

## Determination of Economic Threshold for Cotton Bollworms (*Earias* spp. and *Heliothis armigera* Hb.) on Hybrid-4 Cotton

N. B. Rote, B. K. Patel, N. P. Mehta and A. H. Shah

Main Cotton Research Station, GAU, Surat

### ABSTRACT

An experiment to find out economic threshold levels based on larval units, was conducted during the years 1978-79, 1979-80 and 1980-81 at Main Cotton Research Station, Surat. Four different threshold levels viz. 5, 10, 15 and 20 larval units for spotted bollworms (*Earias* spp.) and 3, 7, 12 and 15 larval units for American bollworms (*Heliothis armigera* Hb.), were tested in comparison to recommended schedule for hybrid-4 cotton. From the results it was found that the threshold level of 10 larval units was found most ideal and economical for spotted bollworms on hybrid-4 cotton.

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### INTRODUCTION

Spotted bollworm (*Earias* spp.) and American bollworm (*Heliothis armigera* Hb.) are the major pests of cotton. Indiscriminate use of pesticides for their control causes several side problems. Eradication of insect-pests is practically impossible and hence proper approach is of "Integrated Pest Management". The temporal Schedule based plant protection measures have certain built in inadequacies. During the season of heavy infestation they are inadequate, whereas, during the season of light infestation they are wasteful. Therefore, it becomes necessary to apply proper pesticide when the level of pest reaches "economic threshold". The purpose of pest control according to economic threshold level is to pin-point the timing of control measures in order to obtain optimal results based on need based plant protection. Therefore, it becomes vital to determine the eco-

nomic threshold levels for bollworms. Economic threshold concept is flexible and the levels may vary from area to area, variety to variety and even time to time (Reynolds, 1972). Mahalle *et al.* (1976) reported that economic injury increases as the cost of control increases and decreases as the price of output increases. In U.S.A. Stern (1965) has worked out the economic threshold of four larvae per plant for bollworm, *Heliothis zea* on cotton. In India attempts were made in past to work out threshold values based on injury caused but so far sound dependable indices are not available. The present approach is based on population density of pest i.e. larval units, reported by Shah and Mehta (1979) and results of the trial conducted in this connection are reported below.

### MATERIALS AND METHODS

The trial was conducted at Main Cotton Research Station, Gujarat Agri-

cultural University, Surat during the years 1978-79, 79-80 and 80-81 in Randomized Block Design with four replications. Four different threshold levels for bollworms were compared with time bound plant protection schedule for hybrid-4 cotton (Appendix "A"). During the year 1978-79 the treatments were as below:

| Treat No. | Threshold levels for spotted bollworms in larval Units (LU) |   | Threshold levels for <i>heliiothis</i> in larval Units (LU) |
|-----------|-------------------------------------------------------------|---|-------------------------------------------------------------|
| 1.        | 5 (LU)                                                      | & | 3 (LU)                                                      |
| 2.        | 10 (LU)                                                     | & | 7 (LU)                                                      |
| 3.        | 15 (LU)                                                     | & | 12 (LU)                                                     |
| 4.        | 20 (LU)                                                     | & | 15 (LU)                                                     |
| 5.        | Schedule for hybrid-4 cotton. (Appendix "A")                |   |                                                             |

#### APPENDIX A

#### Recommended schedule for Hybrid-4 cotton.

| Sr. No. | Period            | Name of insecticides and concentrations                              |
|---------|-------------------|----------------------------------------------------------------------|
| 1.      | August II week    | Phosphamidon 0.03% + Streptoclyline 0.005% + Copper oxychloride 0.2% |
| 2.      | September II week | Endosulfan 0.075%                                                    |
| 3.      | September IV week | Carbaryl 0.2%                                                        |
| 4.      | October II week   | Phosalone 0.087%                                                     |
| 5.      | October III week  | Endosulfan 0.075% + DDT 0.2% + Copper oxychloride 0.2%               |
| 6.      | October IV week   | Carbaryl 10% dust                                                    |
| 7.      | November II week  | Endosulfan 0.075% + DDT 0.2%                                         |
| 8.      | November IV week  | Phosalone 0.087% + Stretptoclyline 0.005% + Copper oxychloride 0.2%  |
| 9.      | December II week  | Endosulfan 0.075%                                                    |
| 10.     | December IV week  | Phosalone 0.087%                                                     |
| 11.     | January II week   | Carbaryl 10% dust                                                    |
| 12.     | January IV week   | Endosulfan 4% dust                                                   |

The above threshold levels were based on the 20 plants randomly selected from four replications (5 plants x 4 replications). The plot size was 64.80 sq.m. and spacing was 1.20 x 0.60 m. The observations were recorded twice in a week (Monday and Thursday) from 5 plants randomly selected from each net plot. Total number of spotted and *Heliothis* larvae were counted from whole plant and recorded separately as small, medium and big according to their sizes. The treatment-wise larval units (on the basis of 20 plants) were worked out and as soon as larval units reached equal or above threshold level of the respective treatment the insecticides were applied to control the particular pest. Carbaryl 10% dust and DDT 10% dust were used for the control of spotted bollworm and *Heliothis* respectively. In all 24, 14, 13 and 9 applications were made throughout the season in the treatments 1, 2, 3 and 4 respectively.

#### Calculation of Larval Units (LU)

##### I. Spotted bollworm

1. Small larvae—having the length upto 4 mm. = 1 LU
2. Medium larvae—having the length of 4 to 8 mm. =  $\frac{1}{2}$  LU
3. Bigger larvae—having the length more than 8 mm. = 0 LU

##### II. *Heliothis* sp.

1. Small larvae upto 4 mm. length = 0 LU
2. Medium larvae from 4 to 12 mm. length = 1 LU
3. Bigger larvae more than 12 mm. length = 2 LU

The above larval units were fixed on *ad-hoc* basis considering the long experience in pest control and the experimental results.

### Combined effects of two bollworms

When both the bollworms were damaging at a time but their individual threshold level could not surpass the threshold levels, the combined effect was worked out. For working out the combined effects, the respective threshold levels were considered equal to 100 per cent for each bollworm and the observed population was converted into the percentages, and as soon as the sum of percentages of the two bollworms reached above 100% the measures were taken to control both the bollworms.

As the infestation of *Heliothis* was not severe during 1978-79, the experiment was repeated for spotted bollworm alone during the years 1979-80 and 1980-81. Monocrotophos @ 0.8 kg. ai/ha. was used for the control of spotted bollworm, whereas, DDT 0.2% was used as a blanket spray, for the control of *Heliothis* whenever necessary.

The observations on bollworm infestation were recorded at each picking on bolls and locules. The data were subjected to Arcsin percentage wherever required before statistical analysis.

## RESULTS AND DISCUSSION

### 1. Bollworm infestation during the year 1978-79

The data are presented in Table-1. It is evident from the results that the lowest bollworm infestation to bolls was recorded in Treatment-1 (5 LU for spotted and 3 LU for *Heliothis*) and it was at par with treatment-2 (10 LU for spotted and 7 LU for *Heliothis*). The other treatments have recorded comparative higher infestation.

Treatment-1 (5 LU and 3 LU) has also recorded significantly lower bollworm infestation to locules and it was followed by Treatment-2 (10 LU for spotted and 7 LU for *Heliothis*). Other treatments have recorded higher bollworm infestation.

### 2. Bollworm infestation during the year 1979-80 and 1980-81

The data are presented in Table-2. From the results of the pooled data of the two years it is revealed that the lowest threshold i.e. 5 larval units for spotted bollworm, has recorded the lowest bollworm infestation to bolls (15.8%) and it was at par with treatment of 10 larval units (18.0%). Other treatments have recorded higher infestation.

From the same Table-1 it is also seen that more or less the same trend was observed in case of bollworm infestation to locules.

### 3. Yield of seed cotton

The yield data are also presented in Table-1 and 2. During the year 1978-79, Treatment-1 (5 LU for spotted and 3 LU for *Heliothis*) has recorded significantly higher yield (2224 kg/ha). It was followed by Treatment-2 (10 LU for spotted and 7 LU for *Heliothis*) i.e. 1803 kg/ha. which was at par with Treatment-3 (1712 kg/ha). Treatment-4 has recorded significantly lower yield.

During the year 1979-80, the highest yield was obtained in the treatment of 5 larval units for spotted bollworm (3068 kg/ha) and it was followed by the treatments of 10 larval units (2860 kg/ha),

15 larval units, schedule for hybrid-4 and 20 larval units.

During the year 1980-81 also highest yield was obtained in the treatment of 5 larval units (1653 kg/ha) and the other treatments

have recorded the same trend as previous year.

From the pooled data it is revealed that the lowest threshold level i.e. 5 larval units has recorded highest yield (2359 kg/ha) and it

TABLE 1

Percentage infestation of bollworms and yield of seed cotton during the year 1978-79.

| Sr. No. | Treatments                                | Av. % infestation to |              | Yield of seed cotton kg/ha. |
|---------|-------------------------------------------|----------------------|--------------|-----------------------------|
|         |                                           | bolls                | Locules      |                             |
| 1.      | 5 LU for spotted and 3 LU for Heliothis   | 46.2 (42.82)         | 27.1 (31.38) | 2224                        |
| 2.      | 10 LU for spotted and 7 LU for heliothis  | 50.2 (45.17)         | 33.8 (35.53) | 1803                        |
| 3.      | 15 LU for spotted and 12 LU for heliothis | 58.0 (49.60)         | 37.2 (37.59) | 1712                        |
| 4.      | 20 LU for spotted and 15 LU for heliothis | 68.8 (56.03)         | 42.9 (40.90) | 1090                        |
| 5.      | Recommended schedule for hybrid-4         | 61.6 (51.72)         | 40.4 (39.45) | 1451                        |
|         | S.E.                                      | 1.12                 | 1.30         | 108                         |
|         | C.D. @ 5%                                 | 3.45                 | 4.00         | 336                         |
|         | C.V. %                                    | 4.61                 | 7.00         | 18.28                       |

Note: Figures in parenthesis are angular transformed values.

TABLE 2

Percentage infestation and yield of seed cotton during the years 1979-80 and 1980-81.

| Sr. No. | Treatments                        | Av. % infestation to bolls |                 |                 | Av. % infestation to locules |                 |                 | Yield of seed cotton (kg/ha) |         |             |
|---------|-----------------------------------|----------------------------|-----------------|-----------------|------------------------------|-----------------|-----------------|------------------------------|---------|-------------|
|         |                                   |                            |                 |                 |                              |                 |                 |                              |         |             |
|         |                                   | 1979-80                    | 1980-81         | Pooled Mean     | 1979-80                      | 1980-81         | Pooled Mean     | 1979-80                      | 1980-81 | Pooled Mean |
| 1.      | 5 LU for spotted bollworm         | 17.6<br>(24.82)            | 14.0<br>(22.01) | 15.8<br>(23.41) | 10.8<br>(18.84)              | 6.8<br>(15.13)  | 8.5<br>(16.98)  | 3068                         | 1653    | 2359        |
| 2.      | 10 LU „ „                         | 22.0<br>(22.99)            | 14.3<br>(22.27) | 18.0<br>(25.13) | 13.1<br>(21.22)              | 7.9<br>(16.30)  | 10.3<br>(18.76) | 2860                         | 1623    | 2241        |
| 3.      | 15 LU „ „                         | 27.4<br>(31.57)            | 34.4<br>(35.92) | 30.1<br>(33.29) | 17.5<br>(24.75)              | 17.9<br>(25.01) | 17.7<br>(24.88) | 2554                         | 1466    | 2010        |
| 4.      | 20 LU „ „                         | 33.8<br>(35.58)            | 59.6<br>(50.53) | 46.6<br>(43.05) | 21.1<br>(27.33)              | 34.4<br>(34.90) | 27.5<br>(31.61) | 2075                         | 123     | 1099        |
| 5.      | Recommended schedule for Hybrid-4 | 33.0<br>(35.05)            | 33.8<br>(35.54) | 33.4<br>(35.29) | 17.6<br>(24.79)              | 16.2<br>(23.73) | 16.9<br>(24.25) | 2477                         | 1309    | 1893        |
|         | S-E                               | 2.37                       | 5.59            | 3.14            | 1.92                         | 2.59            | 3.75            | 59                           | 242     | 136         |
|         | C.D. @ 5%                         | 5.15                       | 12.18           | 6.50            | 4.19                         | 5.64            | 7.73            | 129                          | 525     | 280         |
|         | C.V. %                            | 12.09                      | 23.92           | 19.66           | 11.70                        | 15.78           | 32.17           | 7.95                         | 27.63   | 14.78       |

Note: Figures in parenthesis are angular transformed values.

TABLE 3

Economics of the treatments during the year 1978-79.

| Sr. No. | Treatments                                       | Yield (kg/ha) | Gross income Rs/ha | Cost of treatment Rs/ha | Net realisation Rs/ha | No. of applications |
|---------|--------------------------------------------------|---------------|--------------------|-------------------------|-----------------------|---------------------|
| 1.      | 5 LU for spotted and 3 LU for <i>Heliothis</i>   | 2224          | 13121              | 6746                    | 6375                  | 24                  |
| 2.      | 10 LU for spotted and 7 LU for <i>heliothis</i>  | 1803          | 10637              | 3839                    | 6798                  | 14                  |
| 3.      | 15 LU for spotted and 12 LU for <i>heliothis</i> | 1712          | 10100              | 3450                    | 6650                  | 13                  |
| 4.      | 20 LU for spotted and 15 LU for <i>heliothis</i> | 1090          | 6431               | 2432                    | 3999                  | 9                   |
| 5.      | Recommended schedule for hybrid-4                | 1451          | 8560               | 2101                    | 6459                  | 12                  |

TABLE 4

Economics of the treatments during the years 1979-80 and 1980-81.

| Sr. No. | Treatments                        | Av. yield of seed cotton kg/ha | Gross income Rs/ha | Av. cost of treatment Rs/ha | Net realisation Rs/ha | No. of spraying 1979-80 | 1980-81 |
|---------|-----------------------------------|--------------------------------|--------------------|-----------------------------|-----------------------|-------------------------|---------|
| 1.      | 5 LU for spotted bollworm         | 2359                           | 13042              | 4177                        | 8865                  | 12                      | 11      |
| 2.      | 10 LU " "                         | 2241                           | 12424              | 3499                        | 8925                  | 9                       | 10      |
| 3.      | 15 LU " "                         | 2010                           | 11149              | 2806                        | 8343                  | 7                       | 8       |
| 4.      | 20 LU " "                         | 1099                           | 5587               | 1580                        | 4007                  | 6                       | 2       |
| 5.      | Recommended schedule for Hybrid-4 | 1893                           | 10446              | 2706                        | 7740                  | 12                      | 12      |

was at par with 10 larval units (2241 kg/ha). It was followed by 15 larval units, schedule for hybrid-4 and 20 larval units.

#### 4. Economics

The data on economics during the year 1978-79, are presented in Table-3. From this it can be observed that highest net realisation (6798 Rs/ha) was obtained in the treatment-2 (10 LU for spotted and 7 LU for *Heliothis*) and it was followed by treatment-1 (5 LU for

spotted and 3 LU for *Heliothis*), treatment-3 and treatment -4.

The data of economics during the years 1979-80 and 1980-81 are presented in Table-4. It is seen from the results that treatment of 10 larval units for spotted bollworm gave highest net realisation (8925 Rs/ha). Though treatment of 5 larval units has recorded highest yield, it has failed to record higher net realisation because of higher incremental cost of the treatment.

During the year 1978-79 four threshold levels for spotted bollworms and *Heliothis* as (1) 5 larval units for spotted and 3 larval units for *Heliothis* (2) 10 LU and 7 LU (3) 15 LU and 12 LU, (4) 20 LU and 15 LU were compared with schedule treatment. During that season the threshold levels of 10 larval units for spotted bollworm and 7 larval units for *Heliothis* were found most effective and economical.

During the years 1979-80 and 1980-81, the experiment was carried out only for spotted bollworms and the same threshold levels viz. 5 LU, 10 LU, 15 LU and 20 LU were tested with schedule for hybrid-4 cotton.

From the results of the two years data it was found that the threshold level of 10 larval units was found most ideal and economical for spotted bollworm on hybrid-4 cotton. Maisuria et al. (1982) have also reported that the 10 larval units were found as most economical threshold level for spotted bollworm on G. Cot. 11 cotton.

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