

## Influence of Crop Biodiversity on Population Dynamics of Gram Pod Borer, *Helicoverpa armigera* (Hub) in Pigeonpea and Border Crops

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### ABSTRACT

In a field trial influence of crop biodiversity on population dynamics of *Helicoverpa armigera* (Hub) in pigeonpea was studied with four treatments i.e. Pigeonpea + Maize (M) as border crop, Pigeonpea + Sorghum fodder (SF) as border crop, Pigeonpea sole unprotected (PP - UP) and Pigeonpea sole protected (PP - P). The mean minimum population of *Helicoverpa armigera* (Hub) was found in Pigeonpea + Sorghum fodder (SF) as border crop (0.75) while maximum in Pigeonpea sole unprotected (PP - UP) (0.94). Correlation between various abiotic factors and gram pod borer population in leaf were found to be non significant.

**Key words:** *Helicoverpa armigera*, Pigeonpea, Population dynamics.

### INTRODUCTION

Pigeonpea crop accounts ~5% of global acreage (4.16 million ha) and production (2.85 million tonnes), of which Asia is nearly the sole contributor<sup>1</sup>. In India pigeonpea occupies an area of about 4.42 million ha with a total production of 2.89 million tonnes with productivity of 655 kg/ha<sup>4</sup>. In the country, the crop is extensively grown in Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Gujarat.

India is the largest producer of pulses in the world and the domestic pulses production is about 14 - 15 million tonnes, but the demand is higher, of about 18 - 19 million

tonnes<sup>3</sup>. The major pulse grown in India is gram which is cultivated on 9.21 million hectare with production and productivity of 8.25 million tonnes and 0.89 tonnes/ha respectively<sup>4</sup>.

Immediately after gram, pigeonpea is the next important pulse crop, which is grown world over, mostly in tropical and sub-tropical countries for grains, green manuring, fodder and forage as sole crop, intercrop, mixed crop and in sequential cropping systems<sup>6</sup>. The countries with notable pigeonpea production are India, Nepal and Myanmar in Asia, Malawi and Uganda along with some other countries in eastern Africa and the Dominican Republic in the Americas<sup>2</sup>.

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Pigeonpea crop accounts 5% of global acreage (4.16 million ha) and production (2.85 million tonnes), of which Asia is nearly the sole contributor<sup>1</sup>. In India pigeonpea occupies an area of about 4.42 million ha with a total production of 2.89 million tonnes with productivity of 655 kg / ha<sup>4</sup>. To meet the growing demands, this needs to be increased at least by 28 percent in the next 10 years<sup>5</sup>. In the country, the crop is extensively grown in Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Gujarat. Uttar Pradesh has an unique distinction of contributing about 20 percent production in the country followed by Madhya Pradesh. Pigeonpea is a rich source of protein (21.71%) and supplies a major share of protein requirement of the vegetarian population of the country, besides it is also a rich source of iron, iodine and essential amino acids like arginine, cystine and lysine<sup>7</sup>.

#### MATERIAL AND METHODS

The present investigation was carried out in the experimental field of Department of Entomology, Live Stock Farm, Adhartal, J.N. Krishi Vishwa Vidyalyaya, Jabalpur (M.P.) during *kharif* season of 2012-2013. The experiment was conducted with 4 treatments and 8 replications. Observations were carried out on three different situations *viz.*, maize and sorghum fodder were sown around pigeonpea plots as border crops and pigeonpea sole plots under protected and unprotected conditions. The varieties used for sowing were Pigeonpea - JA-4, Maize - QPM-1, Sorghum fodder - MP Chari.

Observations on gram pod borer were recorded on 3 randomly selected pigeonpea plants from each block twice in a standard week from sole pigeonpea unprotected, pigeonpea having border crops of maize and sorghum fodder, respectively. Thus a total of 24 pigeonpea plants were observed from 8 blocks of each treatment. Similarly observations on 25 plants of border crops *i.e.* maize and sorghum fodder were recorded twice in a standard week. Observations were started from the first appearance of the insect

and were continued till their availability or maturity of the crop, which ever was earlier.

#### RESULTS AND DISCUSSION

First appearance of the pod borer larva was observed on 18<sup>th</sup> December *i.e.* during the 51<sup>st</sup> SW on pigeonpea in all the three different crop habitats. The number of pod borer larvae were worked out as weekly average per plant. Data are presented in the Table 1.

##### (i) Pigeonpea bordered with maize (PP+M):

From the table 1, it is seen that pod borer larvae appeared from 51<sup>st</sup> SW and was available upto 5<sup>th</sup> SW. Larval population attained its first peak (0.94 larvae/plant) during 1<sup>st</sup> SW when maximum and minimum temperature was 23.3 and 7.2°C respectively, whereas morning and evening relative humidity was 87 and 32%, respectively. Further sunshine, wind speed, morning and evening vapour pressure and evaporation were 5.9 hrs, 3.6 km/hr, 7.7 mm, 8.7 mm and 2.2 mm respectively. There was no rainfall received during this week.

The larval population attained its second peak (0.90 larvae / plant) during 3<sup>rd</sup> SW when maximum and minimum temperature was 26.7 and 10.1°C, respectively, whereas morning and evening relative humidity was 86 and 36%, respectively. Further, sunshine, wind speed, morning and evening vapour pressure and evaporation were 8.1 hrs, 4 km/hr, 9 mm, 9.1 mm and 3.1 mm, respectively. There was no rainfall during this week.

##### Correlation studies: (Table 2)

###### Positive correlation:

Wind speed showed significant positive correlation ( $r = 0.84$ ) with larval population.

The regression equation being:

$$Y = 0.14 + 0.13x \quad (R^2 = 0.71)$$

From the above equation it may be expressed that with every unit increase in wind speed there was an increase of 0.13 pod borer larvae per plant.

Correlation studies further revealed that minimum temperature, morning relative humidity, evening relative humidity, morning vapour pressure, evening relative humidity and

evaporation exhibited positive correlation ( $r = 0.30, 0.19, 0.63, 0.32, 0.36$  and  $0.11$  respectively) with pod borer larval population, but statistically found to be non significant.

#### **Negative correlation:**

Maximum temperature, sunshine, rainfall and rainy days showed negative correlation ( $r = -0.04, -0.52, -0.16$  and  $-0.38$  respectively) with pod borer larval population, but statistically found to be non significant.

#### **(ii) Pigeonpea bordered with sorghum fodder (PP+S):**

From the table 1, it is seen that pod borer larvae appeared from 51<sup>st</sup> SW and was available upto 5<sup>th</sup> SW. Larval population attained its first peak (0.98 larvae/plant) during 1<sup>st</sup> SW, when maximum and minimum temperature was 23.3 and 7.2°C respectively, whereas morning and evening relative humidity was 87 and 32%, respectively. Further sunshine, wind speed, morning and evening vapour pressure and evaporation were 5.9 hrs, 3.6 km/hr, 7.7 mm, 8.7 mm and 2.2 mm respectively. There was no rainfall received during this week.

The larval population attained its second peak (0.80 larvae / plant) during 3<sup>rd</sup> SW when maximum and minimum temperature was 26.7 and 10.1°C respectively, whereas morning and evening relative humidity was 86 and 36% respectively, Further, sunshine, wind speed, morning and evening vapour pressure and evaporation were 8.1 hrs, 4 km/hr, 9 mm, 9.1 mm and 3.1 mm respectively. There was no rainfall during this week.

**Correlation studies:** (Table 2)

#### **Positive correlation:**

Minimum temperature, morning relative humidity, evening relative humidity, wind speed, morning vapour pressure and evening vapour pressure exhibited positive correlation ( $r = 0.04, 0.65, 0.26, 0.49, 0.04$  and  $0.09$  respectively) with pod borer larval population, but statistically found to be non significant.

#### **Negative correlation:**

Maximum temperature, sunshine, rainfall, evaporation and rainy days showed negative correlation ( $r = -0.01, -0.22, -0.08, -0.23$  and -

$0.32$  respectively) with pod borer larval population, but statistically found to be non significant.

#### **(iii) Pigeonpea sole unprotected:**

From the table 1, it is seen that pod borer larvae appeared from 51<sup>st</sup> SW and was available upto 5<sup>th</sup> SW. Larval population attained its first peak (1.52 larvae/plant) during 2<sup>nd</sup> SW, when maximum and minimum temperature was 23 and 5.2°C respectively, whereas morning and evening relative humidity was 84 and 36%, respectively. Further sunshine, wind speed, morning and evening vapour pressure and evaporation were 9.2 hrs, 2.6 km/hr, 6.7 mm, 7.3 mm and 2.6 mm respectively. There was no rainfall received during this week.

**Correlation studies:** (Table 2)

#### **Positive correlation:**

Morning relative humidity, evening relative humidity and wind speed exhibited positive correlation ( $r = 0.34, 0.22$  and  $0.12$ , respectively) with pod borer larval population, but statistically found to be non significant.

#### **Negative correlation:**

Maximum temperature, minimum temperature, sunshine, rainfall, morning vapour pressure, evening vapour pressure, evaporation and rainy days showed negative correlation ( $r = -0.37, -0.32, -0.06, -0.18, -0.30, -0.005, -0.29$  and  $-0.46$  respectively) with pod borer larval population, but statistically found to be non significant.

#### **(iv) Pigeonpea sole Protected:**

From the table 1, it is seen that pod borer larvae appeared from 51<sup>st</sup> SW and was available upto 5<sup>th</sup> SW. Larval population attained its first peak (1.08 larvae/plant) during 52<sup>nd</sup> SW when maximum and minimum temperature was 23.8 and 5°C respectively, whereas morning and evening relative humidity was 87 and 42% respectively. Further sunshine, wind speed, morning and evening vapour pressure and evaporation were 9.1 hrs, 2.2 km/hr, 6.8 mm, 7.4 mm and 2.3 mm respectively. There was no rainfall received during this week.

The larval population attained its second peak (0.90 larvae / plant) during 3<sup>rd</sup>

SW when maximum and minimum temperature was 26.7 and 10.1°C respectively, whereas morning and evening relative humidity was 86 and 36%, respectively. Further, sunshine, wind speed, morning and evening vapour pressure and evaporation were 8.1 hrs, 4 km/hr, 9 mm, 9.1 mm and 3.1 mm, respectively. There was no rainfall during this week.

**Correlation studies:** (Table 2)

**Positive correlation:**

Morning vapour pressure showed significant positive correlation ( $r = 0.87$ ) with pod borer larval population.

The regression equation being:

$$\hat{Y} = 1.07 + 0.02x \quad (R^2 = 0.02)$$

From the above equation it may be expressed that with every unit increase in wind speed

there was an increase of 0.02 pod borer larvae per plant.

Correlation studies further revealed that maximum temperature and sunshine exhibited positive correlation ( $r = 0.17$  and  $0.45$  respectively) with pod borer larval population, but statistically found to be non significant.

**Negative correlation:**

Minimum temperature, rainfall, evening relative humidity, wind speed, morning vapour pressure, evening vapour pressure, evaporation and rainy days showed negative correlation ( $r = -0.12, -0.20, -0.48, -0.01, -0.16, -0.37, -0.12$  and  $-0.26$  respectively) with pod borer larval population, but statistically found to be non significant.

**Table 1: Incidence of gram pod borer, *Helicoverpa armigera* (Hub). On pigeonpea infesting in different crop habitats at Jabalpur during 2012-2013**

SW	Month	CA (D)	CGS	Mean gram pod borer larval population per plants			
				PP+M	PP+S	PP	
						UP	P
51	Dec.'12	126	RS	0.70	0.72	0.70	0.96
52	Dec.'12	133	RS	0.78	0.86	0.90	1.08
1	Jan.'13	140	RS	0.94	0.98	1.36	0.86
2	Jan.'13	147	RS	0.70	0.72	1.52	0.84
3	Jan.'13	154	RS	0.90	0.80	0.70	0.90
4	Jan.'13	161	MS	0.84	0.68	0.70	0.78
5	Jan-Feb.'13	168	MS	0.64	0.50	0.68	0.60
<b>Mean</b>				<b>0.79</b>	<b>0.75</b>	<b>0.94</b>	<b>0.86</b>

PP+M = Pigeonpea bordered with maize

UP = Unprotected

CA (D) = Crop age in day

VS= Vegetative stage

P = Protected

CGS=Crop growth stage

RS= Reproductive stage

PP+S = Pigeonpea bordered with sorghum fodder

PP=Pigeonpea sole

SW= Standard week

MS = Maturity stage

Mean of two observations per SW 25 plant per observation

**Table 2: Correlation (r) and regression coefficient (byx) of abiotic factors on Gram pod Borer population on pigeonpea in different crop habitats during 2012-2013**

Weather factors	Gram pod borer on pigeonpea in different crop habitats							
	Pigeonpea + maize border crop		Pigeonpea + sorghum fodder border crop		Pigeonpea sole			
	R	Byx	r	byx	UP		P	
				r	byx	R	byx	
Max. temp. (°C)	-0.04 NS	-	-0.01 NS	-	-0.37 NS	-	0.17 NS	-
Min. temp. (°C)	0.30 NS	-	0.04 NS	-	-0.32 NS	-	-0.12NS	-
Sunshine (hrs)	-0.52 NS	-	-0.22 NS	-	-0.06 NS	-	0.45 NS	-
Rainfall (mm)	-0.16 NS	-	-0.08 NS	-	-0.18 NS	-	-0.20 NS	-
Morning RH (%)	0.19 NS	-	0.65 NS	-	0.34 NS	-	0.87 *	0.02
Evening RH (%)	0.63 NS	-	0.26 NS	-	0.22 NS	-	-0.48 NS	-
Wind speed (Km/hr)	0.84 *	0.13	0.49 NS	-	0.12 NS	-	-0.01 NS	-
Morning Vapour pressure (mm)	0.32 NS	-	0.04 NS	-	-0.30 NS	-	-0.16 NS	-
Evening Vapour pressure (mm)	0.36 NS	-	0.09 NS	-	-0.005 NS	-	-0.37 NS	-
Evaporation (mm)	0.11 NS	-	-0.23 NS	-	-0.29 NS	-	-0.12 NS	-
Rainy days	-0.38 NS	-	-0.32 NS	-	-0.46 NS	-	-0.26 NS	-

UP= Unprotected

P=Protected

\*\* Significant at 1 % level. NS = Non significant

\*Significant at 5 % level

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