

Seasonal Incidence of Major Insect Pests in Maize Crop (*Zea mays* L.) Under Chhattisgarh Plains

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ABSTRACT

The seasonal incidence of the major insect pests of maize crop was investigated during *Kharif* season 2014-15 at the experimental field of research cum instructional farm, I.G.K.V., Raipur, Chhattisgarh, India to find out seasonal incidence of major insect pests in maize crop (*Zea mays* L.) under Chhattisgarh plains. Results revealed that the incidence of Pink stem borer (*Sesamia inferens*), green stink bug (*Nezara viridula*), leaf hopper (*Cicadulina spp.*), black aphid (*Rhopalosiphum maidis*) and cob borer (*Helicoverpa armigera*) were appeared on the maize crop during crop growing period. The higher number of pin holes (24 plant⁻¹) and percentage of dead hearts (60%) of pink stem borer were recorded during the second week of September and fourth week of September as compare to other months, respectively. The peak population mean of black aphid (30 plant⁻¹) was recorded in the third week of September, while the green sting bug (1.80 plant⁻¹) attained their highest in second week of September and the highest population mean of cob borer was recorded during the fourth week October.

Keyword Abiotic factor, Maize, Major insect pest and Seasonal incidence.

Maize (*Zea mays* L.) belong to family poaceae is one of the most important cereal crop of the world and contributes to food security in most of the developing countries. In India, maize is emerging as third most important crop after rice and wheat. Its importance lies in the fact that it is used for human food and animal feed, at the same time it is also widely used for corn starch industry, corn oil production, and baby corn in recipe (Singh, 2014). The worldwide area, production, and productivity under maize crop cultivation in the year 2013 was 184.4 million ha, 1016.7 million tonnes 5.5 tonnes ha⁻¹ respectively. The total area, production, and productivity under maize crop cultivation in India during 2012-2013 was 9.50 million ha, 23.29 million tonnes, and 2.45 tonnes ha⁻¹ (FAOSTAT 2013). In Chhattisgarh, it is cultivated in an area of 0.22 million

ha with production of 0.41 million tonnes and productivity is 1.82 tonnes ha⁻¹ (Anonymous, 2013). Studies on pest succession of any crop are essential as these provide information on the status of various insect pests and also help in identifying the vulnerable stage of the crop. This information helps in developing an efficient management model for the insect pests attacking at various growth stages of the crop. Pink stem borer, leaf aphid and shoot fly are the important insect in maize ecosystem (Sahito *et al.*, 2012). Pink stem borer is one of the most economically important insect. The loss due to *S. inferens* in *Kharif* season from 60-81.7% and 25.7-78.9% in *Rabi* season (Sekhar *et al.*, 2010). There are four species of aphid found to attack the maize plants, *Rhopalosiphum maidis* Fitch being the dominant species. The fluctuation of the mixed populations exhibits two peaks in mid and late May and late June (Ding *et al.*, 2002). *Rhopalosiphum maidis* and *Sesamia inferens* are also the major insects of maize crop (Hirai, 1991). The minor insect pests of maize crop include *Nezara viridula* and *Helicoverpa armigera* (Ahad *et al.*, 2012).

MATERIAL AND METHODS

The present investigation was conducted during *Kharif* season of 2014-15 at Maize crop Research Area, IGKV., Raipur (C.G.) to study the Seasonal incidence of major insect pests in maize crop (*Zea mays* L.) under Chhattisgarh plains. Insect pest of Maize was observed on variety NK-30 which was sown on 1st week of July. Having spacing of 60x20 c.m. recommended management practices except plant protection measures were followed for raising the crop. Incidence of different insect pests was recorded at weekly interval on randomly selected 10 plants. During the whole cropping season *i.e.* from July to November, the pink stem borer observations was recorded on the basis of number of pin hole and dead heart from each plot. The population of cob borer (*Helicoverpa armigera*) was recorded by counting the larvae on

Table 1. Weekly meteorological data during the crop period (July 7, 2014 to November 1, 2014)

Months and year	Standard Week No.	Temperature (°C)		Rain-fall (mm)	Relative Humidity (%)		Wind velocity (km/ph)	Evaporation (mm)	Sun shine (Hours)
		Max.	Min.		I	II			
Jul, 2014	27	37.7	27.0	9.0	72	44	9.0	8.5	5.3
	28	34.3	23.8	152.8	92	72	8.4	6.6	4.1
	29	28.5	24.6	260.2	95	88	12.1	2.8	0.5
	30	28.7	23.8	37.2	95	82	9.4	2.7	1.6
	31	29.8	24.8	136.0	95	86	9.7	4.0	1.9
Aug, 2014	32	30.2	24.8	42.1	91	71	9.1	3.6	2.8
	33	31.8	25.3	45.0	91	70	7.0	4.7	5.5
	34	32.3	25.1	25.8	92	73	4.0	3.7	3.4
	35	31.8	25.0	84.8	91	76	5.8	4.1	3.6
Sep, 2014	36	25.1	28.3	79.5	94	83	6.2	1.7	0.5
	37	30.5	24.3	41.0	95	79	5.8	3.3	3.4
	38	32.1	24.6	57.6	94	68	3.6	3.7	4.4
	39	33.4	24.0	0.0	93	57	2.1	4.1	8.3
Oct, 2014	40	33.2	24.0	0.0	91	57	2.5	3.9	8.3
	41	30.4	23.6	52.2	89	66	6.9	3.6	4.9
	42	31.5	22.5	1.2	91	56	2.6	3.4	8.4
	43	29.1	19.4	5.4	92	52	2.0	2.8	5.9
	44	30.1	16.9	0.0	94	37	1.9	3.0	8.0

cob. Green stink bug and leaf hopper were recorded as number basis per plant where as number of aphids was recorded per sq c.m. area of leaf/cob sheath.

The data on infestation of various pests were correlated with prevailing temperature, relative humidity, sunshine hours, rain fall and wind velocity obtained from observatory of the university and similarly correlated with insect pest population. The correlation study was worked out by using formula as given below:

$$r = \frac{\sum XY - n\bar{x}\bar{y}}{\sqrt{\sum X^2 - n\bar{X}^2} \times \sqrt{\sum Y^2 - n\bar{Y}^2}}$$

Where,

X = Mean of first factor

Y = Mean of second factor

n = Total no. of observations

r = Correlation coefficient

After correlating significant and non-significant findings, t-test value n-2 degrees of freedom were calculated on the following formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \approx t \text{ with } (N-2) d.f$$

RESULT AND DISCUSSION

Insect pests recorded infesting maize variety 'N K 30' are presented Table-1. Study revealed that many insect pests were observed at different growth stage of the crop. Pink stem borer (*Sesamia inferens*), green stink bug (*Nezara viridula*), leaf hopper (*Cicadulina spp.*), black aphids (*Rhopalosiphum maidis*) and cob borer (*Helicoverpa armigera*) were noticed causing damage at vegetative growth, tasseling and cob stages of the crop. Periodical observations on the incidence of pink stem borer on maize crop revealed that the dead heart incidence (10%) first appeared during third week of August and reached to its peak infestation (60 %) during third week of

Table 2. Seasonal weekly incidence of major insect pests during the crop growth on maize at weekly interval, period (Kharif, 2014-2015)

S. No.	SMW	DATE	Population 10 plant/plot							
			<i>Sesamia inferens</i>	<i>Nezara viridula</i>	<i>Cicadulina spp.</i>	<i>Rhopalosiphum maidis</i>	<i>Helicoverpa armigera</i>			
			No. of pin holes 10 plant ⁻¹	Scale (1-9) LIR	DH (%)	Adults	Adults	Nymphs and adults	Larvae 10 cob/plot	Cob damage (%)
1	31	30 July-05Aug	1.50	1.00	0.00	0.00	0.00	0.00	0.00	0.0
2	32	06 Aug-12Aug	3.20	3.00	0.00	0.23	0.26	0.00	0.00	0.0
3	33	13 Aug-19Aug	8.10	3.00	0.00	0.33	0.53	0.00	0.00	0.0
4	34	20 Aug-26Aug	12.20	5.00	10.00	0.63	1.20	6.60	0.00	0.0
5	35	27 Aug-02 Sep	15.00	5.00	30.00	0.83	1.36	15.53	0.00	0.0
6	36	03 Sep-09 Sep	21.00	7.00	40.00	1.46	1.50	23.80	0.50	0.0
7	37	10 Sep -16 Sep	24.00	7.00	40.00	1.80	1.70	26.60	0.70	0.0
8	38	17 Sep -23 Sep	15.40	5.00	60.00	1.46	2.10	30.00	0.80	0.0
9	39	24 Sep -30 Sep	18.10	5.00	60.00	1.26	2.30	16.00	0.83	0.0
10	40	01 Oct -07 Oct	14.00	5.00	50.00	0.83	1.10	15.66	1.50	10.0
11	41	08 Oct -14 Oct	12.00	5.00	50.00	0.20	0.10	5.30	1.66	20.0
12	42	15 Oct -21 Oct	10.20	5.00	30.00	0.00	0.00	0.00	2.06	40.0
13	43	22 Oct -28 Oct	4.20	3.00	30.00	0.00	0.00	0.00	3.02	50.0
14	44	29 Oct -04Nov	3.40	3.00	30.00	0.00	0.00	0.00	1.20	50.0
15	45	05Nov-11Nov	0.00	0.0	0.0	0.00	0.00	0.00	0.00	40.0
Seasonal mean			10.82	4.13	28.66	0.6	0.81	9.26	0.82	14.0

DH= Dead heart

LIR= Leaf Injury Rating

September Thereafter, there was sudden decrease of incidence (30%) during third week of October, during this period, maximum and minimum temperature, morning and evening relative humidity, wind velocity, bright sunshine hours and rain fall were observed as 32.1°C, 24.6°C, 94%, 68%, 2.0km/h, 5.9 h/day and 57.6mm respectively (Table 1)

The maximum activity of dead heart was recorded during third week of September. The dead heart damage showed non-significant positive correlation with maximum temperature ($r = 0.008$), morning relative humidity ($r = 0.22$) and sun shine ($r = 0.13$). Whereas negative non-significant correlation with minimum temperature ($r = -0.056$), evening relative humidity ($r = -0.16$) and rain fall

Table 3. Major insect pests population of maize during *Kharif*, 2014-15

S.N.	Major insect pests		Population range / 10plant	Active period	Peak activity period
	Name of insect	Scientific name			
1	Pink stem borer	<i>Sesamia inferens</i> (Walker)	1.0-6.0	(V th week of July to V th week of October)	II st week of September
2	Green stink bug	<i>Nezara viridula</i> (Linn.)	0.20-1.80	(I st week of August to II nd week of October)	III rd week of September
3	Maize leaf hopper	<i>Cicadulina spp.</i>	0.10-2.30	Tasseling to cob maturity (I st week of August to II nd week of October)	IV th week of September
4	Black aphid	<i>Rhopalosiphum maidis</i> (Fitch)	5.30-30	Tasseling to cob maturity (III rd week of August to II nd week of October)	III rd week of September
5	Cob borer	<i>Helicoverpa armigera</i> (Hub.)	0.50-3.02	Tasseling to cob maturity (I st week of September to V th week of October)	IV th week of October

($r = -0.34$). But wind velocity ($r = -0.62^{**}$) showed highly significant negative correlation with dead heart percent (Table 5). The present findings of positive correlation between minimum temperature and relative humidity with stem borers incidence irrespective of seasons are in line with the reports of Panwar and Sarup, 1980, Dharmasena, 2002 and Zahid, 2009 who reported that the minimum temperature favoured the development of *C. partellus* in maize crop.

The observations revealed that the adult of green stink bug appeared in first week of August (32th SMW). Initially, the population of green stink bug was 0.23 plant⁻¹. The highest adult population (1.80 plant⁻¹) was noticed during second week of September. During this period, maximum and minimum temperature, morning and evening relative humidity, wind velocity and bright sunshine were observed as 30.5°C, 24.3°C, 95%, 79%, 5.8km/h and 3.4 h/day respectively (Table 1). Thereafter, the adult population gradually decreased reaching 0.20 adult per plant during second week of October onwards. The adult population ranged from 0.23 to 1.80 plant⁻¹ during August to October months (Table 2). The present findings are in close conformity with the findings of Ahad (2008) studied that the effect of agro meteorological factors on population fluctuation green stink bugs were recorded from 3rd week of August to 1st week of

October with its range of 1 – 5. with a peak incidence during 2nd week of September. The maximum activity of green stink bug was recorded during second week of September. The adult population of green stink bug showed non-significant positive correlation with maximum temperature ($r = 0.020$), minimum temperature ($r = 0.33$), morning ($r = 0.28$) and evening ($r = 0.26$) relative humidity. Whereas, rain fall ($r = -0.13$), wind velocity ($r = -0.30$) and sunshine hours ($r = -0.21$) showed negative correlation with adult population (Table 4).

The adult of maize leaf hopper appeared in first week of August (32th SMW). Initially the adult population of leaf hopper was 0.26 plant⁻¹. The highest adult population (2.30 plant⁻¹) was noticed during fourth week of September; during this period, maximum and minimum temperature, morning and evening relative humidity, wind velocity and bright sunshine hours were observed as 33.4°C, 24.0°C, 93%, 57%, 2.1km/h and 8.3 h/day respectively (Table 1). Thereafter, the adult population gradually decreased reaching 0.1 adult plant⁻¹ during second week of October onwards as the crop approached maturity. The adult population ranged between 0.10 and 2.30 plant⁻¹ during August to October months (Table 2). The maximum activity of maize leaf hopper was recorded during first week of August. The adult population of leaf hopper

Table 4. Correlation coefficients among major insect pests of maize against weather parameters

Weather parameter	Major insect pests			
	Green stink bug	Maize leaf hopper	Black aphid	Cob borer
Maximum Temperature ($^{\circ}$ C)	0.020	0.13	0.015	-0.15
Minimum Temperature ($^{\circ}$ C)	0.33	0.34	0.29	-0.44*
Rain fall (mm)	-0.13	-0.17	-0.08	-0.41
Morning Relative humidity (%)	0.28	0.25	0.26	0.096
Evening Relative humidity (%)	0.26	0.18	0.23	-0.43*
Wind velocity (km/h)	-0.30	-0.37	-0.30	-0.62**
Sunshine hours (hours)	-0.21	-0.15	-0.20	0.15

*: Significant (5%)

**: Highly significant (1%)

showed non-significant positive correlation with maximum temperature ($r = 0.13$) minimum temperature ($r = 0.34$), morning ($r = 0.25$) and evening ($r = 0.18$) relative humidity. Whereas, rain fall ($r = -0.17$), wind velocity ($r = -0.37$) and sun shine ($r = -0.15$) showed non-significant negative correlation with adult population (Table 4).

The maximum activity of black aphid was recorded during third week of September. The black aphid population showed non-significant positive correlation with maximum temperature ($r = 0.015$), minimum temperature ($r = 0.29$) morning relative humidity ($r = 0.26$) and evening relative humidity ($r = 0.23$). Whereas, rain fall ($r = -0.086$) wind velocity ($r = -0.30$) and sun shine ($r = -0.20$), showed non-significant negative correlation with aphid population (Table 4). Present findings are in confirm with the results of Sahito *et al.*, 2012 where in the appearance of leaf aphid was noted at initial observation on 16th January 0.04 ± 0.01 plant⁻¹) but it was absent during the observations on 23rd January, while it appeared again on 30th January with a negligible population of 0.04 ± 0.01 and disappeared during next three weeks. In a real case, leaf aphid infestation started during last week of February and its population on 27th February was 2.00 ± 0.06 which reached to its peak level of 2.38 ± 0.07 plant⁻¹ on 6th March and slightly decreased 2.24 ± 0.06 plant⁻¹ on 13th March and later sustained its population around 1.0-1.5 plant⁻¹ up to 17th April. The leaf aphid population dropped to 0.76 ± 0.02 on 24th April and reached to its minimum

population of 0.48 ± 0.01 plant⁻¹ on 1st May. Overall, there was 0.96 plant⁻¹ Seasonal population of leaf aphid population on maize crop.

Periodical observations on the incidence during tasseling and cob formation period of maize revealed that the larva of cob borer population appeared during 1st week of September (36th SMW). Initially the larval population of cob borer was (0.50 cob⁻¹). The highest larval population (3.02 cob⁻¹) was noticed during fourth week of October, during this period, maximum and minimum temperature, morning and evening relative humidity, wind velocity and bright sunshine hours were observed as 29.1° C, 19.4° C, 92%, 52%, 2.0km/h and 5.9 h/day respectively (Table 1) Thereafter, the larval population gradually decreased reaching 1.20 cob⁻¹ during five week of October onwards up to the maturity of maize. The larval population ranged between 0.50 to 3.02 cob⁻¹ during September to October months (Table 2). Present findings are in accordance with findings of Ahad, 2008 who reported the effect of agro meteorological factors on population fluctuation. Cob borer infest the cobs from milking stage to the dough- dent stage of the crop. The corn borer damage was recorded in the month of August and 1st week of September with its peak damage of 8.00 / 100 cobs in the 3rd week of August. Bijjur and Verma, 1996 also reported that *H. armigera* was adversely affected by minimum temperature and rainfall in pea crop may be due to variation in weather parameters.

Table 5. Correlation studies on the incidence of pink stem borer and cob borer of maize with weather parameters

Weather parameter	Major insect pests	
	Pink stem borer DH (%)	Cob borer Cob incidence (%)
Maximum Temperature ($^{\circ}$ C)	0.08	-0.23
Minimum Temperature ($^{\circ}$ C)	-0.56	-0.89**
Rain fall (mm)	-0.34	-0.44*
Morning Relative humidity (%)	0.22	-0.015
Evening Relative humidity (%)	-0.16	-0.70**
Wind velocity (km/h)	-0.62**	-0.60**
Sunshine hours (hours)	-0.13	0.24

*: Significant (5%)

** : Highly significant (1%)

The maximum activity of cob borer was recorded during fourth week of October. The cob borer larvae population showed non-significant negative correlation with maximum temperature ($r = -0.15$) and rain fall ($r = -0.41$) but morning relative humidity ($r = 0.096$), and sun shine hours ($r = 0.15$) showed positive non-significant correlation. Whereas, minimum temperature ($r = -0.44^*$) and evening relative humidity ($r = -0.43^*$) showed significant negative correlation but wind velocity ($r = -0.62^{**}$) showed highly significant negative correlation with larval population (Table 4). Similar findings were reported by Srinivas, 1984 where in the negative significant correlation of trap catches and *H. armigera* with maximum

temperature ($r = 0.45$) at Bangalore. Patil *et al.*, 1992 also obtained significant negative correlation between *H. armigera* trap catches with maximum temperature ($r = -0.496^*$) and minimum temperature ($r = -0.702^*$).

The maximum incidence of cob damage was recorded during fourth week of October. The cob damage incidence showed non-significant negative correlation with maximum temperature ($r = -0.23$) and morning relative humidity ($r = -0.015$). There was negative highly significant correlation with minimum temperature ($r = -0.89^{**}$), evening relative humidity ($r = -0.70^{**}$) and wind velocity ($r = -0.60^{**}$), however rain fall ($r = -0.44^*$)

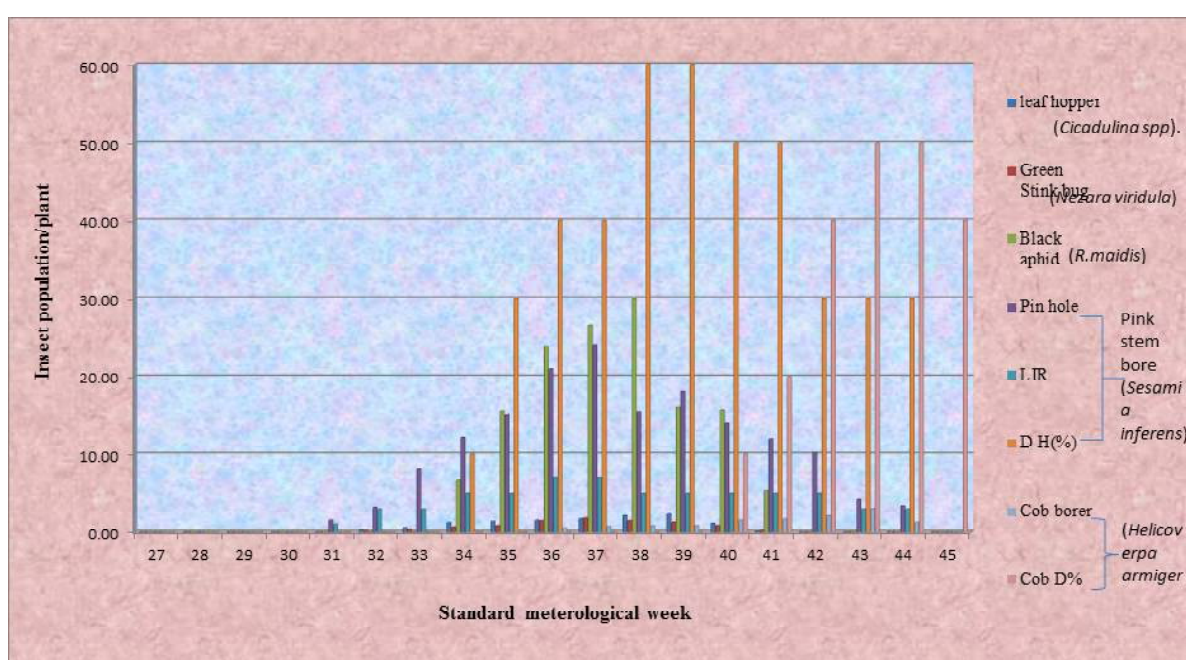


Fig. 1. Seasonal weekly incidence of *S.inferens*, *N.viridula*, *Cicadulina spp*, *R. maidis* and *H. armigera* at weekly interval, during the crop growth period on maize

showed significant negative correlation with cob incidence (Table 5).

The seasonal incidence studies indicated that five insect species *viz.* During the course of study, five insect species *viz.* pink stem borer [*Sesamia inferens* (Walker)], green stink bugs [*Nazara viridula*], leaf hopper [*Cicadulina spp*], black aphid [*Rhopalosiphum maidis* (Fitch)] and maize cob borer [*Helicoverpa armigera* (Hubner)] were observed as the major insect pests on maize. The majority of insect pests were showed positive correlation with maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and negative correlation with rainfall, wind velocity and sunshine hours.

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