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Relative Abundance of Gram Pod Borer, *Helicoverpa armigera* on different host crops

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ABSTRACT

The *Helicoverpa armigera* (Hubner) attack several economically important crops in India, including cotton, pigeonpea, chickpea, sunflower, maize, chilli, tomato and okra. The current study examined the relative abundance of *H. armigera* on different host crops within a crop mosaic. Field studies conducted during 2016-17 at the Experimental Farm, College of Agriculture, Annamalai University, indicated differences in egg and larval densities among the different host plant species. All of the host crops supported eggs and larvae of *H. armigera*, but the populations on chickpea (3.36 eggs/plant and 1.59 larvae/ plant) and pigeonpea (2.77 eggs/plant and 1.30 larvae/plant) were significantly higher than on cotton and other host crops. The damage caused by *H. armigera* larvae was highest in chickpea (18.02 %) followed by pigeon pea (17.42 %). Thus, in *kharif* pigeonpea and okra crops and in *rabi* season chickpea appeared to be the major host crops for *H. armigera*.

Key words: *Helicoverpa armigera*, Host Population, Weather parameters

Introduction

Helicoverpa armigera (Hubner) is a pest of global importance and is most closely associated with deserts and temperate broad leaf and mixed forests; tropical and subtropical grasslands, Savannas, and shrub lands; and tropical and subtropical moist broadleaf forest (Wasihun, 2016). It has a wide host range of 360 species and cultivated crops. Tomato, cotton, pigeonpea, chickpea, okra, sorghum, cowpea and range of vegetables suffer severly by *H. armigera* damage (Anon., 2006). *Helicoverpa armigera* is able to adapt to various cropping systems due to its high polyphagy, wide geographical range, mobility, migratory potential, facultative diapause and high fecundity (Reigada *et al.*, 2016).

Due to rapid development of resistance to various groups of insecticides (OP, Carbamates *etc*), there has been quick shift in insecticide usage pattern. This is evidenced by very high level of resistance to synthetic pyrethroids, which occupied 50-70 per cent of the insecticides sprayed over the cotton in India. The number of insecticides being used to control bollworm varied across locations in India. Cypermethrin, endosulfan and chlorpyriphos, as representative of the pyrethroid, organochlorine and organophosphate insecticides respectively, rank amongst the most commonly used insecticides on cotton in India and accounted for at least 40 per cent of all insecticides used on cotton (Kranthi *et al.*, 2002). Thus, new chemistry based insecticides are dominating in protection scenario (Akbar *et al.*, 2016). Introduction of *Bt* transgenic crop varieties (cotton, soybean, maize *etc*) was due to widespread resistance to different insecticides in *H.armigera*. Since, the ineffectiveness of insecticide predominantly has arisen from highly pesticide prone areas where intensive agriculture is in practice, it gives a scope to relate the degree of

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development of resistance in the population from different geographical areas of the state vis-à- vis intensity of pesticide usage. A change in insecticide pattern against *H.armigera* in different host crops has been evident through research. After 15 years of *Bt* cotton cultivation in India and changes in insecticide usage pattern it was essential to know the incidence of *H. armigera* in a multicropping system as free choice for natural incidence.

Material and Methods

The experiments were carried out in *kharif* and *rabi* seasons during 2016-17 at Experimental Farm, Faculty of Agriculture, Annamalai University. The experiment comprised of ten crops as treatments *viz*, Bt cotton, Non Bt cotton, pigeon pea, sunflower, maize, okra, tomato, chilli, chickpea and safflower which were replicated three times satisfying RBD requirements. The plot size was 5.4 x 5.4 m per treatment. The observations were recorded from two weeks after germination on ten randomly selected plants *viz.,* number of eggs per plant, number of larvae per plant, total number of fruiting bodies and damaged fruiting bodies. Whereas, whole plot was considered in maize and sunflower for taking observation on total fruiting bodies and damaged bodies. The observations were recorded from each treatment at fortnightly intervals after the appearance of eggs and larvae of *H. armigera* till harvest of the crop. Finally, the mean values of each observation were subjected to ANOVA and means were separated by DMRT. Further, co-relation co-efficient was worked to know the impact of weather parameters on the incidence of *H.armigera.* For all statistical analysis MSTAT–C software programme was used.

Results and Discussion

The activity of *H. armigera* during 2016-17 cropping season is summarised in Table 1. In Bt cotton oviposition and larval incidence ranged from 0 to 4.3 ± 0.36 per plant and 0 to 1.1 ± 0.17 per plant, respectively. The peak egg load was noticed during 39th Standard Week - SW (second fortnight of September) and larval peak incidence was recorded during 41st SW (1st first fortnight of October). Thus, it was evident that *H. armigrea* still prefers cotton however Bt toxin delivery suppress the build-up of population further. Such phenomenon and its relation to evolution of resistance has been evidenced and also as an impact of Bt genes (Downes and Mahon, 2012).

Table 1. Abundance of *Helicoverpa armigera* eggs, larvae and percent of damage among different host crops

Treatments	Seasonal Length (weeks)	Mean abundance /plant Eggs	Larvae	Per cent Damage
Bt cotton	14	0.63 $(1.05)^{def}$	0.14 $(0.80)^{cd}$	0.81 $(5.77)^{h}$
Non Bt cotton	14	1.19 $(1.29)^{c-f}$	0.62 $(1.05)^{a-d}$	3.71 $(12.53)^{g}$
Pigeon pea	13	2.77 $(1.80)^{ab}$	1.30 $(1.34)^{ab}$	17.42 $(21.96)^{cd}$
Sunflower	07	1.61 $(1.45)^{bcd}$	1.17 $(1.29)^{ab}$	32.33 $(35.65)^{a}$
Maize	07	0.38 $(0.94)^{ef}$	0.25^{bcd} (0.87)	11.75 $(22.78)^{cd}$
Okra	07	2.24 $(1.65)^{abc}$	1.12^{ab} (1.27)	10.01 $(21.13)^{d}$
Tomato	07	1.50	1.11	9.34

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		(1.41)[b-e]	(1.27)[ab]	(17.79)[f]
Chilli	08	1.47	1.06	8.28
		(1.40)[b-e]	(1.24)[abc]	(19.62)[e]
Chickpea	08	3.36	1.59	18.02
		(1.96)[a]	(1.45)[a]	(27.97)[b]
Safflower	08	0.14	0.08	0.75
		(0.80)[f]	(0.76)[d]	(7.03)[h]
S.Em.±		0.07	0.06	0.77
C.D. @ 5 %		0.20	0.19	2.29

Note: Figures in the parentheses are √X+0.5 transformed values. In vertical columns, means followed by similar alphabets arenot different statistically (0.05) as per DMRT

Incidence on pigeonpea, was observed during second week of September recording 0.96 ± 0.12 eggs per plant and 0.16 ± 0.37 larave per plant with peak egg load between 39 and 41 SW (2nd fortnight of Sept. and 1st fortnight of October) and larval incidence between 41 and 43 SW (October month). Thereafter it decreased gradually during last week of December. The damage in unprotected condition was maximum (17.42%) in this crop. Egg load on sunflower ranged from 0.00 to 4.83 ± 0.25 eggs per plant. However, there was damage to tune of 11 per cent. This damage was considered in deciding the preference because the observation was on whole plant basis in sunflower and maize. As these crops bear a single fruiting body the damage rating obviously goes high compared to other crops which bear plenty of fruiting structures and pest gets distributed. In tomato crop peak ranged from 0.00 to 3.25 ± 0.06 per plant and reached highest egg load during 35 SW and larval incidence between 37 and 39 SW (within Sept.). Whereas, in case of maize peak was seen in 33 SW(1st fortnight of August). Whereas, in case maize peak was seen in 33 SW (1st fortnight of August) and 35 SW (2nd fortnight of August), respectively. Further, in chilli the peak egg load and larval incidence was noticed between 37 and 39 SW (September). The host availability and preferred stage play important role in the incidence of *H.armigera* in a multicropping system as observed by Ravi *et al.* (2005). Similarly, being a key host of *H. armigera* okra hosted egg and larval incidence upto 5.87 ± 0.25 and 2.60 ± 0.17 per plant respectively and peak during 37 and 39 SW (September) in okra. This is the pattern of *H. armigrea* in okra as observed by Venkanna and Balikai (2016) and Bt cotton or new insecticides have not reduced its incidence. Thus, okra plays a key role in sustenance of this pest beyond a selection pressure of various kinds.

Chickpea plays a very dominant role in fitness of *H. armigera* during *rabi* season. The peak egg and larval incidence in chickpea ranged from 0.00 to 7.77 ± 0.25 eggs per plant and 0.00 to 3.33 ± 0.21 larvae per plant and the peak egg load was observed between 48 and 52 SW (2nd fortnight of Nov and 1st fortnight of Dec.). Whereas, larval incidence highest in between 50 and 52 SW (1st to 2nd fortnight of Dec.). Thus, among all crops considered in this study the damage was highest (18%) in chickpea. The earlier studies (Ravi *et al.*, 2005, Ranjith and Prabhuraj, 2013) also justify this phenomenon. The incidence in safflower was negligible which could be due to lower preference or existence of chickpea as preferred host since both are grown in same season. Thus, from the present study it was evident that chickpea had more eggs and larval population followed by pigeonpea which may be due co-incidence in sowing period of cotton and pigeonpea, however blooming in pigeonpea usually initiates 4-5 week after cotton intially on foliage and once the inflorescence initiates, the larvae move to these parts. Hence, the incidence and dynamics of

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H. armigera is supported by manycultivated host crops.

Relationship between weather parameters and *H. armigera* eggs and larval incidence in different host crops

In a multicropping system limited to smaller area it would be difficult to find a clear impact of weather factors on incidence of *H. armigera*. However, among the weather parameters (Table 2), maximum temperature had significant and negative correlation on larval incidence in chick pea (r= -0.736) whereas, rainfall also had significant negative impact on larval incidence in tomato (r = -0.919) and okra (r= -0.891). Likewise Chatar *et al.,* (2010) and Ranjith and Prabhuraj (2013) have noticed significant negative correlation in chickpea and tomato and Kuldeep Singh *et al.*, (2013) in tomato and okra. The significant impact observed in the present study could be due to larval preference towards the selected hosts coupled with the rainfall and temperature.

Thus, in *kharif* pigeonpea and okra in *rabi* chickpea act as major host crop for *H. armigera*. The abundance of population, survival continues beyond the flowering period of cotton. *Helicoverpa armigera* adult population emerging from cotton and other host crops become attracted to lay eggs heavily on pigeonpea due to phenological overlap. Chickpea as a *rabi* crop hosts the *H. armigera* egg and larval population as extended coincidnce with cotton crop. In chickpea, *H. armigera* larval feed for longer duration and over season indicated that *H. armigera* is successful in adopting to changes in the insecticide usage pattern. Further, it is surviving better despite wide scale cultivation of Bt cotton because of better alternate host crops. Thus, multicropping system is in favour of *H.armigera* resistance management which also acts as natural refugia.

Table 2. Relationship of weather parameters with *H. armigera* eggs and larvae in different host crops

Crops	Temperature (°C)				Relative humidity (%)				Rainfall (mm)		Wind velocity (kmph)	
	Max		Min		Morning		Evening					
	Egg	Larva	Egg	Larva	Egg	Larva	Egg	Larva	Egg	Larva	Egg	Larva
Bt cotton	-0.382	-0.200	0.422	0.314	0.488	0.376	0.489	0.332	0.067	0.133	-0.417	0.133
Non Bt cotton	-0.086	0.241	0.401	0.125	0.341	-0.034	0.275	-0.063	-0.066	-0.202	-0.103	-0.202
Pigeonpea	0.058	0.411	0.204	-0.073	0.154	-0.195	0.124	-0.242	-0.177	-0.351	-0.067	-0.351
Sunflower	0.023	0.411	-0.072	-0.073	-0.057	-0.195	-0.159	-0.242	-0.441	-0.351	0.553	-0.351
Maize	-0.238	0.359	0.115	-0.221	0.271	-0.427	0.044	-0.359	-0.204	-0.515	0.284	-0.515
Okra	0.036	0.544	-0.145	-0.745	-0.063	-0.633	-0.094	-0.427	-0.573	-0.891**	0.486	-0.891**
Tomato	0.062	0.482	-0.241	-0.684	-0.149	-0.514	-0.129	-0.392	-0.653	-0.919**	0.539	-0.919**
Chilli	-0.054	0.143	-0.02	-0.181	0.282	0.110	0.216	0.060	-0.469	-0.546	0.166	-0.546
Chickpea	-0.522	-0.736*	0.309	-0.222	0.442	0.101	0.643	0.249	0.152	-0.207	0.021	-0.207
Safflower	-0.625	0.064	-0.167	-0.466	0.129	-0.341	0.085	-0.485	-0.239	-0.213	0.287	-0.213

**Significant at the 0.01 level, *Significant at the 0.05 level

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