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Seasonal incidence of tobacco caterpillar, *Spodoptera litura* (Fabricius) infesting cabbage, *Brassica oleracea* var. *capitata* L.

Priti S Shigwan, Kumud V Naik, MS Karmarkar, PB Sanap and AV Mane

Abstract
The field experiment was conducted to study the seasonal incidence of tobacco caterpillar, *S. litura* infesting cabbage during *rabi* season of 2020-21 and 2021-22 at Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The population of *S. litura* ranged from 0.28 to 5.04 and 0.24 to 7.72 larvae per plant during *rabi* 2020-21 and *rabi* 2021-22, respectively. The peak population of *S. litura* was observed in 4th and 2nd SMW during *rabi* season of 2020-21 and 2021-22, respectively. However, pooled data on both the years revealed that the *S. litura* population was in the range of 0.14 to 6.26 larvae per plant, whereas peak population was observed during 2nd SMW. The population of *S. litura* was fluctuating till the harvesting of cabbage. During *rabi* 2020-21, the mean population of *S. litura* exhibited positive non-significant correlation with maximum and minimum temperature, wind speed and bright sunshine hours, while negative non-significant correlation with morning and evening relative humidity. During *rabi* 2021-22, the mean population of *S. litura* showed positive non-significant correlation with morning and evening relative humidity and wind speed, while negative non-significant correlation with maximum and minimum temperature and bright sunshine hours. The pooled data of *S. litura* population showed positive non-significant correlation with minimum temperature, morning and evening relative humidity and wind speed whereas, the maximum temperature and bright sunshine hours had negative non-significant correlation with *S. litura* population.

Keywords: Seasonal incidence, tobacco caterpillar, *Spodoptera litura* (Fabricius), correlation

Introduction
Cabbage (*Brassica oleracea* var. *capitata* L.) is an important vegetable crop mainly grown in winter season. It is from a group of plants known as the cole crops. The word 'cole' is abbreviated from latin word 'Caulis' which means 'stem'. It is the member of Brassicaceae family. The origin of cabbage is Europe. It consists of thick leaves overlapping tightly on growing main bud called 'head'. It is commonly used as cooked vegetable and also used in salad, pickle etc. It is rich in minerals like potassium (170 mg), calcium (40 mg), phosphorus (26 mg), sodium (18 mg), magnesium (12 mg) and vitamin C (36.6 mg). It also contains carbohydrates (5.8 g), fibre (2.5 g), protein (1.8 g) and water (92.18 g) per 100 gram. It prevents oxidative stress, induce detoxification enzymes, stimulate the immune system and reduce cancer risk (Sanlier and Guler, 2018) [10].

Cabbage is an introduced vegetable crop in India, but it has adapted itself well and is grown all over the country. In India, it is cultivated on an area of 412.40 thousand hectare with total production of 9560.01 thousand MT and average productivity is 23.18 MT/ha. While in Maharashtra, it is cultivated on an area of 10.85 thousand hectare with total production 180.11 thousand MT and productivity is 16.6 MT/ha in 2020-21 (Anonymous, 2021) [2]. India ranks second in cabbage production after China. In India, West Bengal (2321.15 thousand MT) is major cabbage producing state followed by Odisha (1130.54 thousand MT), Madhya Pradesh (911.53 thousand MT) and Assam (739.89 thousand MT). In case of productivity of cabbage, Tamil Nadu (67.74 MT/ha) ranks first followed by Uttar Pradesh (33.56 MT/ha) and Telangana (32.99 MT/ha) (Anonymous, 2021) [2].

Although cabbage being one of the important crop, it suffers economic losses due to infestation of various insect pests. The insect pests namely, aphids (*Lipaphis erysimi* Kalt. and *Brevicoryne brassicae* Linn.), diamond back moth (*Plutella xylostella* Linn.), cabbage borer (*Hellula undalis* Fabr.), cabbage looper (*Trichoplusia ni* Hb.), leaf webber

(*Crocidolomia binotalis* Zell.), painted bug (*Bagrada cruciferarum* Kirk.), cabbage butterfly (*Pieris brassicae* Linn.) and tobacco caterpillar (*Spodoptera litura* (Fabricius)) etc. are of more significance on cabbage which affect yield and quality throughout the country (Yadav and Malik, 2014) [12]. Among these insect pests, tobacco caterpillar, *S. litura* (Noctuidae: Lepidoptera) is the most important pest causing severe yield loss to cabbage every year. *S. litura* is the polyphagous pest and has been reported on about 112 cultivated plants. *S. litura* may cause an economic loss ranged from 25.8 – 100 percent (Sahu *et al.*, 2020a) [9]. Neonate larvae of tobacco caterpillar scrap the green matter in the leaf. Late instars feed voraciously on tender leaves and fresh growth (Sardana *et al.*, 2017). [11]

It is very important to reduce the losses caused by pests to improve quality and increased yield. The meteorological factors play important role in the seasonal incidence of pests. For the proper management of pests, it is necessary to study seasonal incidence of pests and their relation with weather parameters. The knowledge of seasonal incidence of insect pests at different growth stages of cabbage crop will be helpful in evolving proper management schedule. Keeping all the above points in view, the experiment was conducted to study the seasonal incidence of *S. litura* and its relations with weather parameters.

Materials and Methods

To study the seasonal incidence of *S. litura* on cabbage, the field experiment was conducted at Vegetable Improvement Scheme, CES, Wakawali, DBSKKV, Dapoli during *rabi* season of 2020-21 and 2021-22. The details of experiment are given below

Experimental Details

Location	:	Vegetable Improvement Scheme, CES, Wakawali, DBSKKV., Dapoli.
Season	:	*Rabi* 2020-21, 2021-22
Crop	:	Cabbage
Variety	:	Golden Acre
Spacing	:	60 cm x 45 cm
Plot Size	:	11.25 m × 1.2 m
Date of transplanting	:	10th December (*rabi* 2020-21) 14th December (*rabi* 2021-22)

Method of recording observations

Seedlings of the cabbage (Golden Acre, 35 days old) were transplanted in the well prepared field. All recommended cultivation practices were followed. The experimental plot was kept unsprayed throughout the cropping season. Twenty-five plants were selected randomly for observation. The observations of *S. litura* infesting cabbage were recorded at weekly interval (Standard Meteorological Week) in the cropping season.

During the cropping season mainly tobacco caterpillar, *Spodoptera litura* (Fabricius) was observed as foliage feeding pest on cabbage. To estimate the *S. litura* population, direct visual counting method was used. Twenty-five plants were selected randomly from plot. The total larval population of *S. litura* on plants was counted at weekly interval and converted into larvae per plant.

In order to study the influence of abiotic factors (meteorological parameters) on incidence of *S. litura*, the correlations were worked out with weekly weather data *viz.*, average maximum and minimum temperatures, morning and evening relative humidity, wind speed and bright sunshine hours available at the meteorological observatory, at Irrigation Water Management Scheme, Central Experiment Station, Wakawali, Tal. Dapoli, Dist- Ratnagiri. The data were used to work out correlation between *S. litura* population and weather parameters.

Statistical analysis

The data on *S. litura* infesting cabbage were averaged. The correlation was worked out between population of *S. litura* and weather parameters by using Microsoft Excel.

Results and Discussion

The data on seasonal incidence of tobacco caterpillar, *S. litura* infesting cabbage during *rabi* season of 2020-21, 2021-22 and pooled are presented in Table 1 and graphically depicted in Fig. 1.

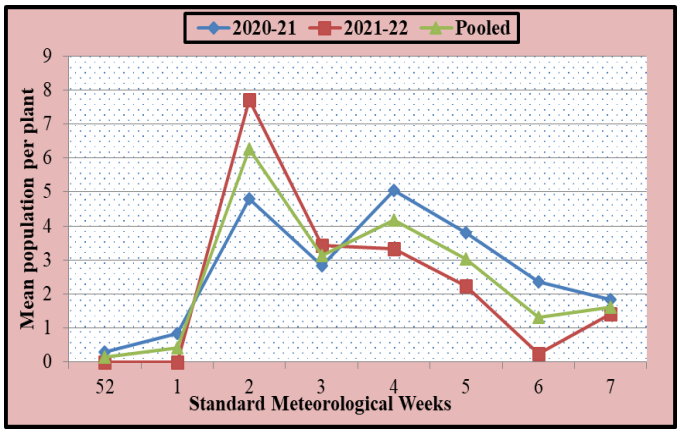

Fig 1: Seasonal incidence of tobacco caterpillar, *S. litura* infesting cabbage during *rabi* 2020-21, *rabi* 2021-22 and pooled data

During *rabi* 2020-21, the incidence of tobacco caterpillar, *S. litura* ranged from 0.28 to 5.04 larvae per plant. The incidence of tobacco caterpillar, *S. litura* started in 52nd SMW (24th December to 31st December) *i.e.* 0.28 larvae per plant. The incidence was increased upto 2nd SMW (8th January to 14th January) and then decreased in next *i.e.* 3rd SMW (15th January to 21st January). In 4th SMW (22nd January to 28th January), the maximum population of tobacco caterpillar, *S. litura* (5.04 larvae per plant) was observed and after that tobacco caterpillar, *S. litura* population was decreasing till harvesting.

Table 1: Seasonal incidence of tobacco caterpillar, *S. litura* infesting cabbage during *rabi* 2020-21, *rabi* 2021-22 and pooled data

SMW	Mean population per plant		
	2020-21	2021-22	Pooled
52	0.28	0.00	0.14
1	0.84	0.00	0.42
2	4.80	7.72	6.26
3	2.84	3.44	3.14
4	5.04	3.32	4.18
5	3.80	2.24	3.02
6	2.36	0.24	1.30
7	1.84	1.40	1.62
SD(±)	1.74	2.60	2.06
SMW- Standard Meteorological Week			

The data of *rabi* 2021-22 showed that the population of tobacco caterpillar, *S. litura* was in between the 0.24 to 7.72 larvae per plant. The incidence was noticed from 2nd SMW (8th January to 14th January) *i.e.* 7.72 larvae per plant which was maximum in the cropping period. Then, incidence was decreasing up to 6th SMW (5th February to 11th February) and slightly increased in 7th SMW (1.40 larvae per plant). The minimum population of tobacco caterpillar, *S. litura* was noticed in 6th SMW (5th February to 11th February).

The pooled data of both the years revealed that the incidence of tobacco caterpillar, *S. litura* population was in the range of 0.14 to 6.26 larvae per plant. The incidence was noticed from 52nd SMW (24th December to 31st December) *i.e.* 0.14 larvae per plant. The maximum incidence was observed in 2nd SMW (8th January to 14th January). In between 3rd (15th January to 21st January) and 7th SMW (12th February to 18th February), the population of tobacco caterpillar, *S. litura* was fluctuating.

The results of present findings are in conformity with findings of earlier workers. Oduor *et al.* (1996) [7] stated that pest infestation on cabbage occurred within 14 days after the seedlings were transplanted and persisted thereafter. Mandi and Baskey (2016) [5] observed that the *S. litura* remained active on cabbage crop for a long period (1st SMW to 17th SMW) and maximum population of *S. litura* was found during 10th to 13th SMW. Reddy *et al.* (2016) [8] studied seasonal abundance of tobacco caterpillar, *S. litura* on cabbage. The result stated that the infestation of tobacco caterpillar, *S. litura* started from the 47th standard week during *rabi* season of 2013-14 and 48th standard week during *rabi* season of 2014-15. However, they reached maximum in the 5th standard week (3.34 larvae/plant) during *rabi* season of 2013-14 and in the 6th standard week (3.41 larvae/plant) during 2014-15. Khan and Talukder (2017) [4] observed that larval population of *S. litura* ranged from 0.56 to 1.57 larvae/plant on cabbage during 8 January to 12 February 2014 crop season while the highest peak was on 5 February 2014 (1.57 larvae/plant). Aiswarya *et al.* (2018) [1] observed that the larval population of tobacco leaf eating caterpillar on cabbage ranged from 1.98 to 3.2 larvae per plant.

Correlation between tobacco caterpillar, *S. litura* population and weather parameters

The data on correlation coefficient of mean population of tobacco caterpillar, *S. litura* in relation to different weather parameters during *rabi* 2020-21, *rabi* 2021-22 and pooled are shown in Table 2.

During *rabi* 2020-21 the mean population of tobacco caterpillar, *S. litura* exhibited positive non-significant correlation with maximum (r=0.458) and minimum (r=0.064) temperature, wind speed (r=0.080) and bright sunshine hours (r=0.105), while negative non-significant correlation with morning (r=-0.052) and evening (r=-0.125) relative humidity.

Table 2: Correlation coefficient of mean population of tobacco caterpillar, *S. litura* infesting cabbage in relation to different weather parameters during *rabi* 2020-21, *rabi* 2021-22 and pooled

Weather parameters	Correlation coefficient (r)		
	2020-21	2021-22	Pooled
Temp. Max.	0.458	-0.610	-0.482
Temp. Min	0.064	-0.246	0.088
RH-I	-0.052	0.209	0.251
RH-II	-0.125	0.338	0.243
WS	0.080	0.070	0.127
BSS	0.105	-0.303	-0.173
*Significant at 0.05 level r=0.707			

The mean population of tobacco caterpillar, *S. litura* during *rabi* 2021-22 showed positive non-significant correlation with morning (r=0.209) and evening (r=0.338) relative humidity and wind speed (r=0.070), while negative non-significant correlation with maximum (r=-0.610) and minimum (r=-0.246) temperature and bright sunshine hours (r=-0.303).

The pooled data of tobacco caterpillar, *S. litura* population showed positive non-significant correlation with minimum temperature (r=0.088), morning relative humidity (r=0.251), evening relative humidity (r=0.243) and wind speed (r=0.127). Whereas, the maximum temperature (r=-0.482) and bright sunshine hours (r=-0.173) had negative non-significant correlation with tobacco caterpillar, *S. litura* population.

The results of present findings are corroborative with results of earlier workers. Reddy *et al.* (2016) [8] revealed that during *rabi* 2013-14 the larval population of *S. litura* larvae had non-significant positive correlation with relative humidity (r=0.359). However, during *rabi* 2014-15 the larval population of *S. litura* had non-significant negative correlation with minimum temperatures (r = -0.437) and sunshine hours (r = -0.336). Khan and Talukder (2017) [4] concluded that the temperature had positive influence on populations of *S. litura* while humidity had negative influence. Mishra *et al.* (2018) [6] observed tobacco leaf eating caterpillar had non-significant relationship with weather parameters (maximum and minimum temperature, morning and evening relative humidity and rainfall). Gaikwad *et al.* (2018) [3] noticed the correlation between all weather parameters and *S. litura* was non-significant. The correlation of morning relative humidity (r=0.146) was positive whereas, maximum temperature (r=-0.263), minimum temperature (r=-0.244) and evening relative humidity (r=-0.149) was negative with *S. litura* population. Lal *et al.* (2020) observed the *S. litura* had non-significant correlation with weather parameters *i.e.* temperature (r=-0.24), relative humidity (r=0.34) and sunshine (r=-0.50).

Conclusion

From the present study, it can be concluded that the population of *S. litura* was fluctuating till the harvesting of cabbage. The *S. litura* population had non-significant correlation with all studied weather parameters *i.e.* maximum and minimum temperature, morning and evening relative humidity, wind speed and bright sunshine hours.

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