January at 2.00 larvae/plant (2nd SMW). After then, the population began to decline. Table1 shows that the average incidence of diamondback moths was 0.65 larvae/plant.

A non-significant positive correlation was found with maximum temperature (r = 0.158), morning relative humidity (r = 0.496), evening relative humidity (r = 0.408), and rainfall (r = 0.103), while a significant negative correlation was found with evaporation (r = -0.592) and non-significant negative correlations with sunshine (r = -0.275), wind speed (r = -0.466), and minimum temperatures (r = 0.070) (Table.2).

3.4 Tobacco caterpillar*, Spodoptera litura* F.

Beginning in the first week of November (45th SMW), the population of tobacco caterpillar larvae was 0.12 larvae per plant at initially. Over time, the population grew steadily and peaked in the first week of January (1st SMW) at 2.50 larvae per plant. After then, the population of pests steadily decreased. Table 1 shows that the average incidence of tobacco caterpillars was 0.87 larvae/plant.

In contrast, it showed non-significant positive correlations with maximum and minimum temperature (r = 0.002 and r = 0.220), rainfall (r = 0.209), and non-significant negative correlations with sunshine (r = 0.458) and wind speed (r = -0.410). The correlation studies revealed that the population of tobacco caterpillar larvae showed significant positive correlations with morning relative humidity (r = 0.633) and evening relative humidity (r = 0.557), as well as significant negative correlations with evaporation (r = -0.521) (Table.2).

3.5 Other insect pests

The painted bugs, with a mean population of 0.07 bugs/plant, were first observed during the third week of December (the 51st SMW). The mean incidence of painted bugs was found to be 0.01 bugs per plant, and cabbage semiloopers were observed starting in the 48th SMW week of November. The population started off at 0.17 larvae per plant, but it climbed to 1.0 larvae per plant during the second SMW (Table.1).

The results of the correlation studies indicated that the population of cabbage semilooper larvae had a significant negative correlation (r=-0.488) with evaporation and a non-significant positive correlation (r = 0.146 and r = 0.101), morning relative humidity (r = 0.396), and evening relative humidity (r = 0.418) with maximum and minimum temperature. The population of painted bugs had a noteworthy positive association with the relative humidity in the morning (r = 0.722), the evening (r = 0.512), and the rainfall (r = 0.650). On the other hand, non-significant negative association (r=-0.248) and non-significant positive correlation (r = 0.345) were found with evaporation and minimum temperature, respectively (Table.2).

3.6 Ladybird beetle (Grubs and adults)

The ladybird beetles, including grubs and adults, were initially observed in the second week of November (45th SMW), with a mean population of 0.15/plant. During the first week of December (49th SMW), the population peaked at 2.21/plant. After then, the population steadily declined until harvest time. Table 1 shows that the average number of adult ladybird beetles per plant was 0.80.

The results of the correlation studies indicated that the population of ladybird beetles had a non-significant positive association with rainfall (r = 0.390), morning and evening relative humidity (r = 0.221 and 0.408), and minimum temperature (r = 0.384). The results of the correlation tests showed a strong positive association (r = 0.591) between the populations of ladybird beetles and aphids (Table 2).

3.7 Syrphids

Syrphids were first observed in the fourth week of November (47th SMW), with a mean of 0.03/plant. By the third week of December (51st SMW), the incidence had peaked at a mean of 1.00/plant. After then, the population steadily declined until harvest time. It was found that the average syrphid population was 0.21 larva/plant (Table.1).

The results of the correlation studies indicated that the population of syrphids exhibited a substantial positive association with rainfall (r = 0.690), an evening relative humidity of 0.745,while showing significant positive correlation with morning relative humidity (r =0.720) and a non-significant positive correlation with the minimum temperature (r = 0.385). Syrphids exhibit a strong inverse relationship with evaporation (r=-0.507) and sunshine (r= -0.678). According to correlation studies, there was a non-significant positive connection (r = 0.226) between the syrphid and aphid populations (Table.2).

3.8 Spiders

The spiders were first observed in the first week of November (45th SMW), with a mean of 0.03/plant. By the fourth week of December (52nd SMW), the incidence had peaked at a mean of 0.15/plant. After then, the population steadily declined until harvest time. It was found that the mean spider population was 0.03/plant (Table.1).

As per Table 2, the correlation studies revealed that there was no significant positive correlation between spiders and maximum temperature (r = -0.246), but there was a non-significant negative correlation with sunshine (r = -0.202), windspeed (r = -0.085), and evaporation (r = -0.147). On the other hand, there was no significant positive correlation with minimum temperature (r = 0.064), morning relative humidity (r = 0.146), evening relative humidity (r = 0.195), and rainfall (r = 0.394).

Table.1 Incidence of major insect pests of cabbage in open field

Standard meteorological week (SMW)	Month(May 2022-Feb 2023)	*Mean insect population						Natural enemies		
		Aphids (inch^2 /3 leaves/plant)	Leaf webber (no./ plant)	DBM (no./plant)	Tobacco caterpillar (no./plant)	Semilooper (no./plant)	Painted bug (no./ plant)	Coccinellids (no./plant)	Syrphids (no./ plant)	Spiders (no./plant)
45	05 Nov-11 Nov	10.51	0.00	0.00	0.12	0.00	0.00	0.15	0.00	0.03
46	12 Nov-18 Nov	16.97	0.00	0.00	0.14	0.00	0.00	0.27	0.00	0.07
47	19 Nov- 25 Nov	20.63	0.15	0.00	0.23	0.00	0.00	2.00	0.03	0.00
48	26 Nov- 02 Dec	29.70	0.30	0.17	0.59	0.17	0.00	1.35	0.07	0.00
49	03 Dec- 09 Dec	18.23	0.60	0.47	0.96	0.10	0.00	2.21	0.45	0.05
50	10 Dec- 16 Dec	4.57	0.90	0.66	1.05	0.10	0.00	1.10	0.30	0.07
51	17 Dec- 23 Dec	3.33	1.50	0.90	1.50	0.15	0.07	2.00	1.00	0.10
52	24 Dec- 31 Dec	5.93	2.00	1.10	2.00	0.21	0.03	1.03	0.60	0.15
1	01 Jan- 07 Jan	3.80	2.50	1.80	2.50	0.80	0.07	0.53	0.30	0.00
2	08 Jan- 14 Jan	3.43	3.00	2.00	2.40	1.00	0.00	0.20	0.60	0.00
3	15 Jan- 21 Jan	3.87	4.00	1.50	0.68	0.50	0.00	0.23	0.00	0.00
4	22 Jan- 28 Jan	2.70	3.50	0.90	0.50	0.00	0.00	0.20	0.05	0.00
5	29 Jan- 04 Feb	2.20	1.00	0.30	0.47	0.21	0.00	0.23	0.00	0.00
6	05 Jan- 11 Feb	1.63	0.52	0.23	0.32	0.00	0.00	0.27	0.00	0.00
7	12 Feb- 18 Feb	1.12	0.35	0.17	0.23	0.11	0.00	0.23	0.00	0.00
8	19 Feb- 25 Feb	0.60	0.23	0.15	0.21	0.00	0.00	0.19	0.00	0.05
	Mean	**8.08**	**1.28**	**0.65**	**0.87**	**0.21**	**0.01**	**0.80**	**0.21**	**0.03**

Table.2 Correlation of insect pests in cabbage and natural enemies with abiotic factors in open field

Abiotic/ Biotic factors	Insect Pests						Natural enemies		
	Aphids	Leaf webber	DBM	Tobacco caterpillar	Semiloo per	Painted bug	Coccinellids	Syrphids	Spiders
Maximum Temperature (^{0}C)	-0.543	0.200	0.158	0.002	0.146	-0.141	-0.471	-0.276	-0.246
Minimum Temperature (^{0}C)	0.440	-0.322	-0.070	0.220	0.101	0.345	0.384	0.385	0.064
RH 1 (%) Morning hours	0.371	0.329	0.496	0.633**	0.396	0.722**	0.221	0.720**	0.146
RH 2 (%) Evening hours	0.270	0.189	0.408	0.557*	0.418	0.512*	0.408	0.745**	0.195
Rainfall (mm)	-0.147	0.044	0.103	0.209	-0.053	0.650**	0.390	0.690**	0.394
Sunshine (hrs)	-0.195	-0.046	-0.275	-0.458	-0.275	-0.407	-0.381	-0.678**	-0.202
Wind speed (Km/hr)	-0.039	-0.335	-0.466	-0.410	-0.435	-0.1	0.001	-0.142	-0.085
Evaporation (mm)	-0.195	-0.523*	-0.592*	-0.521*	-0.488	-0.248	-0.225	-0.507*	-0.147
Aphids							0.591*	0.226	

*** Significant at 5% level**

****Significant at 1% level**

The results of this study are consistent with those of Lal *et al.* (2020), who noted that tobacco caterpillars were also observed to be a major insect pest damaging cabbage crops in both years, along with aphids, painted bugs, and diamondback moths. The months of February and March saw the mean peak populations of these main insect pests. During their study, Aiswarya *et al.* (2018) observed similar variations in the larval populations of the DBM, leaf webber, tobacco leaf-eating caterpillar, and cabbage semilooper. DBM, leaf webber, and cabbage semilooper incidence started during the 47th SMW, but tobacco caterpillar incidence happened during the 46th SMW. [19] The seasons of 2016-17 saw the highest incidences of DBM, leaf webber, cabbage semilooper, and tobacco leaf-eating caterpillar in the 51st, 3rd, 48th, 49th, and 50th SMW, respectively. According to Bhagat *et al*. (2018), the infestation of diamondback moths peaked in March of both years, starting in late December of the previous year and the first week of January of the following year. DBM occurrence was noted by Mane *et al*. (2021) to begin in the second week of February, reach its peak in the first week of March, and then progressively decline in the ensuing meteorological weeks. The cabbage aphid (*Brevicoryne brassicae*) and ladybird beetle (*Coccinella septempunctata*) were both observed by Sharma *et al*. (2022) to be visible from the 49th to the 8th SMW, with peak incidences in the 5th SMW (41.0 larva/plant) and 4th SMW (1.0 larva/plant), respectively.Bhede (2018) reports that during the 2015-16 and 2016-17 seasons, respectively, syrphid populations peaked in the first SMW (5.75/plant) and 52nd SMW (3.55/plant). Syrphids showed a significant inverse link with aphids in both seasons as well as a strong inverse relationship with the lowest temperature during the first season.According to Mane*et al.* (2021), there is a non-significant negative association between DBM and the high temperature, low temperature, morning humidity, and hours of bright sunshine. When Khan and Talukder (2017) looked into how weather conditions affected the number and population dynamics of *S. litura* and *P. brassicae* on cabbage, they discovered that the 5th SMW was when the peak larval populations of *S. litura* (1.57 larvae/plant) and *P. brassicae* (1.98 larvae/plant) occurred. According to Jemimah (2021), coccinellids and syrphids showed a positive link with morning relative humidity and evaporation, but a negative correlation with maximum and minimum temperatures and wind speed.

4. CONCLUSION

The goal of this research is to help create a detailed plan for the effective management of the main insect pests that harm crops. The leaf webber, tobacco caterpillar, diamondback moth, and aphids were found to be often occurring. Furthermore, the numbers of natural enemies like spiders, syrphids, and ladybird beetles were tracked, and their trends were observed during the crop growing season.The tobacco caterpillar exhibits significant positive correlations with morning relative humidity and evening relative humidity, while the aphid population's correlation studies revealed significant negative correlations with maximum temperature, leaf webber's significant negative correlations with evaporation, sunshine, wind speed, and minimum temperature. The predators, known as coccinellids, demonstrated substantial positive relationships with evening time temperatures, while the diamondback moth displayed large negative associations with evaporation.The main objective of this study was to determine how common certain insect pests are that damage cabbage in agricultural fields.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

SMW: Standard MeteorologicalWeek

Rh1: Morning Relative Humidity

Rh2: Evening Relative Humidity

MT: Metric Tonnes

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