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Effect of environmental parameters on population fluctuation of spotted bollworms on cotton genotypes

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ABSTRACT : A field experiment was conducted at Research Farm, Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar during the crop season 2014-2015 to determine the population fluctuation of spotted bollworms (*Earias insulana*) on seven cotton genotypes comprised of five *Bt* with different gene construct (BIOSEED 6588, SP 7007, JK 1947, NECH 6 and RCH 134), one conventional hybrid (HHH 223) and one variety (H 1236). Experiment was conducted under unsprayed condition. Observations on larval population were recorded at weekly intervals. Throughout the period of observation, it was recorded that larval population varied significantly among *Bt* and non *Bt* cotton genotypes. Among all the genotypes, BIOSEED 6588 genotypes showed minimum larval population (0.13 larvae/plant), it was followed by SP 7007 (0.16 larvae/plant), JK 1947 (0.24 larvae/plant), NECH 6 (0.25 larvae/plant), RCH 134 (0.28 larvae/plant) and HHH 223 (0.49 larvae/plant), while maximum population was recorded in H 1236 (1.70 larvae/plant). Peak of larval population were recorded on 40th SMW (1.36 larvae/plant) afterwards it declined. Correlation of environmental parameters on population fluctuation were also studied and found that bollworms population showed significant and negative correlation with minimum temperature (r = 0.802**) and sunshine hours (r = 0.619*).

Key words : *Bt* cotton, correlation, environmental parameters, non *Bt* cotton, spotted bollworms

Cotton is one of the major commercial fibre crops and in India it is the backbone of textile industry which provides employment to a large population directly or indirectly. Being cash crop, it provides income to millions of people allied with its cultivation, textile and apparel industries (Sahito *et al.*, 2011). In India cotton is cultivated on largest area (122.35 lakh ha) with production of 377 lakh bales and average yield of 524 kg/ha (Anonymous, 2018). The low productivity of cotton is caused by a lot of factors, but among them the most serious is the intensity of insect pests damage. Sucking pests and bollworm complex cause damage from germination to maturity of crop. Among the bollworm complex, spotted bollworms, *Earias insulana* (Boisduval) and *E. vittella* (Fabricius)] are destructive pests which reduces yield of cotton up to 40 per cent as seed cotton and quality up to 50 per cent by staining of lint (Ahmad and Arif, 2009). In present, a broad spectrum insecticides are used to control these insect pests. But the nonstop and indiscriminate application of these insecticides accelerate the environmental hazard, insecticides resistance, reduction of natural enemies, etc. Therefore, it is needed an alternate method to control these insect pests. Development of resistant or tolerant

cultivars to pests has a significant potential in integrated management approaches to pest. Population of bollworms also fluctuated by the environmental factors. Hence, the current study was done to assess larval population of spotted bollworm on different *Bt* and non *Bt* cotton genotypes and their correlation with environmental factors.

The field experiment was carried out at Research Farm, Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar during the crop season 2014-2015 on seven genotypes of cotton in order to find the larval population of spotted bollworms in bolls under unsprayed conditions. These genotypes procured from Private Sector and Department of Genetics and Plant Breeding. Five were *Bt* hybrids with different gene construct (BIOSEED 6588, NECH 6, JK 1947, SP7007 and RCH 134) and two were non *Bt* (one conventional hybrid (HHH 223) and one variety (H 1236). Sowing was done on 18th May, 2014 in a randomized block design with three replications in a plot size of (5.4 × 4.5m) each. The seeds were dibbled with row to row spacing of 67.5 cm and plant to plant at 60 cm in case of hybrids and 30 cm in case of the variety. Two to three seeds of respective genotypes were sown at a depth of 3 4 cm in each hill in the well prepared soil. To raise the healthy crop, all cultural practices like weeding, hoeing, irrigation, fertilizer application etc. were adopted as per recommendation of "Package of Practices of *Kharif* Crops" of CCS Haryana Agricultural University, Hisar (Anonymous, 2016). Observations on the bollworms larval population were taken at weekly intervals. It was started from 30th standard meteorological week (SMW) and continued till harvest of crop. Larval population of spotted bollworms, were taken from five plants from each treatment per replication. For this all the available green bolls of five plants/ treatment per replication were taken into account. Later the data for the three replications were pooled and compared among different genotypes.

Correlation with environmental parameters : The data of environmental parameters, *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, total rainfall, wind speed and sunshine hours during the experiment were collected from the Meteorological Observatory of the Department of Agricultural Meteorology, CCS HAU, Hisar to correlate the larval population of bollworms with these parameters.

Statistical analysis : The larval population data of spotted bollworms obtained during experiment was got computed for analysis of variance using the methods of Panse and Sukhatme, 1995. The data were analysed by adopting square root transformation by using OPSTAT software at the 5 per cent level of significance.

Population dynamics of spotted bollworm : Data presented in (Table 1) indicated spotted bollworm larval population on boll basis in different cotton genotypes. Data indicated that larval population varied significantly in *Bt* and non *Bt* genotypes being very high in non *Bt* genotypes. During 30th to 32nd SMW population was nil in all cotton genotypes irrespective of *Bt*

Table 1. Population of spotted bollworms on *Bt* and non *Bt* genotypes of cotton

Genotypes	Mean larvae of bollworm /5 plants on green boll basis (Standard Meteorological Weeks)												Mean
	30	31	32	33	34	35	36	37	38	39	40	41	
BIOSEED 6588	0.00(1.00)*	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.08(1.04)	0.18(1.08)	0.31(1.14)	0.23(1.11)	0.43(1.20)	0.31(1.14)	**0.13**
NECH 6	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.10(1.07)	0.24(1.16)	0.44(1.20)	0.54(1.24)	0.42(1.19)	0.64(1.28)	0.53(1.23)	**0.25**
JK 1947	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.06(1.03)	0.18(1.08)	0.35(1.16)	0.41(1.19)	0.56(1.25)	0.68(1.29)	0.58(1.25)	**0.24**
SP 7007	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.12(1.06)	0.26(1.12)	0.35(1.16)	0.32(1.15)	0.45(1.21)	0.40(1.18)	**0.16**
RCH 134	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.09(1.04)	0.32(1.10)	0.36(1.17)	0.47(1.21)	0.61(1.27)	0.91(1.38)	0.65(1.28)	**0.28**
HHH 223	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.07(1.039)	0.16(1.07)	0.40(1.19)	0.60(1.26)	0.83(1.35)	1.10(1.45)	1.54(1.59)	1.20(1.48)	**0.49**
H 1236	0.00(1.00)	0.00(1.00)	0.00(1.00)	0.08(1.04)	0.54(1.242)	0.89(1.4)	1.34(1.53)	1.78(1.67)	2.67(1.91)	3.98(2.23)	4.87(2.42)	4.21(2.28)	**1.70**
Mean	**0.00**	**0.00**	**0.00**	**0.01**	**0.09**	**0.19**	**0.38**	**0.57**	**0.80**	**1.03**	**1.36**	**1.13**	
SE(m)±	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	
CD (p=0.05)	(NS)	(NS)	(NS)	(0.09)	(0.02)	(0.03)	(0.04)	(0.05)	(0.10)	(0.07)	(0.1)	(0.05)	

* Figures in parentheses are “n+1 transformed values

and non *Bt*. During 33rd SMW only non *Bt* genotype H 1236 showed larval population of (0.08 larvae/plant) and it continued till 41st SMW. From 34th SMW population was recorded in hybrid HHH 223 (0.07 larvae/plant). From 36th SMW all the cotton genotypes (both *Bt* and non *Bt*) showed larval population. During this SMW minimum larval population was recorded in BIOSEED 6588 (0.08 larvae/plant) which was statistically *at par* with SP 7007 (0.12 larvae/plant) and JK 1947 (0.18 larvae/plant). It was followed by NECH 6 (0.24 larvae/plant) and RCH 134 (0.32 larvae/plant) whereas in non *Bt* hybrid HHH 223 (0.40 larvae/plant) was recorded. Significantly higher larval population was recorded on non *Bt* variety H 1236 (1.34 larvae/plant) and it was inferior among all genotypes.

On the basis of genotypes mean value it has been observed that *Bt* genotypes showed less population of bollworms as compared to non *Bt* genotype. It was recorded that minimum larval population of spotted bollworm was recorded in BIOSEED 6588 (0.13 larvae/plant). It was followed by SP 7007 (0.16 larvae/plant), JK 1947 (0.24 larvae/plant), NECH 6 (0.25 larvae/plant), RCH 134 (0.28 larvae/plant) and HHH 223 (0.49 larvae/plant). Maximum larval population was recorded in H 1236 (1.70 larvae/plant). Weekly mean values indicated that incidence of spotted bollworm was started from 33rd standard meteorological week (SMW) (0.01 larvae/plant). After that it increases continuously and reached to its peak during 40th SMW (first week of October) (1.36 larvae/plant) after that decreases and on 41st SMW, it was recorded (1.13 larvae/plant). Results are in agreement with Kalkal *et al.*, (2018) who reported that larval population reached to its peak during 40th SMW, after that it declined. Results are also in agreement with Dhaka and Pareek (2008) who reported that the

Table 2. Correlation of spotted bollworm population (larval) with environmental parameters

Environmental parameters	Correlation coefficient (r value)
Temperature max. (°C)	-0.356
Temperature min. (°C)	-0.802**
Morning RH (%)	-0.122
Evening RH (%)	-0.488
Rainfall (mm)	-0.108
Wind speed (Km/h)	-0.362
Sunshine h	-0.619*

*Significant at 5%, **Significant at 1%

Table 3. Multiple regression analysis between spotted bollworm population and environmental parameters on cotton genotypes

	Regression equations	R2
Larval population	Y1= 9.79 - 0.04 X_1 -0.27 X_2 - 0.03 X_3 + 0.08 X_4 - 0.025X_5 -0.04 X_6+0.02X_7	0.87
	Y2 =7.23-0.253 X_2 -0.06 X_6	0.84
	Y3=5.72-0.21 X_2	0.81

X_1 = Maximum Temperature (°C), X_2 = Minimum Temperature (°C), X_3 = Morning Relative humidity (%), X_4 = Evening Relative humidity (%), X_5 = Wind speed (Km/hr), X_6 = Bright sunshine (hrs), X_7 = Rainfall (mm)

bollworm population reached to its peak during 41st SMW and thereafter it declined. Variation may be due to difference in sowing time. They had also reported significantly lower larval population in *Bt* cotton and higher in non *Bt* cotton genotypes, which supports present finding. Results was also in conformity with several authors (Morse *et al.*, 2005; Bal and Dhawan, 2008 and Arshad *et al.*, 2015) who reported larval density of spotted bollworm was significantly lower in *Bt* cotton than non *Bt* cotton plots. Amongst *Bt* genotypes, MRC 7031 BG II, VBCH 1504 BG II, NECH 6 *Bt*, KDCHH 441 BG II, TULSI 45 BG II and MRC 6301 *Bt* showed incidence of spotted bollworms (Kalkal, 2011).

Correlation and regression with environmental parameters : Effect of environmental parameters on bollworms larval population was calculated and presented in Table 2. It was found that larval population showed significant and negative correlation with minimum temperature (r = 0.802**) and sunshine hours (r = 0.619*). Non significant and negative correlation with maximum temperature (r = 0.356), morning relative humidity (r = 0.122), evening relative humidity (r = 0.488), total rainfall (r = 0.108) and wind speed (r = 0.362). Results are in agreement with Kalkal *et al.*, (2018) who reported that spotted bollworm population showed significant and negative correlation with minimum temperature and sunshine hours. Results are also supported by several authors (Dhaka and Pareek 2008; Rawal *et al.*, 2017) who had reported that bollworms population showed significant and negative correlation with minimum temperature and non significant negative with maximum temperature, evening relative humidity and total rainfall.

Regression equation : Based on regression analysis (Table 3) by taking bollworms larval population (y) as a dependent variable and environmental parameters (x) as independent variables different equations were fitted. The multiple regression analysis explained the relationship between larval population and environmental parameters *i.e.* the amount of changes in larval population/unit change in environmental parameters indicated that there was significant (87%, regression equation Y1) contribution of these factors (R2 = 0.87) for variability in larval population. Out of 87 per cent variability in larval population due to various environmental parameters, minimum temperature and sunshine h accounted for 84 per cent variability (regression equation Y2) and these were the most important factors affecting larval population. Out of 84 per cent variability in larval population, minimum temperature accounted for 81per cent contribution (regression equation – Y3). Results are in conformity with Babu and Meghwal (2014) who reported that environmental parameters contributed 44 per cent variability in predicting the larval population. The correlation and regression analysis evidently showed the importance of environmental parameters in predicting the spotted bollworms incidence in cotton.

CONCLUSION

It was concluded from above studies that spotted bollworm population varied significantly

in *Bt* and non *Bt* genotypes, being very high in non *Bt* genotypes and very low in *Bt* genotypes. *Bt* genotype BIOSEED 6588 showed minimum larval population (0.13 larvae/plant), while maximum population was recorded in H 1236 (1.70 larvae/plant). It was also concluded that larval population showed significant and negative correlation with minimum temperature (r = 0.802**) and sunshine h (r = 0.619*).

REFERENCES

Ahmad, M. and Arif, M.I. 2009. Resistance of Pakistani field populations of spotted bollworm *Earias vittella* (Lepidoptera: Noctuidae) to pyrethroid, organophosphorus and new chemical insecticides. *Pest Manag. Sci.,* **65** : 433-39.

Anonymous 2016. *Package of Practices for Kharif Crops*. CCS Haryana Agricultural University, Hisar, 234.

Anonymous 2018. *"Annual Report, 2017 2018"*. ICAR All India Coordinated Research Project on Cotton.

Arshad, M., Abdin, Z., Gogi, M.D., Arif M.J. and Khan, R. R. 2015. Seasonal pattern of infestation by spotted bollworm, *Earias insulana* (Boisd.) and pink bollworm, *Pectinophora gossypiella* (Saund.) in field plots of transgenic *Bt* and non *Bt* cottons. *Pakistan J. Zool.*, **47** :177-86.

Babu, S.R., and Meghwal, M.L. 2014. Population dynamics and monitoring of sucking pests and bollworms on *Bt* cotton in humid zone of Southern Rajasthan. *The Bioscan,* **9** : 629-32.

Bal, H.K. and Dhawan, A.K. 2008. Effects of intercropping on population of pests and natural enemies in *Bt* and non *Bt* cotton under sprayed and unsprayed conditions. *Indian J. Eco.,* **35**: 59-63.

Dhaka, S.R. and Pareek, B.L. 2008. Weather factors influencing population dynamics of major insect pests of cotton under semi arid agro ecosystem. *Indian J. Entomol.,* **70 :** 157-63.

Kalkal, D., Lal, R., Dahiya, K.K., Rohlania, K., Kumar, D. and Janu, A. 2018. Population dynamics of spotted bollworms and their correlation with abiotic factors. *J. Entomol. Zool. Stud.*, **6**: 1583-88.

Morse, S., Bennett, R. and Ismael, Y. 2005. Comparing the performance of official and unofficial genetically modified cotton in India. *AgBioForum*, **8**:1-6.

Panse, V.G. and Sukhatme, P.V. 1995. *Statistical Methods for Agricultural Workers,* ICAR: New Delhi, 15.

Rawal, R., Dahiya, K.K., Kumar, A. and Saini, V. 2017. Effect of abiotic factors on bollworms infestation in *Bt* and Non *Bt* cotton genotypes. *J. Entomol. Zool. Stud.*, **5** : 902-05.

Sahito, H.A., Abro, G.H., Syed, T.S., Memon, S.A., Mal, B. and Kaleri, S. 2011. Screening of pesticides against cotton mealybug, *Phenacoccus solenopsis* (Tinsley) and its natural enemies on cotton crop. *Inter. Res. J. Biochem. Bioinform.* **1** : 232-36.

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