Entomon 1990 Vol. 15 No. 1 & 2 pp. 89 to 93

ANTIBIOSIS IN CHICKPEA (*CICER ARIETINUM* L.) TO GRAM POD BORER, *HELIOTHIS ARMIGERA* (HUBNER) (NOCTUIDAE: LEPIDOPTERA) IN INDIA

C. P. SRIVASTAVA[1] & R. P. SRIVASTAVA
Department of Zoology and Agricultural Entomology, Rajasthan College of Agriculture, Udaipur, India 313 001

(*Received* 7 *March* 1989)

The antibiotic effect of the chickpea genotypes 'ICCX-730041', 'ICC-10613', 'ICC-10817', 'ICCL-79048' (less susceptible), 'C-235' (moderately susceptible) and 'K-850', 'ICC-1403' and 'ICC-3137' (more susceptible) against gram pod borer, *Heliothis armigera* (Hubner) was studied at Udaipur during 1985. The genotypes showed a wide variability in larval survival (77-90%), larval weight (333-436mg/larva), pupal weight (231-310 mg/pupa), egg viability (55-78.5%), adult longevity, 8-10 days in males and 10-12 days in females and Howe's growth index 0.079-0.099 depending upon the susceptibility. The genotypes were grouped into five clusters and the inter and intra-cluster distances were worked out.

(*Key words*: *Heliothis armigera*, chickpea, resistance, antibiosis)

INTRODUCTION

Heliothis armigera (Hübner) is a key pest and is one of the limiting factors in the successful cultivation of chickpea. The pod damage has been found to range from 0 to 84.4% (SITHANANTHAM et al., 1984). The monetary loss is estimated upto 2030 million rupees annually (LAL et al., 1985). Chickpea varieties however differ in their susceptibility to *H. armigera* due to differences in antibiosis mechanism (SINGH & SHARMA, 1970). Work on antibiosis to *H. armigera* in different crops, including chickpea has been reported by COAKER (1959), DHANDAPANI & BALASUBRAMANIAN (1980), DUBEY et al. (1981) and JAYARAJ (1982). The present investigation is a further contribution on antibiosis to pod borer in chickpea.

MATERIAL AND METHODS

The experiment was carried out at Udaipur during the post-rainy season of 1985. The genotypes used were 'ICCX–730041', 'ICC–10817', 'ICCL–79048' (less susceptible), 'C–235' (moderately susceptible) and 'K–850, 'ICC–1403', 'ICC–3137' (more susceptible) as reported by Lateef, ICRISAT (personal communication). The genotypes were grown as per recommended agronomic practices, without any pesticide application.

The experiment was conducted in a controlled chamber maintained at 26 ± 1°C and 80 ± 5% relative humidity with 12 hours photophase and 12 hours scotophase. The developmental study was conducted on 30 individual larvae grouped into three replications of 10 larvae each. The newly hatched larvae were released in separate vials (5 × 2.5 cm) containing fresh leaves of the test genotype with the help of a camel hair brush. The larvae were fed leaves for first five days, next 5 days on buds and flowers and further on pods.

Data on various growth and developmental parameters of *H. armigera* were recorded from each replication (Tables 1 and 2).

[1]Present address: Legume Entomology, ICRISAT, Patancheru, A. P., 502 324.

For larval and pupal weights, five 10-day-old larvae and five 10-day-old pupae were taken from each replication. For fecundity, two pairs of newly emerged adults, collected at random from each replicate, were confined in oviposition jars separately for each pair and each replicate. The data collected were analyzed in completely randomized design.

Mahalanobis D^2 analysis as used by RAO (1970) was applied to find out the genetic diversity in test genotypes in relation to the growth and development of *H. armigera*. Percent contribution of an individual parameter in creating diversity in developmental behaviour of *H. armigera* was calculated as under.

$$\text{Percent contribution} = \frac{N \times 100}{n\,(n-1)/2}$$

Where N = number of times a particular character ranked first.

n = number of treatments.

RESULTS AND DISCUSSION

Larval survival:

The percent larval survival on different genotypes differed significantly. It was lowest on 'ICCL-79048' (76.8%) and this exhibited a higher degree of antibiosis (Table 1).

TABLE 1. Antibiotic influence of chickpea genotypes on the larval survival, larval weight, larval period, growth index, pupal wight, pupal period and pupal survival of *Heliothis armigera*.

Genotype	Mean larval survival [%]	Mean larval weight [mg/larva]	Mean larval period [days]	*Howe's growth index	Mean pupal weight [mg/pupa]	Mean pupal period [days]	Mean pupal survival* [%]
'ICCX-730041'	83.65 (66.14)	337.3	22.1	0.087	231.0	14.6	83.65 (66.14)
'ICC-10613'	80.00 (63.43)	344.7	21.3	0.089	248.7	13.8	80.00 (63.43)
'ICC-10817'	83.65 (66.14)	333.0	23.0	0.084	249.0	14.9	83.65 (66.14)
'ICCL-79048'	76.80 (61.22)	356.0	24.0	0.079	252.7	14.7	76.80 (61.22)
'C-235'	83.65 (66.14)	382.0	21.2	0.091	260.3	13.9	83.65 (66.14)
'K-850'	90.00 (71.57)	429.3	19.9	0.098	282.7	12.6	90.00 (71.57)
'ICC-1403'	87.00 (68.86)	388.0	20.7	0.094	268.3	12.5	87.00 (68.86)
'ICC-3137'	90.00 (71.57)	436.7	19.8	0.099	310.3	12.7	90.00 (71.57)
S Em±	2.07	5.13	0.14	—	3.91	0.17	2.07
CD at 5%	6.20	15.40	0.40	—	11.70	0.50	6.20

$$\text{*Howe's growth index} = \frac{\text{Log percent larval survival}}{\text{Mean larval period in days}}.$$

Mean larvel and pupal survival percentage was calculated from the initial number of larvae released. (Figures in parentheses are arc-sin values).

Whereas it was highest on 'K–850' and 'ICC–3137' (90%), which showed that these two genotypes proved more suitable for the survival of larvae. DUBEY *et al.* (1981) have studied the antibiotic influence of various food plants on the developmental stages of *H. armigera*. They reported highest larval survival on lucerne and lowest on pea.

Larval weight:

The mean larval weight of the 10-day old larvae reared on different genotypes differed significantly. It was highest on 'ICC-3137' (436.7 mg) and lowest on 'ICC–10817' (333.0 mg). This indicates that 'ICC–10817' exhibited more antibiosis. DUBBEY *et al.* (1981) recorded significantly lower weight of the larvae fed on pea than on other plants under investigtion.

Larval period:

Table 1 shows that the average larval period on different genotypes differed significantly. It was longest (24 days) on 'ICCL–79048', which indicate more antibiosis in this genotypes. COAKER (1959) reported more antibiosis by sunflower corolla than maize silk with respect to average larval period.

Growth index:

'ICC–3137' and 'ICCL–79048' showed the highest (0.099) and lowest (0.079) Howe's growth index respectively (Table 1). This suggest that 'ICCL–79048' exhibited the highest level of antibiosis.

Pupal weight:

Data in Table 1 show that the mean pupal weight of 10 day old pupae developed on different genotypes differed significantly. It was highest on 'ICC–3137' and lowest on 'ICCX–730041' which indicate the pupae will be heavier on susceptible genotypes and lighter on resistant ones.

Pupal period:

Table 1 shows that the average pupal period on different genotypes differed significantly. It was longest on 'ICC–10817' and shortest on 'ICC–1403'. DUBEY et al. (1981) have studied the antibiotic effect of various food plants on pupal period and reported significantly shorter pupal period on lucerne and pigeonpea than on chickpea.

Pupal survival and adult emergence:

All the larvae fed on different genotypes, which survived upto prepupal stage, pupated successfully (Table 1). As there was no pupal mortality and adults emerged from all the pupa formed, the percent adult emergence was same as the percent pupal survival.

Sex ratio:

Table 2 shows that females outnumbered the males, when reared on 'ICC–3137', whereas males outnumbered the females with a slight margin on less susceptible genotypes.

Fecundity and egg viability:

The fecundity and egg viability of adults developed on different genotypes did not differ significantly.

Adult longevity:

The longevity of male and female moths developed on different genotypes did not differ significantly. However the females produced by all genotypes survived longer than males, produced from corresponding genotypes.

Mahalanobis D^2 statistics:

Growth and developmental parameters which differed significantly were chosen for this analysis. These parameters were larval survival, larval weight, average larval period, pupal weight and average pupal period. By

TABLE 2. Antibiotic influence of chickpea genotypes on adult emergence, sex ratio, facundity, egg viability and adult longevity of *Heliothis armigera*.

Genotype	Mean adult emergence* (%)	Sex ratio		No.of eggs laid/female	Viability of eggs (%)	Mean adult longevity (days)	
		Male	Female			Male	Female
'ICCX–730041'	83.65 (66.14)	1	0.8	338.3	59.7 (50.6)	8.3	10.0
'ICC–10613'	80.00 (63.43)	1	0.8	323.7	54.7 (47.7)	7.7	10.0
'ICC–10817'	83.65 (66.14)	1	0.7	344.7	63.2 (52.7)	8.0	10.7
'ICCL–79048'	76.80 (61.22)	1	0.9	303.0	58.0 (49.6)	10.0	10.7
'C–235'	83.65 (66.14)	1	0.8	383.0	62.9 (52.5)	9.0	11.0
'K–850'	90.00 (71.57)	1	0.9	379.0	66.3 (54.5)	9.3	12.3
'ICC–1403'	87.00 (68.86)	1	1.0	329.7	66.0 (54.3)	9.7	11.7
'ICC–3137'	90.00 (71.57)	1	1.1	402.3	78.5 (62.4)	10.0	12.0
S. Em±	(2.07)	—	—	25.6	(3.04)	0.66	0.77
CD at 5%	6.20	—	—	NS	NS	NS	NS

*Percent adult emergence was calculated from the initial number of larvae released.

Figures in parentheses are arc-sin values.

using D^2 statistics, all the genotypes were grouped into five clusters (Fig. 1). These clusters show the groupings of genotypes based on the response of growth and developmental parameters of *H. armigera* on them. For example cluster A, in this cluster there are two genotypes, which mean the groth and development of *H. armigera* showed a similar response towards these two genotypes. The inter cluster distance was highest between cluster B (which consist of the 'ICC–3137' and 'K–850', (the more susceptible genotypes) and cluster D (which comprised 'ICCL–79048' the less susceptible genotype). This means that the growth and development of *H. armigera* responded differently on the genotypes in cluster B than on genotype in cluster D. This intra-cluster distance was highest in cluster C and lowest in cluster A, which mean the genotypes in cluster A were more closer to each other than the genotypes in cluster C in their influence on growth and development of *H. armigera*.

The contribution of different parameters in creating diversity in feeding and development of this insect was also measured by using D^2 statistics. It was observed that larval weight contributed maximum, 50% followed by average larval period, pupal weight and average pupal period 32.1, 14.3 and 3.6% respectively.

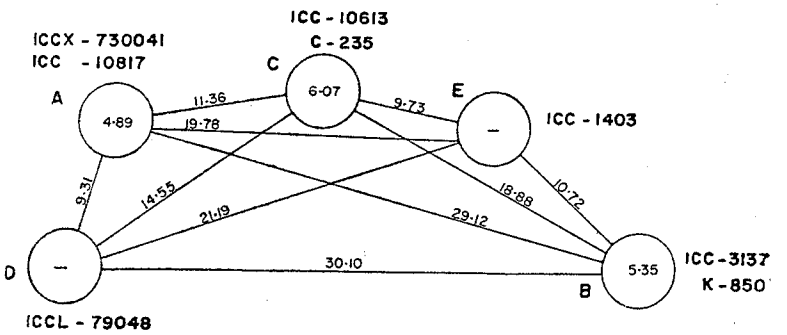

Figure 1. Intra- and inter-cluster distances among different genotypes of chickpea based on their effect on the growth and development of *Heliothis armigera*.

ACKNOWLEDGEMENTS

We wish to thank Dr. S. S. LATEEF, Entomologist, Legumes, ICRISAT for providing the seed material required in this study. The senior author is thankful to Indian Council of Agricultural Research for providing the senior fellowship during the present investigation.

REFERENCES

COAKER, T. H. (1959) Investigations on *Heliothis armigera* (Hb) in Uganda. *Bull. ent. Res.*, **50**, 487–505.

DHANDAPANI, N. & M. BALASUBRAMANIAN (1980) Effect of different food plants on the devlopment and reproduction of *Heliothis armigera* (Hbn.) *Experientia*, **36**, 930–931.

DUBEY, A. K., U. S. MISHRA & S. A. DIXIT (1981) Effect of host plants on the developmental stages of gram pod borer, *Heliothis armigera* (Hübner). *Indian J. Ent.*, **43** (2), 178–182.

JAYARAJ, S. (1982) Biological and Ecological studies of *Heliothis*, 17–28, *in*: *Proceedings of the International Workshop on Heliothsis Management*, 15–20 November 1981, ICRISAT Center, Patancheru, A.P. India.

LAL, S. S., C. P. YADAVA & C. A. R. DIAS (1985) Assessment of crop losses in chickpea caused by *Heliothis armigera*. *FAO Plant Protection Bulletin*, **33** (1), 27–35.

RAO, C. R. (1970) *Advanced Statistical Methods in Biometric Research*. Darien, Hofner Publishing Company, 378 pp.

SINGH, H. & S. S. SHARMA (1970) Relative susceptibility of some important varieties of gram to *Heliothis armigera* Hübner. *Indian J. Ent.*, **32**, 170–171.

SITHANANTHAM, S., V. R. RAO & M. A. GHAFAR (1984) International review of crop losses caused by insects on chickpea, 269–283, *in*: *Proceedings of the National Seminar on Crop Losses due to Insect Pests*, 7–9 January 1983, Hyderabad, India.