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Seasonal Incidence of Insect Pests and their natural enemies on *Kharif* Maize

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ABSTRACT: The present investigation on population dynamics of different insect pests of maize viz., maize stem borer (*Chilo partellus* Swinhoe), maize aphid (*Rophalosiphum maidis* Fitch), grey weevil (*Myllocerus discolour* Bochemann), maize cobworm (*Helicoverpa armigera* Hubner) and the abundance of natural enemies in the maize field was conducted during *Kharif*, 2018 at Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur. Results of the study revealed that the maximum leaf injury (8.30 mean LIR) by *C. partellus* was recorded in the second week of August at 30th days after sowing. The dead heart incidence first appeared during last week of July and reached to its peak (3.00 per cent) during second week of August at 30th days after sowing. The peak infestation (96.50 /plant) of *Rhopalosiphum maidis* was observed in the second week of August. The maximum population of *Myllocerus discolour* (5.50 /plant) was noticed during third week of August. The incidence of *Helicoverpa armigera* larvae began in third week of July and reached to its peak (3.30/plant) in the first week of August. The *H. armigera* larvae population showed a significant negative correlation with mean relative humidity (-0.764). Natural enemies' *viz.,* coccinellids and green lacewing reached to its peak respectively, 7.50/plant and 2.50/ plant in the second week of August. The coccinellids beetles (0.914) and green lacewing (0.938) population showed a significant positive correlation with *R. maidis* population.

Keywords: Insect pests, natural incidence, population dynamics, seasonal incidence.

INTRODUCTION

Maize *Zea mays* L., 1753 (Poaceae) has huge economic importance worldwide given its use in food for humans and livestock. In addition, it is a source of industrial rawmaterial for the production of bio products, such as oil, alcohol, starch, and glucose (Al-Eryan *et al*., 2019). In India, maize is cultivated in an area of 10.04 M ha with the production and productivity of 33.62 MT and 3349 kg per hectare, respectively. In Rajasthan, it is being grown an area of .95M ha (9.48 % of India) with the production of 2.04 MT (6.08 % of India) and productivity of 2149 kg per hectare (Agricultural Statistics at a Glance 2022). The yield and production potential of this crop is under pressure due to different constraints. Insect pests are amongst the major biotic constraints causing losses in quantities and qualities in the maize crop. Corn attacked by numbers of insect pests and diseases at different plant growth stages which causes damage to all plant parts including root, stem, leaf, tassels, silk and grain (Singh and Singh, 2018). About 250 species of insect and mite pests have been reported damaging maize crop out of which only half a dozen are of economics importance, which threatens to limit the production of this crop (Mathur *et al*., 1991). Major limiting factors are maize stem borer *Chilo partellus* (Swinhoe), pink stem borer *Sesamia inferens* (Walker), two species of shoot fly, *Atherigona nuquii* Steyskaland and *Atherigona soccata* Rund, armyworm *Mythimna seprata* (Walker), maize cob borer *Helicoverpa armigera* and maize aphid *Rhopalosiphun maidis* Fitch which cause economic yield losses during different seasons all over the country (Siddiqui and Marwaha, 1994). From sowing to harvest, about 130 species of insect pests will damage the crop (Sarup *et al*., 1987). Seventeen species of insect pests, among which *Chilo partellus* (Swinhoe), *Agrotis ipsilon* (Hufnagel) and *Holotrichia* species were the most important (Bhagat *et al*., 2012). The insect pest complex of a particular crop varies from area to area and depends on the agro climatic conditions of the particular region; moreover, the status of insect pests of a particular crop has changed with climate change. Regular assessment of insect pests and their natural enemies can help to determine the relative economic importance of different pests to the crop. In view of this, the present study was undertaken to

investigate the objective "To study the seasonal incidence of insect pests in maize ecosystem".

MATERIALS AND METHODS

The present investigation was carried out at the Agronomical Instructional farm and Department of Entomology, Rajasthan College of Agriculture, Udaipur, during *kharif*, 2018. The incidence of major insect pests infesting maize along with their natural enemies was recorded at weekly intervals on variety Pratap M-9 from 7 days after germination to till harvest the crop. The plot size maintained was 4.5 m × 3.0 m with row to row and plant to plant spacing of 75 cm × 20 cm, respectively. All agronomic practices were followed as per recommendations given in the package of practices for raising a good and healthy crop. The incidences of stem borer was recorded on the basis of number of plants showing leaf injury symptoms and number of plants with dead hearts till 30 DAS from central two rows (each row comprising of 15 plants) of each plot at weekly intervals. Grey weevil, Cob worm and Natural enemies were counted visually on ten randomly selected plants at weekly interval; whereas Maize aphid were counted visually from top, middle and lower leaves of each selected plant. The weather data of different standard meteorological weeks (SMW) during crop growth period was obtained from the Agro met observatory of Instructional farm, Rajasthan College of Agriculture, Udaipur. The weekly meteorological data includes abiotic factors *viz*., temperature (maximum and minimum), relative humidity (morning and evening) and total rainfall.

RESULT AND DISCUSSION

The results obtained from the present investigationas well as relevant discussion have been presented underfollowing heads:

Maize stem borer (*Chilo partellus*, Swinhoe):

Leaf injury rating: The first appearance of leaf injury by *C. partellus* during third week of July with 1.50 LIR rating and reached to its peak 8.30 LIR during second week of August under the prevalence of mean atmospheric temperature (26.01 ^{o}C), mean relative humidity (79.50 per cent) and total rainfall (27.20 mm) at 30 days after sowing of maize. Coefficient of correlation between leaf injury from *C. partellus* and weather parameters revealed that the leaf injury rating showed non-significant correlation with mean atmospheric temperature, mean relative humidity and total rainfall.

Per cent dead hearts: The occurrence of *C. partellus* on maize crop revealed that the dead heart incidence (1.60 per cent) first appeared during last week of July and reached to its peak (3.00 per cent) during second week of August at 30th days after sowing of maize. During this period, mean atmospheric temperature (26.59 ^{o}C), mean relative humidity (67.07 per cent) and total rainfall (0.00 mm). The pest showed significant negative correlation with mean relative humidity (r = -0.771) but non-significant with mean atmospheric temperature and total rainfall during the cropping season 2018. These findings are partially agreement with findings of Kandalkar *et al*. (2002) who observed that only minimum temperature showed significant and negative correlation with stem borer leaf injury and also reported that maximum temperature, morning RH, evening RH and rainfall did not influence stem borer incidence significantly and the highest infestation of stem borers was recorded in the month of August followed by July and September months.

Relatively more infestation (11.54 to 15.41 per cent) was observed during early stages of the crop growth (20 to 70 days). Raigar *et al*. (2002) reported that the incidence in terms of leaf injury was started in third week of August and dead hearts were formed a week later. Bhagat *et al*. (2008) reported that mean infestation (dead heart + leaf infestation) of stem borer ranged from 0.0 to 23.16 per cent during *Kharif* season. Similarly, Biradar *et al*. (2011), Mallapur *et al*. (2012), Sahito *et al*. (2012) and Kumar *et al*. (2017) also reported similar results.

Maize aphid (*Rhopalosiphum maidis* Fitch): The *R. maidis* infestation began from the last week of July (21.50 *R. maidis* per plant), that gradually increased and reached to its peak in the second week of August with a mean of 96.50 *R. maidis* per plant at that time mean atmosphere temperature, mean relative humidity and total rainfall were 26.01 ^{o}C, 79.50 per cent and 27.20 mm, respectively. However, the *R. maidis* did not show any significant correlation with abiotic factors of the environment. These findings are similar to results of Chansigaud and Vaillant (1987) who reported that population fluctuations and distribution of *R. maidis* on maize was recorded in July which remained until late October. Similarly, Rana (1998), Karimullah *et al*. (2000), Krawczyk *et al*. (2009), Singh and Singh (2013).

Grey weevil (*Myllocerus discolour* Bochemann): The infestation of the *M. discolour* adult appeared in the last week of July. Initially, the population of *M. discolour* was 0.30 per plant. The maximum *M. discolour* population (5.50 per plant) was noticed during third week of August at that time mean atmospheric temperature (^{o}C), mean relative humidity and total rainfall were 26.80 ^{o}C, 77.43 percent and 67.60 mm. The abiotic factors of the environment did not influence the population of M. discolour. These findings are partially agreement with findings of Mathur and Rawat (1979) reported that both Ganga 5 and Basi local were equally damaged by the grey weevil and causes 97.97 to 100 per cent damage. Rathore (1984) reported that the grey weevil caused minor infestation to maize plants. The initial population was significantly higher when the crop was sown with the advent of local rains than other times of sowing. Ratnoo (1992) observed that the grey weevil caused minor to moderate damage in early stage of the crop. Kalaisekar and Ramamurthy (2004), Chavan *et al*. (2006) reported similar results to these findings.

Cobworm (*Helicoverpa armigera* Hubner): The incidence of *H. armigera* larvae began in third week of July with an initial sample count of 0.10 *H. armigera* larvae per plant. The population then increased and reached to its peak in the first week of August with a mean population of 3.30 *H. armigera* larvae per plant. At the time of peak period of *H. armigera* larvae the mean atmospheric temperature was 26.59 ºC, mean relative humidity 67.07 per cent and total rainfall received was 0.00 mm. The *H. armigera* larvae population showed a significant negative correlation (r = -0.764) with mean relative humidity, while they did not have significant correlation with mean atm. temperature and total rainfall. As demonstrated by Karimullah *et al*. (2000) and Byrne *et al*. (2008) who concluded that the corn earworm, *Helicoverpa zea* a major pest of maize while Gerald *et al*. (2008) monitored insect pests of maize and reported that corn earworm, *H. zea* is a major pest of maize in the United States. These findings are conformity with results of Bhagat *et al*. (2012) and Ranjith and Prabhuraj (2013).

Abundance of Natural enemies in the maize field:

The Coccinellid (1.50 per plant) and Green lacewing (0.90 per plant) appeared in the third week of July and thereafter gradually increases and reaching to its peak in the second week of August with the mean values of coccinellids (7.50 per plant) and green lacewing (2.50 per plant). Those times were the mean atmospheric temperature (26.01ºC), mean relative humidity (79.50 per cent) and total rainfall (27.20 mm). The mean atmospheric temperature, mean relative humidity and total rainfall did not influence the coccinellids and green lacewing population; while the coccinellids beetles (r = 0.914) and green lacewing (r = 0.938) population showed a significant positive correlation with *R. maidis* population. Earlier workers reported that the ladybird beetle, *Coccinella septempunctata* L. predated on all the species of aphid. Srivastava *et al*. (1978). Psota and Hula (2008) recorded that natural enemies of aphids were recorded in the monitored fields: parasitoids of genera *Aphidius* and *Praon* (Hymenoptera: Aphidiidae), predatory syrphid flies (Diptera: Syrphidae), ladybirds (Coleoptera: Coccinellidae), *Orius* bugs (Heteroptera: Anthocoridae), green lacewing *Chrysoperla carnea* (Neuroptera: Chrysopidae) and spiders (Araneida). Parasitoid *Cotesia* spp. Recorded in maize sporadically in southern Togo (Hailemichael *et al*., 2008). Patel and Das (2010) studied that the build-up of coccinellids population attributed to temperature and host availability. Thomson *et al*. (2012) reported that because of the diverse and often indirect effects of climate change on natural enemies, predictions would be difficult unless there is a good understanding of the environmental effects impact on tritrophic interactions.

Table 1: Seasonal incidence of major insect pests in maize ecosystem *kharif* during 2018.

Date of observations	Mean Atm. Temp. (^{0}C)	Mean RH (%)	Total rainfall (mm)	Insect pests				
				C. partellus		*R. maidis*/plant	*M. discolour*/plant	*H. armigera*/plant
				Mean LIR (30th DAS)	Per cent dead hearts (30th DAS)			
July 23, 2018	26.56	85.93	98.20	1.50	0.00	21.50	0.30	0.10
July 30, 2018	25.56	78.36	2.40	4.90	1.62	39.50	0.70	2.70
Augt. 06, 2018	26.59	67.07	0.00	6.90	3.00	52.00	1.50	3.30
Augt. 13, 2018	26.01	79.50	27.20	8.30	2.56	96.50	4.70	1.00
Augt. 20, 2018	26.86	77.43	67.60	5.40	1.50	69.50	5.50	0.50
Augt. 27, 2018	25.55	80.43	33.60	2.60	0.80	20.00	2.20	0.80
Sept. 03, 2018	25.55	78.93	17.40	1.40	0.27	7.50	1.20	0.10
Seasonal mean	**26.10**	**78.24**	**35.20**	**4.43**	**1.39**	**43.79**	**2.30**	**1.21**
Coefficient of correlation (r) b/w insect pests and mean Atm. Temp.				0.292	0.248	0.411	0.353	0.006
Coefficient of correlation (r) b/w insect pests and mean RH				-0.572	-0.771*	-0.278	-0.105	-0.764*
Coefficient of correlation (r) b/w insect pests and total rainfall				-0.397	-0.566	-0.068	0.136	-0.704

*** Significant at 5% level of significance**

Table 2: Abundance of natural enemies in maize ecosystem *kharif* during 2018.

Date of observations	Mean Atm. Temp. (^{0}C)	Mean RH (%)	Total Rainfall(mm)	Aphid/plant	Coccinellids	Green lacewing
July 23, 2018	26.56	85.93	98.20	21.50	1.50	0.90
July 30, 2018	25.56	78.36	2.40	39.50	2.50	1.30
Augt. 06, 2018	26.59	67.07	0.00	52.00	5.50	1.90
Augt. 13, 2018	26.01	79.50	27.20	96.50	7.50	2.50
Augt. 20, 2018	26.86	77.43	67.60	69.50	3.50	1.50
Augt. 27, 2018	25.55	80.43	33.60	20.00	1.70	0.90
Sept. 03, 2018	25.55	78.93	17.40	7.50	0.80	0.30
Seasonal mean	**26.10**	**78.24**	**35.20**	**43.79**	**3.29**	**1.33**
Coefficient of correlation (r) b/w natural enemies and mean Atm. Temp.					0.329	0.374
Coefficient of correlation (r) b/w natural enemies and mean RH					-0.470	-0.407
Coefficient of correlation (r) b/w natural enemies and total rainfall					-0.278	-0.199
Coefficient of correlation (r) b/w natural enemies and aphid					0.914*	0.938*

*** Significant at 5% level of significance**

CONCLUSION

The population dynamics of different insect pests and their natural enemies were observed significantly influenced by weather parameters and the damage caused by these insect pests are affected by fluctuation in abiotic factors.

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