

## Incidence of bollworms in promising cultivars of cotton in Haryana

SARWAN KUMAR AND R. K. SAINI

Department of Entomology, CCS Haryana Agricultural University, Hisar-125 004

**ABSTRACT :** The response of 4 *Gossypium hirsutum* genotypes (H 1117, HS 6, H 1098 and H 1226), an *intra hirsutum* hybrid (HHH 223) and 2 *G. arboreum* genotypes (HD-123 and HD-324) to bollworms infestation was evaluated at Hisar, Haryana during the *kharif* season of 2004. Weekly observations on larval population of *Earias* spp. and *Helicoverpa armigera* in green fruiting bodies and combined bollworms incidence (including pink bollworms, *Pectinophora gossypiella*) in open bolls of cotton at harvest were made in all the genotypes mentioned above. While the population of spotted bollworms (*Earias vittella* and *E. insulana*) started building up in the month of June in *hirsutum* genotypes and peaked in end September, that of American bollworm (*Helicoverpa armigera*) started in second week of August and peaked in second week of October. *H. armigera* population showed strong negative correlation with temperature while no such correlation was visible in the case of *Earias* spp. *G. arboreum* genotypes recorded comparatively lower bollworms population than *hirsutum* ones. On the basis of per cent incidence of bollworms and number of diapausing pink bollworm larvae in open bolls, genotypes H 1226 and the hybrid HHH 223 performed better than the remaining genotypes.

**Key words :** Cotton, bollworms, incidence, genotypes

Bollworms are serious pests of cotton worldwide. In northern India, the prominent bollworms species are spotted bollworms, *Earias insulana* (Boisd) and *Earias vittella* (Fab.), pink bollworm, *Pectinophora gossypiella* (Saunders) and the American bollworm, *Helicoverpa armigera* (Hubner). Apart from environmental, nutritional and other factors, varietal characters also affect their severity on cotton crop. Therefore, in order to find out resistant cultivars, incidence of major insect pests needs to be monitored. Therefore, it becomes imperative to evaluate the field performance of different cultivars/hybrids over years to establish sound correlations between pest incidence and environmental factors. Earlier, when long duration varieties were in cultivation, the order of bollworms severity was pink bollworm, followed by spotted bollworms. However, ever since the first appearance of *H. armigera* on cotton in Haryana during 1978 (Jayaswal and Singh, 1979) and popularization of early maturing short duration varieties, the bollworms status has gradually changed. Presently, *H. armigera*, followed by spotted bollworms and pink bollworm, are serious on cotton in decreasing order of their damage. However, there are significant variations in their populations during different years depending upon the environmental and other factors. *E. insulana* population dominated *E. vittella* during dry periods (Singh and Chaudhary, 1988). Similarly, in years when *H. armigera* population on cotton is low or its build up is quite late in the season, the spotted bollworms take a heavy toll of the crop. Therefore, cotton cultivars/hybrids which were found promising in the advanced breeding trials with respect to yield and other

attributes were evaluated in the field along with already recommended varieties for their susceptibility to bollworms.

The present studies were conducted at the Research Farm of Department of Entomology, CCS Haryana Agricultural University, Hisar during June to November, 2004. Six genotypes and one hybrid evaluated against bollworms were (*hirsutum* genotypes), H 1117, HS 6, H 1098 and H 1226, HD 123 and HD 324 *Arboreum* genotypes, and the *intra hirsutum* hybrid, HHH 223. These genotypes were sown in last week of April, except HHH 223, which was sown in the first week of June, in plots of 13 x 16.5 m<sup>2</sup> each and replicated thrice. A row to row and plant to plant spacing of 67 x 30 cm was kept in the case of cultivars while it was 1m x 30 cm for the hybrid. Recommended package of practices for raising a good crop were followed, except for spraying of insecticides (Anonymous, 2004).

Observations on the incidence of spotted bollworms (SBW) (*Earias vittella* and *E. insulana*) and American bollworm (*H. armigera*) larvae were made at weekly interval starting from third week of June to third week of November, 2004. Larval counts were made from 10 randomly selected cotton plants from each replication of a genotype. Different parts of the plant were carefully examined to record the incidence and presence of larvae of *H. armigera* and *Earias* spp. on them. Squares and young bolls of cotton having entry holes or excreta were split open and examined with the help of a hand lens for the presence of bollworms larvae. The data for the three replications were pooled together and compared among different genotypes.

Incidence of bollworms in different genotypes was also recorded in open bolls at harvest. For this, all the open bolls of cotton from 10 randomly selected plants from each plot were plucked, collected in polythene bags and examined in the laboratory for bollworms damage. Population of diapausing larvae of pink bollworms was also recorded. Per cent bollworms incidence on boll as well as locule basis was worked out. The data so obtained were analyzed statistically using randomized block design (RBD) (Panse and Sukhatme, 1995).

Irrespective of genotypes, the overall trend of fluctuation in bollworms larvae population on *hirsutum* and *arboresum* genotypes and the hybrid during different standard weeks is illustrated in Fig. 1. In *hirsutum* genotypes and the hybrid, SBW started as early as in 25th week, gradually increased and reached its peak during 39th week and declined afterwards. On the other hand, *H. armigera* started in 32nd week, reached its peak during 41st week and gradually declined in subsequent weeks. On *arboresum* genotypes, the overall population level of bollworms remained lower than that on *hirsutum* ones.

Data on comparison of different genotypes with respect to bollworms infestation are presented in Table 1. SBW population on different genotypes/hybrid remained quite low (0-4 larvae/30 plants) upto 31st

standard week. It gradually picked up with the advancement of crop season and reached its peak during 38th and 39th week (i. e. second fortnight of September). Afterwards, the population declined and ranged between 3 and 6 larvae/30 plants on different *hirsutum* genotypes/hybrid during 45th to 47th week. Nevertheless, the population remained quite high (6-35 larvae/30 plants) during 35th to 42nd week (i. e. end of August to third week of October). It corresponded with the mean temperature ranging between 27 and 30°C and mean relative humidity (R. H.) between 59 and 71 per cent. Chaudhari *et al.* (1999) inferred that peak activity of different bollworms in pheromone traps was maximum at temperature ranging from 20 to 30°C and R. H. from 50 to 65 per cent. Dhawan and Simwat (1966) reported peak activity of SBW during mid October under Punjab conditions. Among *hirsutum* genotypes, H 1226 recorded the minimum SBW population, followed by H 1098. Apart from this, the build-up of population on H 1226, HHH 223 and H 1098 also started late (i. e. during 30th to 32nd week) as compared to early build up (i. e. during 25th to 26th week) in H 1117 and HS 6. However, on HHH 223 though initial build up of population was slow yet it supported greater SBW population than the other genotypes during the later part of the season (i. e. 41st to 43rd week). The two *arboresum* genotypes were almost

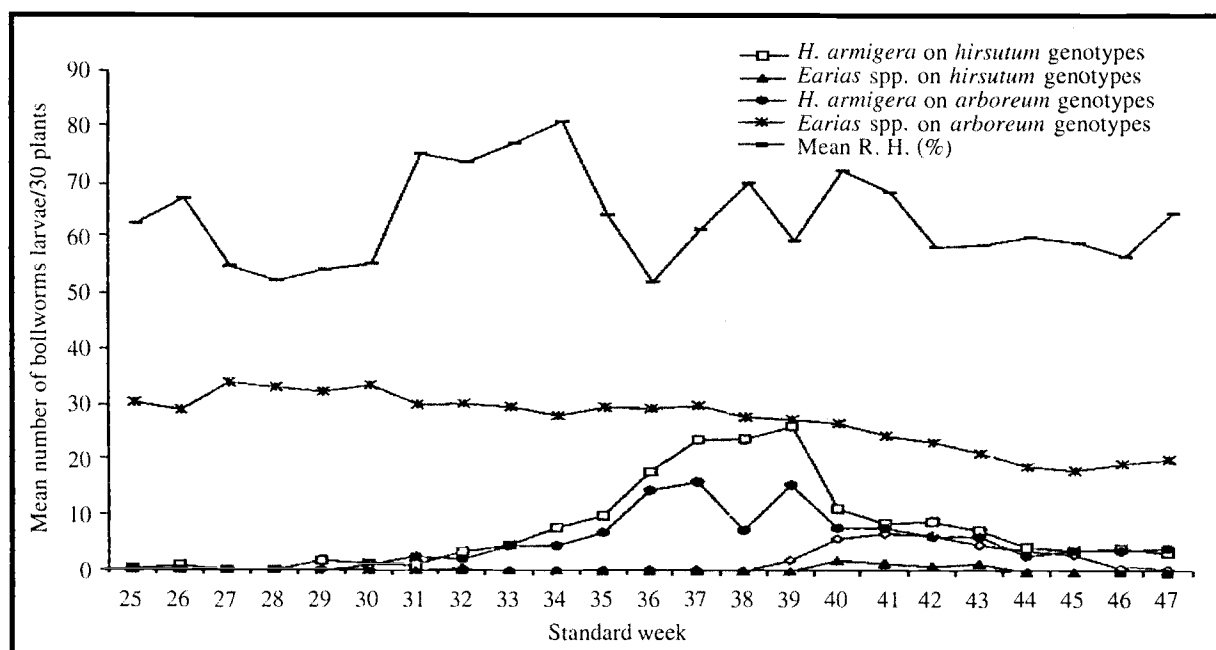


Fig. 1. Comparative larval population of bollworms on green fruiting bodies of *hirsutum* and *arboresum* genotypes

equally tolerant to the SBW attack. Nath and Sharma (2003) have reported that *hirsutum* genotype HS 6 was more susceptible to bollworms in comparison to *arboreum* ones.

In general, there was a low population build up of *H. armigera* during the 2004 crop season. Though a few larvae (0-3/30 plants) could be seen on *hirsutum* genotypes/hybrid during August and September, when the mean temperature fluctuated between 28 and 36°C and R. H. above 70 per cent, yet the population showed an increasing trend only after the 39th week. This corresponded with the mean temperature declining below 28°C and mean R. H. around 70 per cent. The population remained between 3 and 10 larvae/30 plants during October. It declined during November and ranged from 0-6 larvae/30 plants. *H. armigera* larvae population on different genotypes showed significant correlation with the mean temperature ( $r=-0.42$  to  $-0.70$ ). However, no

correlation of the pest's population with R. H. was observed both in *hirsutum* as well as *arboreum* genotypes. Under Tamil Nadu conditions, Ganesaraja *et al.* (2000) also reported negative correlation of *H. armigera* population on cotton with the temperature but positive correlation with relative humidity. On the other hand, Chaudhary *et al.* (1999) concluded that bollworms activity was negatively influenced by minimum temperature, relative humidity, rainfall, wind speed and vapour pressure. In the present studies, *Earias* spp. population showed no correlation with either temperature or relative humidity.

In *arboreum* genotypes, no larval population of *H. armigera* was found on HD 123 while only a few larvae were observed on HD 324 during October. Singh *et al.* (1992) also reported poor survival of *H. armigera* on *arboreum* cotton variety LD 327 as compared to *hirsutum* varieties. Earlier, Singh (1988) had also reported

Table 1. Bollworms population on different cotton genotypes and a hybrid during 2004

| Standard week | Month     | Number of bollworms larvae/30 plants on different genotypes |           |              |           |              |           |              |           |              |           |              |           |              |           | Pooled mean no. of larvae/ 30 plants | Mean Temp. (°C) | Mean R. H. (%) |      |
|---------------|-----------|-------------------------------------------------------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|--------------------------------------|-----------------|----------------|------|
|               |           | H 1117                                                      |           | HS 6         |           | H 1098       |           | H 1226       |           | HHH 223      |           | HD 123       |           | HD 324       |           |                                      |                 |                |      |
|               |           | <i>H. a.</i>                                                | <i>E.</i> | <i>H. a.</i> | <i>E.</i> | <i>H. a.</i> | <i>E.</i> | <i>H. a.</i> | <i>E.</i> | <i>H. a.</i> | <i>E.</i> | <i>H. a.</i> | <i>E.</i> | <i>H. a.</i> | <i>E.</i> |                                      |                 |                |      |
| 25            | June      | 0                                                           | 1         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0.00                                 | 0.14            | 30.4           | 62.5 |
| 26            |           | 0                                                           | 1         | 0            | 2         | 0            | 1         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0.00                                 | 0.57            | 29.1           | 67.0 |
| 27            | July      | 0                                                           | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0.00                                 | 0.00            | 34.0           | 55.0 |
| 28            |           | 0                                                           | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0.00                                 | 0.00            | 33.2           | 52.5 |
| 29            |           | 0                                                           | 4         | 0            | 5         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0            | 0         | 0.00                                 | 1.28            | 32.4           | 54.5 |
| 30            |           | 0                                                           | 3         | 0            | 2         | 0            | 0         | 0            | 1         | 0            | 0         | 0            | 1         | 0            | 1         | 0.00                                 | 1.14            | 33.6           | 55.5 |
| 31            | August    | 0                                                           | 3         | 0            | 1         | 0            | 0         | 0            | 1         | 0            | 0         | 0            | 3         | 0            | 2         | 0.00                                 | 1.42            | 30.2           | 75.5 |
| 32            |           | 2                                                           | 7         | 0            | 2         | 0            | 3         | 0            | 0         | 0            | 5         | 0            | 0         | 0            | 4         | 0.28                                 | 3.00            | 30.3           | 74.0 |
| 33            |           | 0                                                           | 7         | 0            | 6         | 0            | 5         | 0            | 0         | 0            | 5         | 0            | 4         | 0            | 5         | 0.00                                 | 4.57            | 29.8           | 77.5 |
| 34            |           | 0                                                           | 9         | 0            | 8         | 0            | 8         | 0            | 4         | 0            | 10        | 0            | 5         | 0            | 4         | 0.00                                 | 89.28           | 28.1           | 81.5 |
| 35            |           | 0                                                           | 16        | 0            | 12        | 0            | 7         | 0            | 7         | 0            | 8         | 0            | 6         | 0            | 8         | 0.00                                 | 9.14            | 29.8           | 64.5 |
| 36            | September | 0                                                           | 14        | 0            | 13        | 0            | 20        | 1            | 20        | 0            | 22        | 0            | 10        | 0            | 19        | 0.14                                 | 16.85           | 29.5           | 52.5 |
| 37            |           | 1                                                           | 24        | 0            | 35        | 0            | 20        | 0            | 20        | 0            | 20        | 0            | 14        | 0            | 18        | 0.14                                 | 21.57           | 30.1           | 62.0 |
| 38            |           | 0                                                           | 24        | 0            | 24        | 0            | 17        | 0            | 27        | 0            | 28        | 0            | 7         | 0            | 8         | 0.00                                 | 19.25           | 28.1           | 70.5 |
| 39            |           | 1                                                           | 31        | 1            | 29        | 2            | 29        | 3            | 18        | 3            | 25        | 0            | 16        | 0            | 15        | 1.42                                 | 23.28           | 27.7           | 60.0 |
| 40            | October   | 6                                                           | 14        | 4            | 12        | 8            | 10        | 7            | 9         | 5            | 12        | 0            | 9         | 4            | 7         | 4.85                                 | 10.42           | 27.0           | 73.0 |
| 41            |           | 5                                                           | 8         | 5            | 5         | 8            | 9         | 9            | 5         | 8            | 17        | 0            | 8         | 3            | 78        | 5.42                                 | 8.57            | 24.7           | 69.0 |
| 42            |           | 10                                                          | 9         | 7            | 8         | 4            | 11        | 6            | 6         | 6            | 12        | 0            | 8         | 2            | 5         | 5.00                                 | 8.42            | 23.5           | 59.0 |
| 43            |           | 5                                                           | 7         | 5            | 6         | 3            | 9         | 8            | 5         | 4            | 11        | 0            | 10        | 3            | 3         | 4.00                                 | 7.28            | 21.5           | 59.5 |
| 44            |           | 3                                                           | 4         | 4            | 6         | 4            | 6         | 4            | 3         | 5            | 4         | 0            | 4         | 0            | 2         | 2.85                                 | 4.14            | 19.0           | 61.0 |
| 45            | November  | 4                                                           | 4         | 3            | 4         | 2            | 4         | 4            | 4         | 3            | 4         | 0            | 5         | 0            | 3         | 2.28                                 | 4.00            | 18.3           | 60.0 |
| 46            |           | 1                                                           | 5         | 0            | 5         | 0            | 5         | 0            | 4         | 3            | 3         | 0            | 5         | 0            | 3         | 0.57                                 | 4.28            | 19.6           | 57.5 |
| 47            |           | 0                                                           | 3         | 0            | 4         | 0            | 4         | 0            | 3         | 3            | 4         | 0            | 6         | 0            | 3         | 0.42                                 | 3.85            | 20.4           | 65.5 |
| Total         |           | 38                                                          | 198       | 29           | 189       | 31           | 168       | 42           | 137       | 40           | 190       | 0            | 121       | 12           | 118       | 27.43                                | 16.0            | 14             |      |
| (r)           | Temp :    | -0.51                                                       | 0.02      | -0.57        | 0.01      | -0.42        | -0.14     | -0.52        | -0.04     | -0.70        | -0.11     | 0.00         | -0.34     | -0.28        | 0.01      | -0.55                                | -0.07           |                |      |
|               | R. H. :   | -0.01                                                       | 0.12      | -0.05        | 0.03      | 0.12         | -0.02     | -0.01        | -0.05     | 0.03         | 0.09      | 0.00         | 0.00      | 0.13         | -0.02     | 0.02                                 | 0.03            |                |      |

H. a. : *Helicoverpa armigera*, E : *Earias vittella* and E., *insulana*, R. H. Relative Humidity.

*arboreum* genotypes to be resistant to bollworms attack due to their inherent genetic characters and biochemical composition.

Combined incidence of bollworms in open bolls in different genotypes/hybrid ranged from 38.58 to 62.60 per cent on boll basis and 19.58 to 32.33 per cent on locule basis (Table 2). Among *hirsutum* genotypes/hybrid, minimum bollworms incidence on locule basis was recorded in H 1226 (19.58%), followed by HHH 223 (20.16%), H 1098 (25.67%), HS 6 (32.16%) and H 1117 (32.33%) in increasing order. Between the *arboreum* genotypes, HD 123 recorded lower incidence (21.74%) than HD 324 (25.72%).

Comparison of incidence on boll basis among different genotypes revealed that HHH 223, H 1226, HD 123 and HD 324 recorded significantly lower incidence of bollworms than HS 6 and H 1117, while on locule basis, H 1226, HHH 223, HD 123, H 1098 and H 324 recorded significantly lower incidence than H 1117 and HS 6. When population of diapausing pink bollworm larvae in open bolls was compared, it was found that H 1226 and HD 123 recorded significantly lesser number of larvae than H 1098, HHH 223 and HD 324 but were on a par with H 1117 and HS 6.

**Table 2. Bollworms incidence in open bolls of cotton at harvest**

| Variety/<br>hybrid      | Bollworms incidence (%) |                 | Pink bollworm<br>larvae/<br>100<br>bolls |
|-------------------------|-------------------------|-----------------|------------------------------------------|
|                         | Boll<br>basis           | Locule<br>basis |                                          |
| H 1117                  | 62.50 (52.24)           | 32.33 (34.63)   | 8.98 (17.36)                             |
| HS 6                    | 62.60 (52.30)           | 32.16 (34.51)   | 12.21 (20.44)                            |
| H 1098                  | 53.05 (46.72)           | 25.67 (30.40)   | 27.65 (31.69)                            |
| H 1226                  | 41.23 (39.93)           | 19.58 (26.21)   | 6.16 (14.30)                             |
| HHH 223                 | 38.58 (38.35)           | 20.16 (26.64)   | 22.04 (27.97)                            |
| HD 123                  | 41.60 (40.16)           | 21.74 (27.76)   | 7.97 (16.32)                             |
| HD 324                  | 46.72 (43.11)           | 25.72 (30.46)   | 30.60 (33.58)                            |
| C. D. ( $P \leq 0.05$ ) | (10.80)                 | (7.66)          | (12.37)                                  |

Figures in parenthesis are *arc sin* transformed values.

Thus, taking into consideration the overall performance of genotypes against different bollworms, it was concluded that H 1226 and HHH 223 were the best genotypes among *hirsutum* and HD 123 in *arboreum* genotypes.

## REFERENCES

- Anonymous, 2004. *Package of practices for kharif crops*. CCS Haryana Agricultural University, Hisar.
- Chaudhari, G. B., Bharpoda, T. M., Patel, J. J., Patel, K. I. and Patel, J. R. 1999. Effect of weather on activity of cotton bollworms in middle Gujarat. *J. Agromet.* **1** (2) : 137-42.
- Dhawan, A. K. and Simwat, G. S. 1996. Monitoring the seasonal abundance of cotton bollworms with pheromone traps. *Indian J. Ecol.* **23** (2) : 123-29.
- Ganesaraja, V., Gurusamy, A. and Raveendran, M. 2000. Spatial dynamics of bollworms (*Helicoverpa armigera*) in cotton. *J. Phytol. Res.* **13** (1) : 83-84.
- Jayaswal, A. P. and Singh, Z. 1979. *Heliothis armigera*- a new pest of cotton in Haryana. *Haryan Fmg.* **8** (4) : 17.
- Nath, P. and Sharma, P. D. 2003. Studies on incidence of bollworms on cotton (*Gossypium arboreum*) in South Western Haryana. *J. Cotton Res. Dev.* **17** (2) : 186-90.
- Panase, V. G. and Sukhatme, P. V. 1995. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.
- Singh, J., Sandhu, S. S. and Sidhu, A. S. 1992. Biology of *Helicoverpa armigera* (Hub.) on commonly cultivated cultivars of cotton in Punjab. *J. Insect. Sci.* **5** (1) : 91-92.
- Singh, M. 1988. Bollworms resistance in *G. arboreum* cotton. *Indian J. Ent.* **50** (3) : 350-56.
- Singh, R. and Chaudhary, J. P. 1988. *Incidence and relative abundance of Earias spp. on host plants in Hisar, Haryana*. Proceeding National Symposium "Integrated Pest Control-Progress and Perspective", October 15-17, 1987, Trivandrum, 123-28.

Received for publication : March 3, 2005.