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Seasonal incidence of different insect-pests in *Kharif* maize

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Abstract

A field study on population dynamics of different insect-pests of maize *viz.,* maize leaf folder, *Marasima trapezalis,* maize aphid, *Rophalosiphum maidis,* maize cob borer, *Helicoverpa armigera,* pollen feeding beetle, *Chiloloba acuta* was conducted during *Kharif,* 2017 at Entomological Research Area of CCS Haryana Agricultural University, Regional Research Station, Uchani, Karnal. Results of the study revealed that *M. trapezalis* larval population was maximum (0.8 larvae/ plant) during 1st week of August (32th SMW). On the other hand, *R. maidis* population was maximum during 3rd week of September (38th SMW) with 17.1 aphid per plant. Infestation of *H. armigera* was first noticed during 35th SMW and attained a peak value of infestation (3.9 %) during 38th SMW. Similarly, *C. acuta* population was also maximum (1.5 beetle/plant) during 38th SMW. Correlation of insect-pests population with environmental factors and plant age (in days after germination) revealed that larvae of *M. trapezalis* exhibited significant positive correlation with evening relative humidity, rainfall whereas it was negatively correlated with maximum temperature and plant age. *R. maidis, H. armigera* and *C. acuta* population was negatively correlated with minimum temperature, evening relative humidity and rainfall whereas it was positively correlated with plant age (DAG) stating higher infestation in later stages of crop growth.

Keywords: seasonal incidence, insect-pests, population dynamics

Introduction

Maize (*Zea mays* L.) is the third most important grain crop of the world which is widely cultivated all over the world in different agro-climatic zones. Worldwide, it is popularly known as “Queen of cereals” due to its wider adaptability and highest genetic yield potential among cereal crops. It has a wider genetic base and extraordinary level of genotypic diversity which makes it most versatile and adaptive under different agro-climatic conditions. Maize is a storehouse of various nutrients such as carbohydrates, proteins, minerals, vitamins, iron etc. and particularly supplying a high energy of 365 Cal/100g. It serves many purposes such as source of human food, livestock and poultry feed. Besides this, maize has its wider applications in milling industries for starch and oil extraction. Its large scale application lies in bio-fuel or ethanol production in many developed countries especially USA and Brazil. Maize was originated from central Mexico and is currently one of the most widely distributed crops of the world. It is cultivated in tropical, subtropical as well as temperate parts of the world ranging from 0 to 4000 meters height from sea level. It is grown in more than 160 countries of the world and USA, China, Brazil, Mexico, France and India are the major producers. In the beginning of 17th century, it was introduced into India from Central America. 2018). In India, it is cultivated over an area of 9.63 million hectares with annual production of 25.90 million metric tonnes and average productivity of 2.69 metric tonnes per hectare [1]. Throughout the year, it is cultivated both as food and fodder crop in different seasons (*Kharif, Rabi* and *Spring*) in different parts of the country. It is cultivated throughout the country in diverse habitats, though Karnataka, Andhra Pradesh, Maharashtra, Bihar, Punjab, Rajasthan and Haryana are the major producers. In Haryana, it is cultivated over an area of 5000 hectares having annual production of 17000 tonnes with average productivity of 3.40 metric tonnes per hectare [1].

Maize is a crop of high economic significance from India’s point of view. Its production and demand is continuously increasing at a higher rate as compared to other cereal crops. Its production is increasing at a rate three times the annual rate of wheat and two times of annual rate of rice [2]. Maize cultivation is the backbone of many developed countries like USA but its productivity is very low in India. Since the gap between the potential and the productivity is very wide, there is marvellous scope for the management of crop production and protection practices. Many scientists are trying to find ways to double the maize production by 2025 [3].

Maize crop is attacked by a number of insect-pests during different growth stages from sowing to maturity which causes damage to all plant parts (root, stem, leaf, tassels, silk and grain).

About 250 species of insect and mite pests have been reported damaging this crop out of which only half a dozen are of economic importance which threatens to limit the production of this crop [4]. Major limiting factors are maize stem borer, *Chilo partellus* (Swinhoe), pink stem borer, *Sesamia inferens* (Walker), two species of shoot fly, *Atherigona nuquii* Steyskal and *Atherigona soccata* Rund, armyworm, *Mythimna seprata* (Walker) and maize cob borer, *Helicoverpa armigera* and maize aphid, *Rhopalosiphun maidis* Fitch which cause economic yield losses during different seasons all over the country [5].

Pest ecology and population dynamic studies in maize are confined to the major insect-pests of maize *viz*., *C. partellus*, *S. inferens, Atherigona soccata*. Due to this, scanty information is available about population dynamics and seasonal incidence of other insect-pests of maize such as maize leaf folder, *Marasima trapezalis,* maize aphid, *R. maidis,* maize cob borer, *H. armigera*, pollen feeding beetle, *Chiloloba acuta*. Due to expansion of maize cultivation to newer areas and changing climate scenarios, these insect-pests may cause serious damage and yield losses. Therefore, it is necessary to study the population incidence of these insects-pests so that effective and timely management tactics can be initiated.

Material and methods

The Maize hybrid, HM 10 was sown on 26th June, 2017 (26th SMW) during *Kharif* season by following all the recommended package of practices except spraying of insecticides. HM 10 was raised on a plot size of 125 m^2 in randomized block design with spacing of 75 x 20 cm and replicated four times. 100 plants per replicate were selected randomly at the time of germination and tagged for recording observations on population dynamics at weekly intervals starting from 5 days after germination till harvest of the crop. Population of *M. trapezalis* was expressed as larvae per plant and pollen feeding beetle, *C. acuta* as beetle per plant. For recording population of maize aphid, *R. maidis*, three leaves were selected randomly from top, middle and bottom portion of each plant to count nymphs and adults of aphids. Aphid population was expressed as number of aphids per plant. Maize cob worm, *H. armigera* infestation was expressed as per cent cob infestation. The weather data of different standard meteorological weeks (SMW) during crop growth period was obtained from the meteorological observatory of Central Soil Salinity Research Institute (CSSRI), Karnal. Meteorological data includes atmospheric temperature (maximum and minimum), relative humidity (morning and evening), total rainfall and sunshine hours. Correlation of different abiotic factors (temperature, relative humidity, sunshine hours etc.) and plant age with seasonal incidence of these insect-pests was worked out.

Experimental results

Maize leaf folder, *M. trapezalis*: The data related to population changes of leaf folder is given in Table 1 and Figure 1. It revealed that *M. trapezalis* incidence started from 3rd week of July (29th SMW) with 0.2 larvae per plant and attained a peak population (0.8 larvae/plant) during

Table 1: Seasonal incidence of different insect-pests on maize hybrid, HM 10 during *Kharif,* 2017

S. no	Days after germination (DAG)	SMW	*Marasmia trapezalis* (Larvae plant^{-1})	*Rophalosiphum maidis* (No. plant^{-1})	*Helicoverpa armigera* Cob infestation (%)	*Chiloloba acuta* (No. plant^{-1})	T (Max) (ºC)	T (Min) (ºC)	RH (M) (%)	RH (E) (%)	SSH (hours)	Rainfall (mm/week)
1	5 DAG	27	0.0	0.0	0.0	0.0	33.4	26	90	70.9	4.5	85.6
2	12 DAG	28	0.0	0.0	0.0	0.0	33.6	27.2	84.3	70.6	6.1	12.0
3	19 DAG	29	0.2	0.0	0.0	0.0	32.9	26.5	88	71.1	6.3	10.6
4	26 DAG	30	0.5	0.0	0.0	0.0	33.0	26.2	89.9	75.6	2.7	17.0
5	33 DAG	31	0.6	0.0	0.0	0.0	32.3	25.8	88.3	72.6	6.5	59.8
6	40 DAG	32	0.8	0.0	0.0	0.0	31.8	25.7	92.4	80.6	4.3	105.4
7	47 DAG	33	0.3	0.0	0.0	0.0	31.5	25.2	92	77.6	4.7	83.8
8	54 DAG	34	0.2	2.2	0.0	0.2	33.1	25.7	89	69.4	6.5	59.3
9	61 DAG	35	0.1	5.7	1.3	0.8	32.0	24.7	93.3	77.4	4.9	55.0
10	68 DAG	36	0.0	7.1	2.6	0.9	32.6	24.5	87.9	67.1	9.5	00.0
11	75 DAG	37	0.0	9.3	3.4	1.2	33.4	24.1	87.9	62.4	9.9	01.8
12	82 DAG	38	0.0	17.1	3.9	1.5	34.0	24.0	88	59	7	00.0
13	89 DAG	39	0.0	14.3	3.9	1.2	33.8	23.6	91	59	4	00.0

SMW: Standard meteorological week; T (Max): Maximum temperature (°C); T (Min): Minimum temperature (°C); RH (M): Morning relative humidity (%); RH (E): Evening relative humidity (%); SSH: Sunshine hours

First week of August (32th SMW). Afterwards, a declining trend in population was observed till last week of August (35th SMW). After 35th SMW, no further incidence of *M. trapezalis* was recorded. Larval population of *M. trapezalis* showed a highly significant positive correlation with evening relative humidity and significant positive correlation with rainfall with r=0.684 and 0.577, respectively whereas significant negative correlation with maximum temperature (r=-0.626) (Table 2). It was non-significantly correlated with all other weather parameters. Correlation between larval population and plant age was found to be non-significant (r=-0.310) (Table 3).

Maize aphid, *R. maidis*: *R. maidis* incidence was first observed during 3rd week of August (34th SMW) with population of 2.2 aphids per plant. Afterwards the population of aphids increased gradually towards the crop maturity and attained maximum value (17.1 aphids per plant) during third week of September (38th SMW) (Table 1 and Figure 1). Population of aphids, *R. maidis* had a highly significant negative correlation with minimum temperature (r=-0.865), evening relative humidity (r=-0.823), significant negative correlation with rainfall (r=-0.594) and non-significant correlation with all other weather parameters (Table 2). Aphid population was highly significantly positively correlation with plant age (DAG) (r=0.868) (Table 3). Negative correlation with plant age indicates that aphid population increased as the crop approached towards maturity.

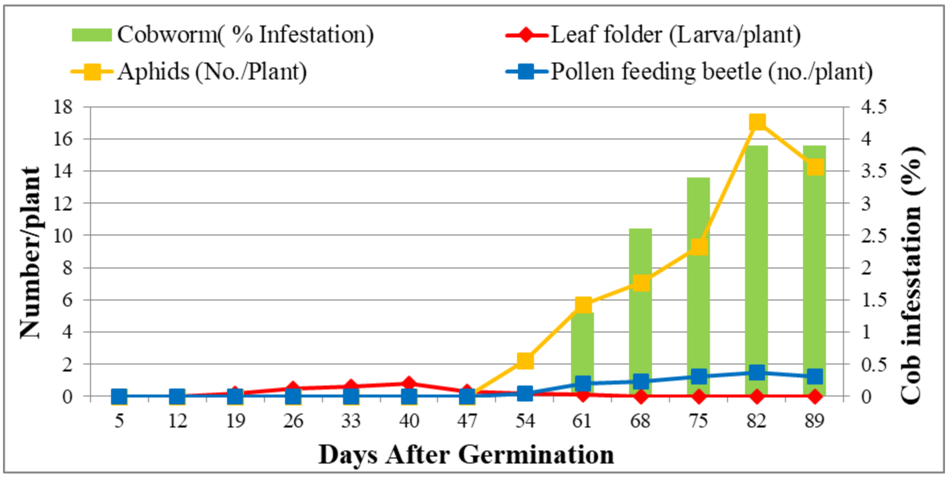

Fig 1: Seasonal incidence of different insect-pests infesting maize during *Kharif*, 2017

Cobworm, *H armigera*: No incidence of *H. armigera* was recorded till last week of August (35th SMW). The first appearance of infestation by *H. armigera* was observed in last week of August (35th SMW) with 1.3 per cent cob infestation. After this, it goes on increasing and attained a peak (3.9 per cent cob infestation) during 38th SMW (third week of September) (Table 1 and Figure 1). Cob borer, *H. armigera* population was highly significantly negatively correlated with minimum temperature and evening relative humidity with r=-0.887, -0.826, respectively. *H. armigera* also had a significant negative correlation with rainfall (r=-0.646) and non-significant correlation with maximum temperature, morning relative humidity and sunshine hours (Table 2). It exhibited highly significant positive correlation with plant age (r=0.865) (Table 3).

Table 2: Correlation of different insect-pest of maize with weather parameters.

Weather parameters	*Marasmia trapezalis*	*Rophalosiphum maidis*	*Helicoverpa armigera*	*Chiloloba acuta*
Maximum temperature (^{0}C)	-0.626*	0.541	0.503	0.458
Minimum temperature (^{0}C)	0.356	-0.865**	-0.887**	-0.891**
Morning RH (%)	0.364	-0.020	0.061	-0.012
Evening RH (%)	0.684**	-0.823**	-0.826**	-0.772**
Sun shine hours	-0.420	0.328	0.443	0.459
Rainfall (mm)	0.577*	-0.594*	-0.646*	-0.603*

*: Significant at P=0.05; **: Significant at P=0.01

Pollen feeding beetle, *Chiloloba acuta*: The first occurrence of pollen feeding beetle was observed during third week of August (34th SMW) with 0.2 beetle/ plant. Afterwards they showed an increasing trend and reached to a peak (1.5 beetle/ plant) during third week of September (38th SMW) (Table 1). Pollen feeding beetle, *C. acuta* had a highly significant negative correlation with minimum temperature (r=-0.891), evening relative humidity (r=-0.772). It was also significantly negatively correlated with rainfall (r=-0.603) while it was highly significantly positively correlated with plant age (r= 0.886) and non-significantly correlated with all other weather parameters recorded (Table 2 and Table 3).

Table 3: Correlation of insect-pests of maize with plant age (in days after germination)

Insect	r - value
M. trapezalis	-0.310
R. maidis	0.868**
H. armigera	0.865**
C. acuta	0.886**

Discussion

Although, literature citing population dynamics of these insect-pests is scanty, results of present finding are supported by many workers. Maize leaf folder, *M. trapezalis* remained active from 15 DAS (days after sowing) to 60 DAS with maximum population (0.53/plant) at 45 DAS in Hyderabad. A declining trend in pest population was observed after 45 DAS which strengthens our findings [6]. Significantly higher aphid, *R. maidis* population (8.29/leaf) was recorded at silking stage of maize crop in Pakistan [7]. Likewise, incidence of *R. maidis* was reported from Hyderabad and it was found that pest remained active from 45 to 75 DAS in sole maize [6]. Higher population of *R. maidis* at tasseling stage was also reported in Egypt [8]. Initiation of *R. maidis* incidence was observed from 31st SMW in Rajasthan [9]. However, they recorded very high population (226-283 adults/plant) during last week of September. Similar level of infestation (3.9%) by cob borer, *H. armigera* with 0.61 per cent severity of infestation was reported at RRS, Uchani, Karnal by earlier workers [10]. However, single peak of *H. amigera* (2.60 larvae/plant) was observed during 12th SMW in Rabi-summer maize at Navsari [11].

Corn aphid, *R. maidis* population was found to be negatively correlated with mean temperature, rainfall and positively correlated with relative humidity [12] which partially satisfies present findings. Correlation studies of present investigation are in partial confirmation with negative correlation of relative humidity (morning & evening) with *R. maidis* and *H. armigera* population recorded at Navsari, Gujarat [11]. They also reported positive correlation with mean temperature which is contrast to present findings. Literature regarding correlation of these insect-pests with plant age is not available.

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