

Control action thresholds for bollworm management in Uganda

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Abstract The bollworms *Helicoverpa armigera* (Hb) and *Earias* spp are of major economic importance on cotton in Uganda. Development of insecticide action thresholds to justify the need for control are urgently needed to reduce yield losses, insecticide costs, and number of insecticide applications. Results from the 1994/95 and 1995/96 studies at two locations in Uganda, Namulonge and Serere indicate that 5 - 7 larvae/100 plants is the appropriate threshold for maintaining high yields of cotton. If this threshold is followed, fewer insecticide sprays than the current recommendation are needed.

Keywords: Bollworms, control action threshold, cotton

Résumé The bollworms *Helicoverpa armigera* (Hb) and *Earias* spp are of major economic importance on cotton in Uganda. Development of insecticide action thresholds to justify the need for control are urgently needed to reduce yield losses, insecticide costs, and number of insecticide applications. Results from the 1994/95 and 1995/96 studies at two locations in Uganda, Namulonge and Serere indicate that 5 - 7 larvae/100 plants is the appropriate threshold for maintaining high yields of cotton. If this threshold is followed, fewer insecticide sprays than the current recommendation are needed.

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Introduction

Forecasting and early warning systems for cotton pests are lacking in Uganda. The application of insecticides only when economically justified would lead to better pest management in addition to lowering the cost of pest control at the farmer level. In Uganda, where cotton is cultivated largely by smallholder farmers at subsistence level, the development of control action thresholds is considered of primary importance.

Among the key pests of cotton in Uganda, *Lygus*, *Taylorilygus vossereli* Pop and the bollworms *H. armigera* and *Earias* spp are considered most important. Control action thresholds have recently been developed for lygus (Sekamatte and Heneidy, 1996) but not for the bollworms. The incidence and economic importance of these bollworm species in Uganda

is discussed elsewhere (Bell and Gilham, 1992, Pearson, 1958). Hearn and Room (1979) discussed the basic considerations in developing thresholds for these bollworms and outlined the salient merits and demerits of thresholds based on pest density as opposed to thresholds based on damage. Elsewhere, problems have been encountered in establishing vivid economic injury levels (ETLs) for these bollworms as the level of damage to cotton bolls is not related to the number of these two pests in any dependable manner (Ring *et al.*, 1992). The damage caused by these pests may not be proportional to their numbers as the number of fruiting bodies attacked by any one bollworm may range from one to several (Keerthinsighe, 1982). As a result, any injury level associated with a pest threshold is subject to great variability to be of practical value.

Insecticides are important components of

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Integrated Pest Management (IPM) systems for bollworm management. Studies conducted in Uganda between 1989 and 1993 showed that the mixture of cypermethrin and dicofol (Sherpa DL), alphacypermethrin + azodrin (Azofas) effectively reduced numbers of *H. armigera* and *Earias* sp. larvae in cotton (Anon, 1991, 1993). The present study, sought to avoid complications of ETL development by resorting to simple, practical control action thresholds as an initial attempt to help farmers use insecticides economically.

Materials and methods

Commercial cotton varieties, BPA 89 and SATU 85 seed were planted at Namulonge and Serere, Uganda, respectively, during the cotton seasons 1994/5 and 1995/6. The experimental designs were Randomised complete blocks with 3 replications. Cotton plants were spaced at 60 x 30cm between and within rows in plots measuring 15 x 20 at Namulonge and 25 x 30 at Serere.

Treatments were 3 spray initiation thresholds; Low threshold (LT), Medium threshold (MT) and Upper threshold (UT). Plots assigned to the three respective test thresholds began receiving insecticide application at infestation levels of 3, 5 and 7 bollworm larvae per 90 plants as determined by whole plant examination.

A single un-sprayed plot located > 50 m away served as control for yield comparisons. The insecticides Sherpa DL and Decis were applied in both experiments using a micron sprayer, Ulva+ and sometimes using the hand operated knapsack.

Sampling for larvae was done visually (Garcia *et al.*, 1982). Weekly scouting to assess numbers of fruiting bodies (squares and bolls) were made on a random sample of 30 plants (spaced 5 m apart) in each plot. The squares were sampled from the 7th week after germination (WAG) and boll sampling commenced 12 WAG and continued up to the start of boll opening, the periods considered important for the two fruiting bodies (Heneidy *et al.*, 1996). A record was kept of damaged and undamaged fruiting bodies.

Samples of 50 cotton bolls from each plot were picked, dissected in the laboratory at two weekly intervals to determine the rates of damage by the bollworms. Yields of seed cotton were estimated

by picking fully open cotton bolls from whole plots. Data were analysed using Mstat-C computer program (1988).

Results and discussion

The incidence of bollworm larvae in the two experimental sites is shown in Figures 1a and 1b. At Namulonge, bollworm infestation through the squaring period (7 - 10 weeks after germination) remained lower than the lowest test threshold value. The infestation, however, increased to reach 3 larvae/90 plants 15 WAG. A second sampling done the following week confirmed increasing infestation when 5 larvae were obtained. Consequently, all plots assigned to the low threshold level (LT) were sprayed on November 11, 1994 (16 WAG) using the insecticide Sherpa DL (cypermethrin + Dicofol). A second insecticide spray using the same chemical was done 18 WAG, on November 28, 1994 when after two consecutive samplings, indicated that the LT was exceeded.

Both the medium (MT) and upper (UT) thresholds were reached only once during the whole season at Namulonge (Fig. 1a). Medium threshold (MT) plots received insecticide spray during the 16th WAG while UT plots were sprayed during the 18th WAG when 5.6 and 8.5 larvae/90 plants were recorded.

The bollworm infestation pattern at Namulonge sharply contrasted with that at SAARI (Fig. 1b). Peak infestation at Serere was recorded during the squaring period and remained significantly ($P = 0.05$) low throughout the boll-set and maturation period. During this season, the LT value was exceeded to 4.6 at 9 WAG, i.e., August 28, 1995 (Fig 1b). Sample counts of larvae at Serere never reached the MT level throughout the season. As a result, the number of sprays for the season were 1 for LT plots and 0 for both MT and UT plots (Table 1).

When the seasonal means of larvae were separated by Tukey's test, no significant ($P=0.05$) differences were detected among the 3 ATLs (Table 2). It was, however, evident that a highly significant ($P=0.01$) difference existed between all test ATLs and the control plot especially at Namulonge (Table 2). No clear differences were detectable at Serere.

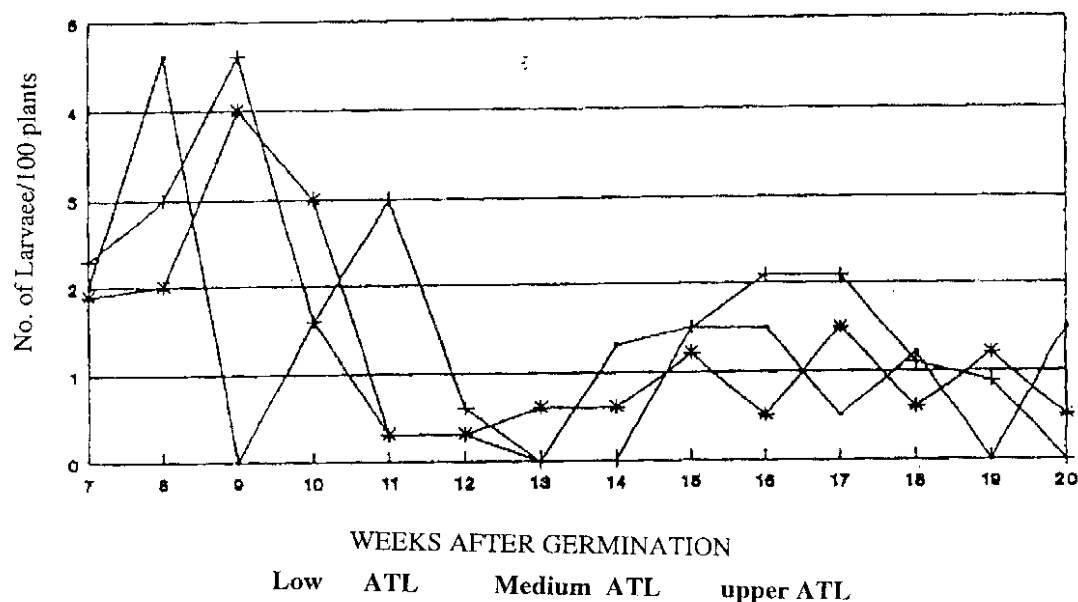


Figure 1(a) Mean number of cotton bollworm Larvae/100 plants in cotton plots sprayed following three test action threshold levels at Namulonge during the 1994/95 season

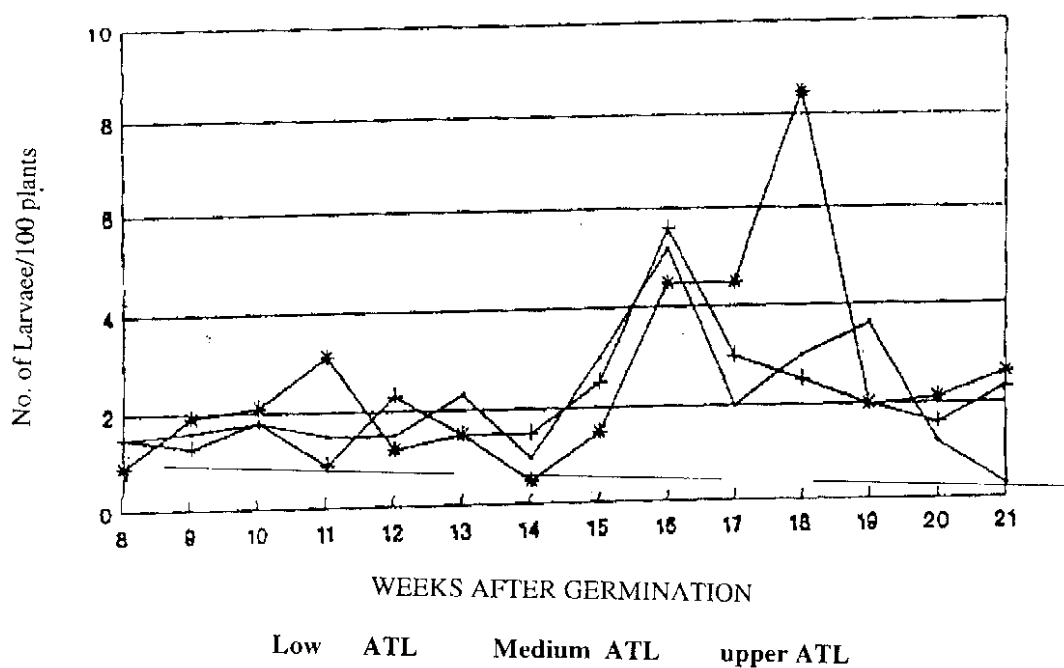


Figure 1(b) Mean number of cotton bollworm Larvae/100 plants in cotton plots sprayed following three test action threshold levels at Serere during the 1995/96 season

With regard to boll damage, the control plot exhibited highest infestation in both locations. Among the ATLs, ANOVA showed highest larvae counts in UT plots. These were significantly ($P=0.05$) higher than the counts from LT and MT plots. This was also true for yields of seed cotton (Table 2). Significantly ($P=0.05$) lower yields were harvested from the control plot. Yields of seed cotton averaged over two years were highest for the MT level, 745.3 kg/ha, compared to 714.8, 534.6 and 233.0 kg/ha for LT, UT and control, respectively.

These results demonstrated the importance of action thresholds in insecticide application for bollworm management. Applications made according to all the 3 test ATLs resulted in reduced number of insecticide sprays compared to the

current recommendation for the farmers. The resulting low yields of seed cotton obtained from Serere, however, seem to suggest that these test ATLs may not be suitable for both locations.

The MT (5 larvae/90 plants) resulted in apparently higher yields of seed cotton with a mean spray of only 0.5 required. The data do show a somewhat higher larvae population in the MT at Namulonge compared to the UT, but such differences were not observed in boll damage and yield. What seemed to influence these results, however, is the time when the test ATL level is reached and hence the time of chemical application. In all cases chemical sprays commenced later than 5 weeks, the start treatment time for the present recommendation. This was more conspicuous at Namulonge where the first

Table 1. Number of insecticide sprays in the bollworm action threshold experiments at Namulonge (1994/5) and Serere (1995/6)

Action threshold level (ATL)	Number of insecticide sprays		
	1994/95 (Namulonge)	1995/96 (Serere)	Mean
LT (3 larvae/60 plants)	2	1	1.5
MT (5 larvae/60 plants)	1	0	0.5
UT (7 larvae/60 plants)	1	0	0.5
Control	0	0	0.0
Current recommendation			4.0
+			

Table 2. Seasonal mean number of bollworm larvae, % boll damage and yield of seed cotton from plots sprayed following three different action thresholds at Namulonge and Serere.

ATL	Number of larvae /100 plants		% boll damage		Yield of seed cotton (Kg/ha)	
	1994/95	1995/96	94/95	95/96	94/95	95/96
LT	3.65b	0.53a	23.9b	9.2b	827.5a	602.1a
MT	4.82b	1.74a	19.1c	11.2b	785.0a	476.7ab
UT	3.59b	1.93a	26.3c	17.8ab	655.0ab	414.3ab
Control	8.93a	1.98a	34.7a	19.8a	255.5b	191.5b
LSD ($P=0.05$)	4.03	2.41	2.71	4.88	149.9	150.3
C.V	23.1	19.8	9.7	9.7	14.9	21.6

treatment was required 16 WAG, suggesting that probably two spray schedules are required for the locations.

The cost of bollworm control in this study was substantially lower in all cases compared to the current recommendation. Higher number of sprays over what we used in this study may be justifiable in view of the lower yields obtained relative to the known potential of 1000kg/ha (Anon, 1991). The low yields, however, are not surprising due to the fact that there are also losses from other pests notably the lygus bug.

The ideal action threshold level appears to be 5-7 larvae/100 plants. However, given real farm situations and sampling realities, use of better application methods, delays in or inadequate sampling and other factors such as levels of cultural control practices, ≤ 5 larvae/90 plants may ultimately prove to be more appropriate. Further refinement of these thresholds is highly necessary to enable the establishment of practical economic thresholds.

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