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Seasonal Incidence of Major Insect Pests of Cabbage (*Brassica oleracea* var. *capitata* L.) at Parbhani, Maharashtra

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ABSTRACT: A study on the seasonal occurrence of major cabbage insect pests was conducted at the Department of Agricultural Entomology, VNMKV, Parbhani during the winter of 2021-2022. Cabbage seedlings were planted in 60 quadrats with weekly monitoring. The most effective strategy for mitigating pest damage involves tackling pests during the early stages of their life cycle. Achieving this requires timely prediction of pest occurrences. However, given the swift changes in climatic conditions, it becomes imperative to investigate the seasonal patterns of key cabbage insect pests in relation to weather parameters. The findings revealed that leaf webber larvae first appeared in the third week of December (SMW 51st) and peaked at 25.04 larvae per quadrat during the second week of January (2nd SMW). Head borer activity peaked during the third week of January (SMW 3rd) at 10.4 larvae per quadrat. The diamondback moth infestation began in the third week of December (SMW 5^{1st}) and reached its peak of 8.6 larvae per quadrat in the last week of January (SMW 4th). The tobacco leaf-eating caterpillar was observed in the last week of December (SMW 52nd) and peaked in the second week of January (SMW 2nd) at 1.4 larvae per quadrat. Larvae of C. illecta were first spotted in the first week of January (SMW 1st), peaking at 0.2 larvae per quadrat in the second week of January (SMW 2nd). Hairy caterpillar activity commenced in the third week of December (SMW 51st) with a peak of 0.2 larvae per quadrat in the second week of January (SMW 2nd). Aphid infestation started in the third week of December (SMW 51st), reaching their peak at 112.2 aphids per quadrat in the second week of January (SMW 2nd). Correlation studies showed that leaf webber correlated negatively with morning humidity (r= -0.736). Head borer had non-significant negative correlations with maximum temperature (r= -0.21), minimum temperature (r= -0.185), morning relative humidity (r= -0.009) and evening relative humidity (r = -0.097). Daimond back moth showed non-significant negative correlations with temperature, minimum temperature (r= -0.444), maximum temperature (r= -0.0169). Tobacco caterpillar showed a negative but non-significant correlation with morning relative humidity (r= -0.175) and maximum temperature (r= -0.157).

Keywords: Seasonal incidence, Cabbage pests, weather parameters, Correlation.

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata* L.) is an important rabi vegetable from the cruciferous family that is widely cultivated in tropical and temperate zones around the world. Cabbage, which has its origins in the coastal regions of Western Europe, the Northern Mediterranean, and Great Britain, offers remarkable health benefits. Cabbage is a key player in scavenging cancer and heart-disease-causing free radicals because it is rich in numerous phytonutrients and important vitamins like A 2000 I. U., B1 50 I.U. and C 124 mg/ 100g (Meena, 2018) all of which serve as natural antioxidants. The use of cabbage in salads, boiled foods, dehydrated foods, cooked curries, and pickles demonstrates the vegetable's adaptability. About 4% of India's total vegetable growing area is dedicated to the cultivation of cabbage. The production of cabbage in Maharashtra is 176.36 thousand tonnes per annum, with a productivity of 17.23 mT/ha (www.indiastat.com, 2022). The cultivation of cabbage is seriously threatened by insect pests, with some of the most notable offenders being the tobacco caterpillar (*Spodoptera litura* Fab.), diamondback moth (*Plutella xylostella* L.), cabbage semilooper (*Trichoplusiani* Hubner), painted bug (*Bagrada hilaris* Burmeister), cabbage butterfly (*Pieris brassicae* L.), flea beetles (*Phyllotreta cruciferae* Goeze), aphids (*Lipaphis erysimi* Kalt.), and the mustard sawfly (*Athalia lugens proxima* Klug) (Bhatia and Verma 1993). Under optimal conditions, these pests have the potential to wreak havoc, inflicting damage ranging from 80-100% in nurseries and around 10-25% in field crops (Rao and Sitaramaiah 2011). Numerous previous researchers (Sharma, 2004; Shukla and Kumar 2004; Wagle *et al*., 2005) have gathered data on the

occurrence of pests during different seasons in various parts of India.

The knowledge of the seasonal incidence of insect pests at different growth stages of cabbage crop will be helpful in evolving proper management schedule. The information on seasonal incidence was however, generated by many workers from different regions of India. This endeavor holds the potential to craft efficient pest management approaches. The seasonal incidence of any pest varies from region to region due to variation in cropping season and climatic conditions. Hence, it was considered imperative to find out the impact of environmental factors on incidence of these important insect pests of cabbage, in order to find out the seasonal pattern of their incidence for a better monitoring and management of these pests.

MATERIAL AND METHODS

The investigation on seasonal incidence of major insect pests of cabbage was carried out during winter 2021-22. The data on the pest incidence were statistically analysed and then computed with correlation co-efficient studies to see the effect of different abiotic factors on the population of major insect pests.

Table 1: Sampling methodology for recording of major pests of cabbage.

Sr. No.	Name of the pest	Unit of expression	Sampling method	No. of samples	Frequency of observation
1.	Diamondback moth	Larvae/quadrat	No. of larvae/quadrat	5	weekly
2.	Tobacco caterpillar	Larvae/quadrat	No. of larvae/quadrat	5	weekly
3.	Leaf Webber	Larvae/quadrat	No. of larvae/quadrat	5	weekly
4.	Head borer	Larvae/quadrat	No. of larvae/quadrat	5	weekly
5.	Aphids	Larvae/quadrat	No. of Aphids/quadrat	5	weekly

RESULTS AND DISCUSSION

During the present studies on seasonal incidence of major insect pests of cabbage were undertaken at the Department of Agricultural Entomology, College of Agriculture, Parbhani during winter season 2021-22. The crop was found to be abundantly infested with the major pests comprising of DBM, head borer, cabbage leaf webber, Spodoptera. This insect pest has also been reported as a serious pest of cabbage by some entomologists (Sharma, 2004), Shukla and Kumar (2004) who also support the present findings. The results obtained during the course of experimentation are presented under the following heads.

Seasonal incidence of major insect pests of cabbage

During winter season 2021-22, the crop was found to be infested with various pests like diamondback moth (*Plutella xylostella*), head borer (*Hellula undali*), tobacco leaf eating caterpillar (*Spodoptera litura*), leaf webber (*Crocidolomia binotalis*), hairy caterpillar (*Spilosoma oblique*) and *Condica illecta*, aphid (*Brevycoryne brassicae*) were presented in Table 2.

Leaf webber, *Crocidolomia binotalis* (Zeller)

The pest infestation was observed consistently throughout the weeks, with larval numbers ranging from 1.2 to 23.4 per quadrat. The highest population, recorded at 25.04 larvae per quadrat, occurred during the second week of January (SMW 2nd) (Table 2 and Fig. 1). These peak numbers coincided with specific meteorological conditions, with a maximum temperature of 27.1°C, a minimum temperature of 15.9°C, morning relative humidity at 87%, and evening relative humidity at 55%. The population of *C. binotalis* showed significant positive correlations with maximum temperature (r=0.552), minimum temperature (r=0.573), and evaporation rate in millimeters per day (r=0.649 notably, the population had a significant negative correlation with morning relative humidity (r=-0.736) but did not show a significant correlation with evening relative humidity (r=-0.346) during this period (Table 3). These findings partially align with previous research. Badjena and Mandal (2005) reported a peak population of insects (25.6 larvae per 10 plants) during the third week of January. Gaikwad *et al*. (2018) have reported leaf webber pest was maximum in 2nd SMW (3.00 larvae / plant). Additionally, Palande *et al*. (2004) noted that the *C. binotalis* population was positively correlated with maximum and minimum temperatures but negatively correlated with morning relative humidity, consistent with our observations.

Head borer, *Hellula undalis* (Fabricius)

During the winter season, the population of *Hellula undalis* on cabbage crops displayed a range of 0.6 to 12.6 larvae per quadrat, with the highest count recorded in the third week of January (SMW 3rd) at 10.4 larvae per quadrat (Table 2 and Fig. 2). The prevailing weather conditions during this time included a maximum temperature of 26.7°C, a minimum temperature of 11.8°C, morning relative humidity at 92%, and evening relative humidity at 44%. The population of *H. undalis* showed non-significant and negative correlations with several weather factors, including maximum temperature (r=-0.21), minimum temperature (r=-0.185), morning relative humidity (r=-0.009), and evening relative humidity (r=0.106) during this period (Table 3). These findings align somewhat with the research of Sahu *et al*. (2019), who noted that the infestation of the Cabbage head borer began in the third week of December (51st SMW). (Gopika *et al*, 2020) have reported peak activity of cabbage head borer was noticed during 5th SMW (5.8 larvae / plant) Additionally, Patait *et al*. (2008) reported negative correlations with forenoon relative humidity and minimum temperature, which is consistent with our observations.

Table 2: Seasonal incidence of major insect pests of cabbage during winter season 2021-22.

	Mean number of larvae/quadrant						
Standard meteorological week	**Leaf Webber**	**Head borer**	**Daimond back moth**	**Tobacco caterpillar**	***C. illecta***	**Hairy caterpillar**	**Aphid**
week 51	1.2	0.6	0	0	0	0.2	4
week 52	6.4	0.4	1.2	0.2	0	0.2	66.2
week 1	8.2	3.2	1.6	0.4	0.2	0	89.4
week 2	25.4	8.4	2.4	1.4	0.2	0.2	112.2
week 3	17.2	10.4	1.8	0	0	0	82.4
week 4	14.2	7.2	8.6	0	0	0	94.2
week 5	22	8.2	6	0	0	0	89.3
week 6	23.4	12.6	0.8	0	0	0	32.6

Table 3: Correlation coefficients of major insect pests of cabbage during winter season 2021-22.

	Correlation coefficient (r value)						
Weather parameters	**Leaf Webber**	**Head borer**	**Daimond back moth**	**Tobacco caterpillar**	***C. illecta***	**Hairy caterpillar**	**Aphid**
Maximum temperature (°C)	0.552*	-0.219	-0.296	-0.157	-0.518*	-0.492	0.603*
Minimum temperature (°C)	0.573*	-0.185	-0.444	0.413	0.063	0.171	0.360
Morning relative humidity (%)	-0.736*	-0.009	0.006	-0.175	0.557*	0.442	0.202
Evening relative humidity (%)	-0.346	0.106	-0.018	0.385	0.655*	0.702*	0.638*
Rainfall (mm)	0	0	0	0	0	0	0.000
Bright sunshine hours	0.236	0.166	0.22	-0.352	-0.551*	-0.616*	-0.285
Evaporation (mm/ day)	0.649*	-0.027	-0.024	0.052	-0.605*	-0.506*	-0.187
Wind velocity (km/hr)	0.468	0.384	0.346	0.916*	-0.068	0.301	0.513*

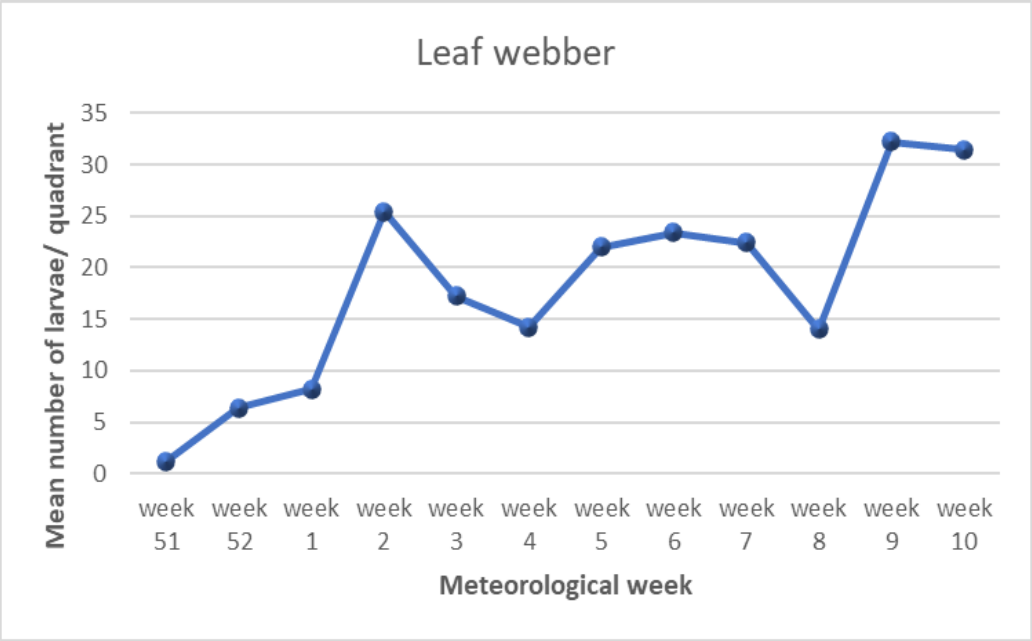

Fig. 1. Seasonal incidence of cabbage leaf webber.

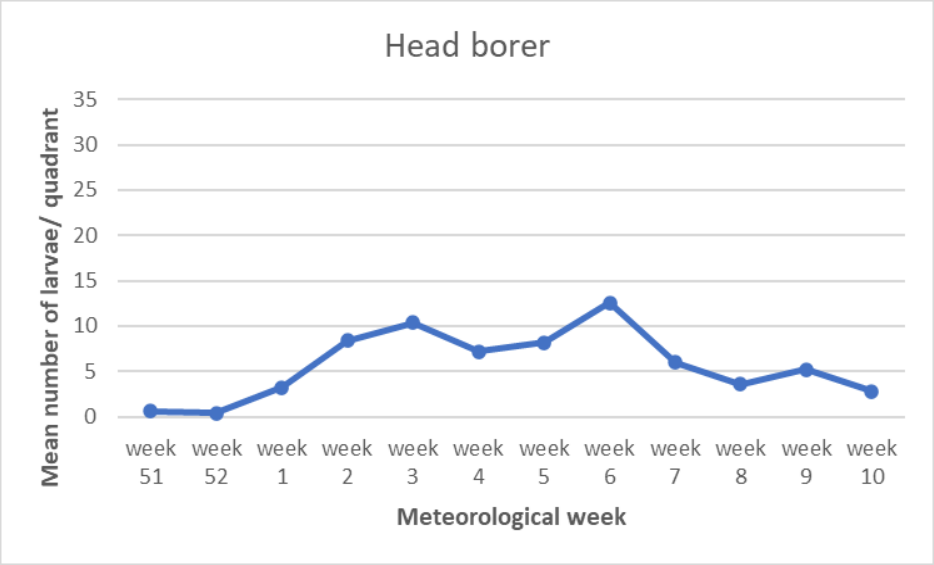

Fig. 2. Seasonal incidence of cabbage head borer.

Diamondback moth, *Plutella xylostella* (Linnaeus)

The population of *Plutella xylostella* on cabbage began its presence in the last week of December (SMW 52nd) and steadily increased, reaching its peak at 8.6 larvae per quadrat during the final week of January (SMW 4th) (Table 2 and Fig. 3).

These peak numbers coincided with specific meteorological conditions, with a maximum temperature of 26.8°C, a minimum temperature of 9.9°C, morning relative humidity at 78%, and evening relative humidity at 34%. These results partially align with previous studies. Godin and Boivin (1998) and Shyam *et al.* (2020) both reported *P. xylostella* infestations starting around late December to early February and reaching their peak during February, which is consistent with our findings. Similarly, Reddy *et al*. (2016) noted a peak population during the 4th SMW, in agreement with our present results. The population of *P. xylostella* displayed non-significant negative correlations with minimum temperature (r=-0.444), maximum temperature (r=-0.296) and evening relative humidity (r=-0.018). However, it showed non-significant positive correlations with morning relative humidity (r=0.006) during this period (Table 3).

These findings are consistent with Gautam *et al*. (2018), who found that maximum temperature had a non-significant negative correlation with larval population, and with Palande *et al*. (2004), who reported a negative correlation with evening relative humidity (Awasthi and Tomar *et al*., 2020) DBM infesting cabbage crop revealed that the first appearance of the pest was started during 2nd week of December and attended peak (5.8 larvae / plant) in the last week of January (5th SMW).

Tobacco caterpillar, *Spodoptera litura* (Fabricius)

The activity of *Spodoptera litura* commenced during the last week of December (SMW 52nd) and gradually intensified, reaching its peak at 1.4 larvae per quadrat during the second week of January (SMW 2nd) (Table 2 and Fig. 4). At the time of this peak population, the prevailing weather conditions were a maximum temperature of 27.1°C, a minimum temperature of 15.9°C, morning relative humidity at 87%, and evening relative humidity at 55%. The population of *S. litura* exhibited positive but non-significant correlations with minimum temperature (r = 0.413), evening relative humidity (r = 0.385), and evaporation in millimeters per day (r=0.052). However, it showed a negative but non-significant correlation with morning relative humidity (r = -0.175), and maximum temperature (r = -0.157) (Table 3). These findings are partially consistent with previous research. Sahu *et al*. (2019) observed a peak infestation of *S. litura* during the third week of January, which are supports with our findings. Narasimha Murthy *et al*. (1998) reported a non-significant correlation between *S. litura* population and morning relative humidity, while Khan and Talukdher (2017) noted negative correlations with maximum relative humidity and minimum relative humidity. Furthermore, Patait *et al.* (2008) found that the *S. litura* population was negatively affected by relative humidity, minimum temperature, and maximum temperature, supporting our results.

***Condica illecta* (Walker)**

C. illecta made its initial appearance on cabbage during the first week of January (SMW 1st) with a low count of 0.2 larvae per quadrat. However, by the third week of January (SMW 3rd), the pest had disappeared (Table 2 and Fig. 5). The population of *C. illecta* exhibited positive but non-significant correlations with minimum temperature (r=0.063) and significant positive correlations with evening relative humidity (r=0.655) and morning relative humidity (r=0.557). Conversely, it displayed negatively significant correlations with evaporation in millimeters per day (r=-0.605) and maximum temperature (r=-0.518).

Hairy caterpillar, *Spilosoma obliqua* (Walker)

The population of *Spilosoma obliqua* on winter cabbage was found to be fluctuating from 0 to 0.2 larvae per quadrat during third week of December (SMW 51st) to second week of January (SMW 2nd) (Table 2 and Fig. 6). The *S. obliqua* population had significant positive correlation with evening relative humidity (r= 0.702) whereas, it had positive but non-significant correlation

with morning relative humidity (r= 0.442) and minimum temperature (r= 0.171). The *S. obliqua* population had non-significant correlation with maximum temperature (r= -0.492) during this period (Table 3).

As there was scarcity of literature available on seasonal incidence of *C. illecta* and *S. obliqua* were not discussed in our present findings.

Aphid, *Brevycoryne brassicae* (Linnaeus)

The population of *Brevycoryne brassicae* aphids on winter cabbage was observed between the second week of December (SMW 51st) and the second week of February (SMW 6th) (Table 2 and Fig. 7). The highest aphid population was recorded during the second week of January (SMW 2nd), with an average of 112.2 aphids per quadrat. At the peak population period, the weather conditions were as follows: the maximum temperature was 27.1°C, the minimum temperature was 15.9°C, the morning relative humidity was 87%, and the evening relative humidity was 55%.

There were notable correlations between *B. brassicae* population and various weather factors. Specifically, there was a significant positive correlation with evening relative humidity (r = 0.638), maximum temperature (r = 0.603). Additionally, there was a positive but non-significant correlation with minimum temperature (r = 0.360) and morning relative humidity (r = 0.202) (Table 3). These findings align with previous research. Sain *et al*. (2017) reported a peak aphid population in the third week of December (Week 50th), while Patra *et al.* (2013) observed the peak population of cabbage aphids during the second week of February (14.17 aphids per leaf), which is consistent with our current results. Furthermore, the significant relationship between aphid population and different weather parameters, such as maximum temperature and evening relative humidity, has also been reported by Raja *et al*. (2014).

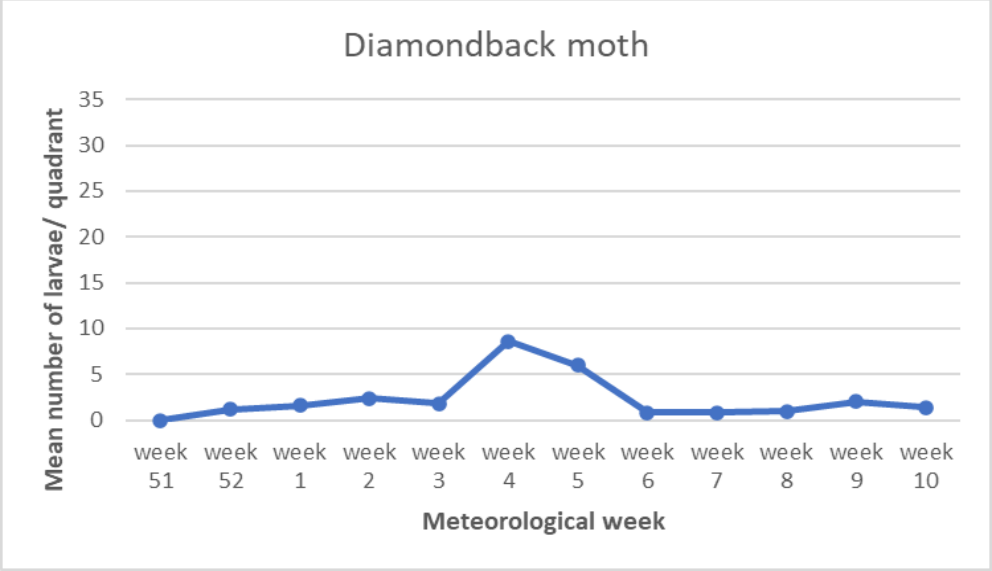

Fig. 3. Seasonal incidence of Diamond back moth.

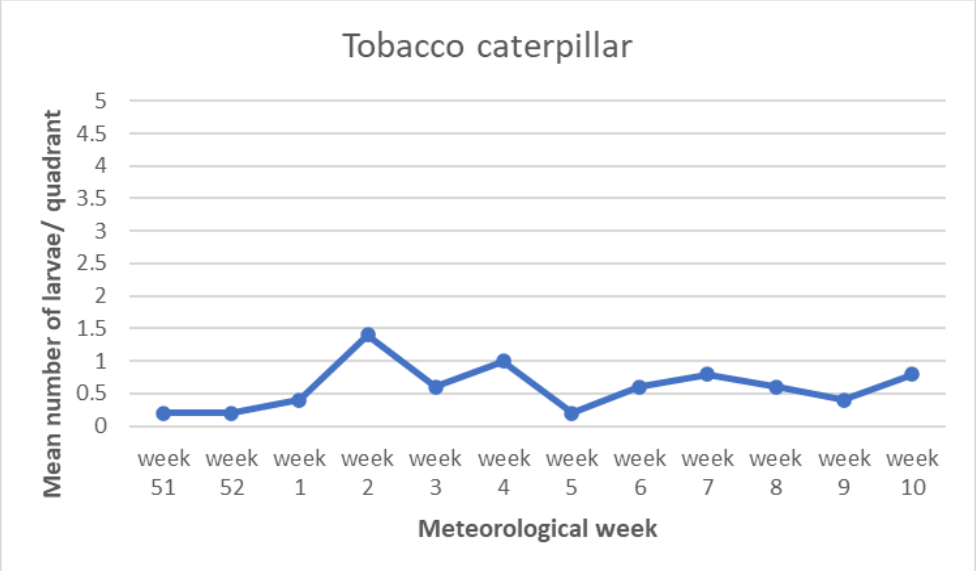

Fig. 4. Seasonal incidence of Tobacco caterpillar.

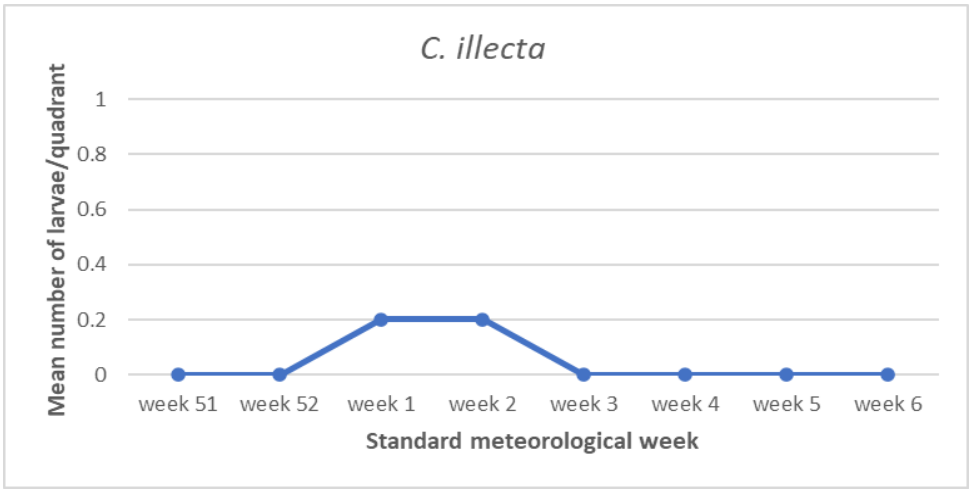

Fig. 5. Seasonal incidence *of Condica illecta.*

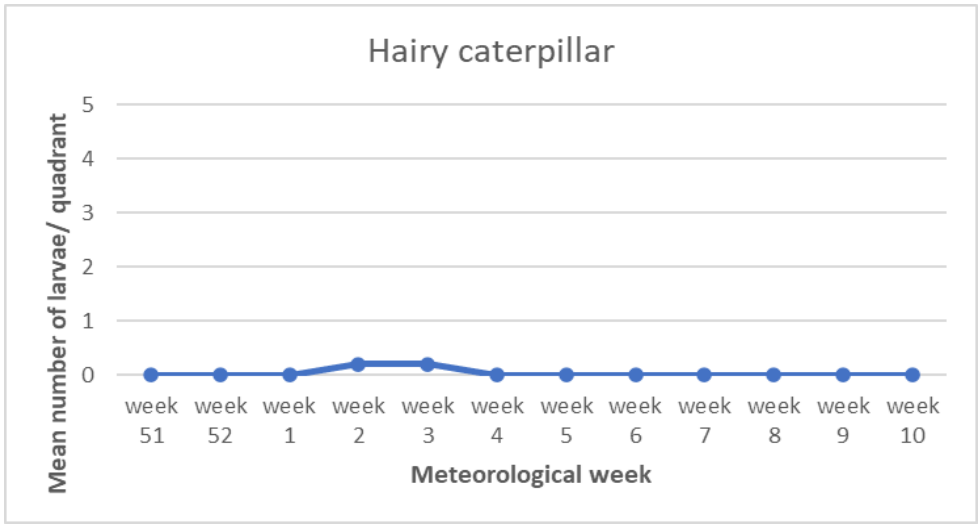

Fig. 6. Seasonal incidence of Hairy caterpillar.

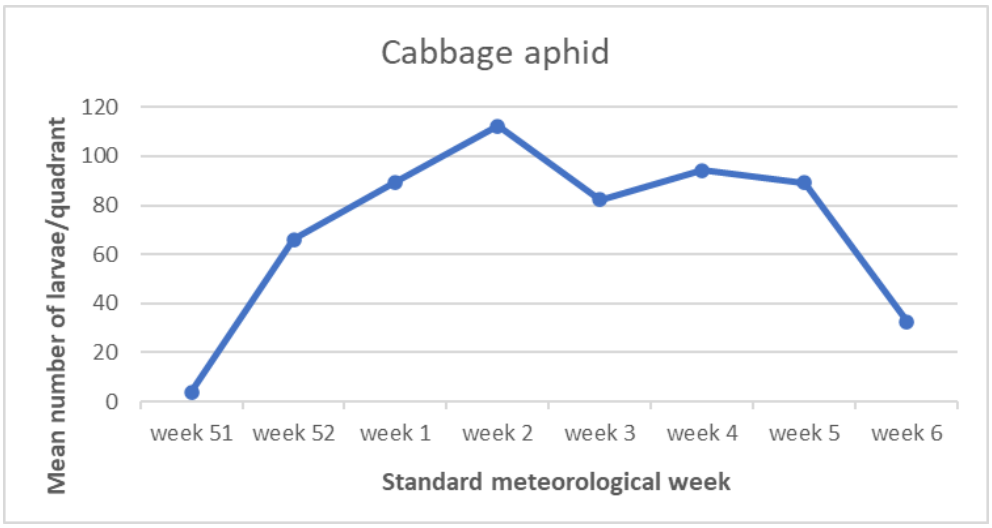

Fig. 7. Seasonal incidence of Aphid.

CONCLUSIONS

On the basis of results and discussion of the present investigation the following recommendations, conclusions are proposed. The leaf webber, Head borer and Daimondback moth larvae varied from 1.2 to 23.4, 0.6 to 12.6, and 0 to 0.8 per quadrat, respectively. Tobacco caterpillar, *C. illecta*, and Hairy caterpillar ranged from 0.2 to 1.4, 0.2 to 0.2, and 0.2 larvae per quadrat, respectively. Aphid was most abundant in the 2nd SMW. Weather conditions showed temperature ranges of 26.7 to 30.4°C, humidity from 8 to 15.9%, and no rainfall during this period. The peak activity of these pests occurred in different weeks with varying populations. Correlation analysis revealed relationships between the pests and weather parameters. For instance, leaf webber correlated positively with minimum and maximum temperature but negatively with morning humidity. Head borer had non-significant negative correlations with temperature and humidity. Diamondback moth showed non-significant negative correlations with temperature and a non-significant positive correlation with morning humidity. Tobacco caterpillar had positive but non-significant correlations with temperature and evening humidity. *C. illecta* had significant positive correlations with evening and morning humidity but non-significant correlations with temperature. Hairy caterpillar showed a significant positive correlation with evening humidity and non-significant correlations elsewhere. These findings provide insights for managing cabbage pests effectively, helping farmers minimize losses due to head borer, diamondback moth, and leaf webber infestations during the growing season.

FUTURE SCOPE

According to the present findings of the investigation, there is a plenty of scope to build the studies that can enhance and implement proper effective management practices for the control of insect pests. This research would aid in the implementation of natural enemies and pest IPM tactics. In order to control the pest, future research should focus more on production and release of natural enemies and parasitoids.

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Conflict of Interest. None

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