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Population dynamics of cob worm, *Helicoverpa armigera* (Hubner) in maize

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Abstract
The present investigation on "Population dynamics of cob worm, *Helicoverpa armigera* (Hubner) in maize" was carried out at Instructional Farm and Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during 2019 and 2020. The peak cob worm larval population of 1.95 and 1.60 larvae/plant was observed in third week of September during 2019 and 2020 respectively. The maximum cob infestation of 23.33 and 20.00 per cent was observed in fourth week of September during 2019 and 2020, respectively. Cob borer, *H. armigera* population had a significant negative correlation with rainfall and relative humidity during 2019 and 2020.

Keywords: population dynamics, cob worm, *Helicoverpa armigera* (Hubner), maize

Introduction
Maize (*Zea mays* L.) is an important cereal crop grown all over the world as food for human consumption, animal feed, fodder and as an industrial product. It is an important crop next to rice and wheat grown over a wide range of geographical and environmental conditions in India as compared to other cereal crops (Anonymous 2013) [2]. Maize is being grown in more than 166 countries in about 163 M ha area with 823 million tons production across the globe including tropical, sub-tropical and temperate regions (Anonymous 2012) [1]. The average maize yield in the developed countries is more than 8 t/ha, while in the developing countries it is around 3 t/ha (Zaidi and Singh 2005) [10]. This low average yield is due to poor adoption of hybrid varieties, unbalanced fertilizer application, less irrigation and high infestation of insect pests.
In spite of taking due care of the production components, at times insect pests take a heavy toll of the crop thus bringing down crop yields. Among various biotic factors responsible for low production of maize, the damage caused by insect pests forms an important limiting factor for its profitable cultivation. As many as 141 insect pests cause varying degrees of damage to the crop right from sowing till harvest (Reddy and Trivedi 2008) [6]. 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), 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) [8]. Cob worm causing damage to grains in the cobs. The knowledge of incidence pattern of cob worm, *H. armigera* of maize plays a great role in their management. Keeping the above facts in view, study on "Population dynamics of cob worm, *Helicoverpa armigera* (Hubner) in maize" was carried out during *Kharif*, 2019 and 2020.

Materials and Methods
The field experiment to investigate the "Population dynamics of cob worm, *H. armigera* in Maize" was conducted during *Kharif*, 2019 and 2020 at the Instructional Farm and Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur, India. The experiment was laid out in plots of size 4.8 x 4.0 m replicated four times. Maize variety Pratap Makka-3 was sown in the prepared field on the 5th July, 2019 and 2nd July, 2020 with row to row and plant to plant spacing of 60 cm × 25 cm, respectively. The population of cob worm was counted by visual method from 15 randomly selected plants at weekly interval. The number of cobs showing cob worm symptom (% cob damage) and number of larvae per infested cobs were recorded at cob formation stage.

Statistical Analysis

The abiotic factors *viz.* mean atmospheric temperature, mean relative humidity and total rainfall were recorded during the crop season and their simple correlation with the population of *H. armigera* was calculated by the Karl Pearson formula of correlation coefficient (Fowler *et al.* 1998) [3]:

$$r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n}\right]\left[\sum Y^2 - \frac{(\sum Y)^2}{n}\right]}}$$

Where,

r_{xy} = Simple correlation coefficient.

X = Variable *i.e.* abiotic component

Y = Variable *i.e.* mean number of insect pests per plant.

n = Number of observations.

The correlation coefficient (r) values were subjected to the test of significance using t-test:

$$t = \frac{r}{\sqrt{1-r^2}} \times \sqrt{n-2} \sim t_{n-2} \text{ d.f.}$$

The calculated t-value obtained was compared with tabulated t-value 5% level of significance.

The multiple linear regression equation was computed by using following modal:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3$$

Where,

a	=	Constant
Y	=	Dependent variable
X_1, X_2 and X_3	=	Independent variables
b_1, b_2 and b_3	=	Partial regression co-efficient

Result and Discussion

The first appearance of infestation of *H. armigera* (0.60 and 0.65 larvae/plant) was observed in the first week of September (35th SMW) during 2019 and 2020. The peak larval population of 1.95 and 1.60 larvae/plant was observed in third week of September during 2019 and 2020 respectively (Table 1 & 2). The maximum cob infestation of 23.33 and 20.00 per cent was observed in fourth week of September during 2019 and 2020, respectively. Cob borer, *H. armigera* population had a significant negative correlation with rainfall (r= -0.70 and r= -0.60) and relative humidity (r= -0.92 and 0.77) during 2019 and 2020. However, correlation with mean temperature was positively non-significant (r= 0.16) and positively significant (r= 0.82) during 2019 and 2020, respectively. The three weather parameters *viz.*, mean atmospheric temperature, mean relative humidity and total rainfall had a joint influence of 98.2 and 79.9 per cent on the cob worm population during 2019 and 2020, respectively.

The present findings are in line with the findings of Ranjith and Prabhuraj (2013) [5], who observed that *H. armigera* larvae had positive correlation with maximum and minimum temperature; whereas negative correlation with rainfall and morning relative humidity. Similarly, Kumar *et al* (2015) [4] observed that incidence of cob borer started in 35th SMW and its peak population (3.40 larvae/plant) during 38th SMW. Sidar *et al.* (2015) [7] reported that the larva of cob borer population appeared during first week of September. The cob worm larvae showed non-significant negative correlation with rainfall and morning relative humidity, while significant negative correlation with evening relative humidity. Singh and Jaglan (2018) [9] observed that infestation of *H. armigera* was first noticed during 35th SMW and attained a peak value of infestation (3.9 %) during 38th SMW in maize.

Table 1: Population dynamics of cob worm, *H. armigera* in maize during *Kharif*, 2019

SMW	Mean Temp.	Mean RH (%)	Rainfall (mm)	Cob worm	
				Cob damage (%)	Larvae (No./ plant)
30	27.8	74.3	12.6	0.00	0.00
31	26.8	83.5	15.0	0.00	0.00
32	25.3	83.0	182.2	0.00	0.00
33	24.6	85.2	153.0	0.00	0.00
34	26.5	73.3	69.6	0.00	0.00
35	25.9	86.4	141.0	8.89	0.60
36	27.1	88.6	85.5	12.22	0.95
37	26.8	82.8	36.1	17.78	1.30
38	26.4	75.1	42.2	21.11	1.95
39	25.6	82.9	14.2	23.33	1.20
Coefficient of correlation (r) for population and atm. temp. (^{0}C)				-	0.16
Coefficient of correlation (r) for population and mean RH (%)				-	-0.92*
Coefficient of correlation (r) for population and total rainfall (mm)				-	-0.70*
MLR: Y = 1.919+(0.232) X_1+(-0.080) X_2+(-0.003) X_3; R^2 : 0.982					

SMW = Standard Meteorological Week; *Significant at 5% level
MLR = Multiple Linear Regression

Table 2: Population dynamics of cob worm, *H. armigera* in maize during *Kharif*, 2020

SMW	Mean Temp.	Mean RH (%)	Rainfall (mm)	Cob worm	
				Cob damage (%)	Larvae (No./ plant)
30	27.8	71.9	26.4	0.00	0.00
31	27.6	79.2	60.0	0.00	0.00
32	27.0	82.0	71.0	0.00	0.00
33	25.9	87.4	56.8	0.00	0.00
34	25.3	86.4	210.5	0.00	0.00
35	24.5	83.7	53.0	10.00	0.65
36	25.5	86.0	165.4	13.33	0.50
37	27.0	77.9	44.0	14.44	1.10
38	27.0	72.4	46.4	16.67	1.60
39	26.2	68.3	7.2	20.00	1.05
Coefficient of correlation (r) for population and atm. temp. (^{0}C)				-	0.82*
Coefficient of correlation (r) for population and mean RH (%)				-	-0.77*
Coefficient of correlation (r) for population and total rainfall (mm)				-	-0.60*
MLR: Y = -5.090+(0.261) X_1+(-0.008) X_2+(-0.002) X_3; R^2: 0.799					

SMW = Standard Meteorological Week; *Significant at 5% level
MLR = Multiple Linear Regression

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