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ACTION THRESHOLD LEVELS DEVELOPED FOR LYGUS, *TAYLORILYGUS VOSSELORI* POP. (HEMIPTERA: MIRIDAE) AND ITS INJURY TO COTTON PLANTS IN UGANDA

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INTRODUCTION

The concept of Action Threshold Level (ATL) was defined, as the pest population size at which management action is required in order to prevent economic loss in integrated pest management (Stern *et al.*, 1959 and Poston *et al.*, 1983). The use of appropriate threshold levels ensures that insecticides are used only when necessary.

In Uganda, research efforts have been directed towards ensuring that crops are produced in sustainable agriculture systems. Sustainable production of cotton requires an immediate diversion to IPM, which has been introduced in, Uganda cotton fields (El-Heneidy *et al.*, 1995). However, difficulties have arisen in making recomendations for controlling the sucking and biting bugs, mainly the lygus bug, *Taylorilygus vosselori* Pop., the cotton stainer, *Dysdercus* spp. and stink bugs.

The present work aimed to investigate the impact of three estimated action threshold levels for lygus bug management control programs in cotton fields.

MATERIAL AND METHODS

Yield response of cotton to lygus bug injury was quantified at two places, Namulonge and Serere Agricultural and Animal Production Research Institutes (NAARI and SAARI) during two cotton-growing seasons 1994/95 and 1995/96. The experimental design was a complete randomized block design with plot treatments, each replicated two and three times during the two seasons, respectively. Each plot measured about 0.5 hectar and was divided into nine sub-plots, i.e. three for each tested action threshold level. The commercial cultivars Bukalasa Pedigree Albar (BPA) was used at NAARI and Serere Albar Type Uganda (SATU) at SAARI. The usual cultural practices were applied.

The two sampling methods; sweeping, using a sweep-net, and visual counts of squares were applied weekly for lygus bug population assessment (Garcia *et al.*, 1982). Square count method was used ony at SAARI in the second season. Fifty sweep-net strokes were applied for each sub-plot and repeated four times. Lygus bug catches were collected, bagged then taken to the laboratory, frozen and number of nymphs and adults were recorded. Monitoring the lygus bug individuals attacking square, plants in five meter row lengths (30 plants) were examined in each plot and the number of squares was recorded (Black, 1973). The number of damaged squares was achieved simply by collecting falling squares in five rows. Squares were checked in the laboratory for symptoms of damage.

The action threshold levels (ATLs) at which insecticides were applied were "Low Threshold" (LT) of 10, a "Medium Threshold" (MT) of 15, and a "High Threshold" (HT) of >15 lygus bugs/50 sweep-net strokes. When the number of lygus bug, nymphs and/or adults exceeded the above levels chemical control was applied twice within two to three days

Harvesting was completed by hand picking. Seeds were picked from whole plots and bulked for each sub-plot of ATL treatment. The actual data were transformed into square root and analyzed using an ANOVA method. Additonal analyzes were made by pooling the data of different sampling periods for each.

RESULTS AND DISCUSSION

During the first cotton season, 1994/95 at NAARI,lygus bugs started to appear in the experimental plots during the 6th week after germination (WAG) and then increased gradually. Up to the 10th WAG, the pre-count data indicated that no significant differences (P=0.05) existed among threshold levels or replicates. Insecticidal application started after the 10th WAG in the LT sub-plots Since the mean number of lygus bugs in the sweep-net catches exceeded the LT (10 bugs/50 strockes) during the 10th and 13th WAG (Table 1). Sherpa DL was used for the two applications. The mean numbers of the pest exceeded the MT (15 bugs/50 strokes) in the MT plots twice (during the 11th and 14th WAG) (Table 1), and a spray was applied on each occasion using Sherpa and Salut, respectively. In the HT plots, the mean number of lygus bugs exceeded the threshold (>15 bugs/50 strokes) only once during the 14th WAG (Table 1), and the sub-plots were sprayed using Salut. There were no significant differences (P=0.05) in lygus bug populations between the thresholds from the 15th WAG to the end of the season.

TABLE (I)

Mean number of lygus bugs/50 sweep-net strokes in ATL plots at NAARI during

Week After Germination	NAARI (1994/95)			SAARI (1995/96)		
	LT	MT	HT	LT	MT	HT
8	5.3	0	0	11.3	8	9.7
9	8.3	0	0	1.5	10.9	11.2
10	13	0	0	4.5	13.2	13.9
11	7	18	9	18.8	12.5	15.3
12	4.8	7.5	14.5	8	9.5	10
13	10.8	5	11.3	11.8	15	18.5
14	9	20.8	16.8	8	11	12
15	6	7	5.5	5.6	5	5.4
16	5.8	6	4.8	6	8	8.3
17	7.5	4.3	5.6	2.7	5.3	5
18	6.3	5.5	6	2.3	3	2.2
19	4.8	6.3	5	0.5	2.8	0.8
20	2.8	2.3	2.8	1.7	1.2	1.3

LT = Low Threshold MT = Medium Threshold HT = High Threshold

During the second cotton season, 1995/96 at SAARI lygus bugs were first found in the experimental plot during the 5th WAG and then increased gradually. There were no significant differences between treatments until the 8th WAG. The first spray was applied in the LT plots during the 8th WAG using Decis. Significant differences (P=0.05) were found between treatments when the lygus bug populations increased in the MT and HT plots during the 9th and 10th WAG while numbers decreased in LT plots as a result of the spray (Table 1) During the 11th WAG, the mean number of lygus bugs exceeded the tested A T Ls in all the experimental plots. Consequently all plots were treated with Thionex. Within two weeks, during the 13th WAG, another spray was required on all plots to suppress the pest population. Decis was used. This application was sufficient to maintain lygus bug populations below the A T Ls for the remainder of the season (Table 1). It was apparent that Thionex was not effective The mean number of insecticide sprays applied in the experimental plots in the two years of study were half of those recommended by the Ministry of Agriculture (four sprays) (Table 2).

TABLE (II)

Number of insecticide sprays required incotton ATL experimental plots at NAARI during 1994/95 and SAARI during 1995/96 cotton seasons.

ATLs	Number of insecticide sprays*		
	NAARI (1994/95)	SAARI (1995/96)	Average
LT (10 bugs/50 sweeps)	2	3	2.5
MT (15 bugs/50 sweeps)	2	2	2.0
HT (>15 bugs/50 sweeps)	1	2	1.5
Average	1.7	2.3	2.0

* Current recommendation is four sprays.

The lygus bug to square ratio at different cotton growth stages during the squaring period is shown in Table 3. During the 8th WAG, the ratio for the LT was significantly (P=0.05, LSD 0.12) higher than that for MT and HT. Despite lack of significance during most of the time periods the lygus bug to square ratio for the LT and the MT were higher than those for the HT in most cases. Overall the lowest mean lygus: square ratio (0.09) occurred in the HT treatment. The highest yield of seed cotton (887.7 kg/ha) at SAARI (Table 3) was obtained from the HT plots which received a mean of 1.5 sprays compared to 2.5 and 2.0 mean sprays for LT and MT, respectively (Table 2).

The regression of seed cotton yields on number of squares indicated that seed cotton yields were linear related to square counts during the 9th WAG only (Table 4). This confirms earlier findings that squares formed during 7-10 WAG contribute most the yield and quality of seed cotton (Mamford *et al.,* 1987) and that the squares may develop into mature bolls after 13-16 weeks.

Wilson, 1986 discussed the merits and demerits of a threshold based on pest density as opposed to a threshold based on damage.. However, the application of a threshold based on pest density is complicated in the case of cotton (Keerthisinghe, 1982), especially where infestation by more than one pest occurs (Ring *et al.,* 1992). Our present method based on the relationship between numbers of lygus bugs, damaging the squares and yield probably requires further studies to obtain more realistic relationships. The results suggest that a lygus threshold of 10-15 bugs/50 sweeps or a lygus bug to square ratio of 0.09 - 0.15 used during the critical period of square set (7-12 WAG) may be used initially for this purpose.

TABLE (III)

Lygus bug to square ratio at different growth stages of cotton during the squaring period at SAARI (1995/96 seasons).

ATLs	Weeks after cotton germination (WAG)					
	8	10	12	14	Mean	Yield(Kg/ha)
LT	0.27a	0.10a	0.10a	0.10a	0.14	627.0
MT	0.03b	0.09a	0.11a	0.12a	0.12	718.7
HT	0.07b	0.09a	0.09a	0.11a	0.09	887.7

TABLE (IV)

Correlation and regression values for yield (seeds Kg/ha), number of squares /30 plants and damaged squares relationships

Week after Germination	Correlation coefficient(r)	Determination coefficient(r^2)	Regression equations
8	0.761**	0.579	Y = 6.690X - 362.78
10	-0.213	0.045	Y = 1.194X + 948.96
12	0.227	0.051	Y = 1.984X + 390.56
14	0.385	0.148	Y = 3.730X + 194.31

** Significantly different at P<0.01

Considering the information currently available on the effects of lygus bug infestation on yield and the infestation levels necessary to cause yield reduction, it would appear that the thresholds used in this experiment were conservative. Nevertheless by, effective scouting, and monitoring of square retention during the critical period of early square set, farmers in Uganda may become able to optimize lygus bug management decisions and avoid unnecessary treatments.

From the economic point of view, the mean number of insecticide sprays in the two years of study was half the current recommendation of four sprays, resulting in significant reductions in the average control costs for this pest. U Shs. 12,500 is an average cost of a liter of insecticide, control costs for lygus bugs (excluding application costs) using the three thresholds were estimated at U Shs. 31.250, 25,000 and 18.750 for LT, MT and HT, respectively, compared with an average U Shs 50,000 required using the current spray recommendations.

The sampling procedure in this study was simple and acceptable to small farmers.

SUMMARY

Field experiments to determine Action Threshold Levels (ATLs) for the lygus bug, *Taylorilygus vosselori* Pop. were conducted on cotton in central and north

eastern Uganda, at Namulonge and Serere Agricultural and Animal Production Research Institutes, NAARI and SAARI, respectively, where the lygus bug, *T. vosselori* is a major insect pest. Three A T Ls were tested for this pest in the two locations. Sweep-net catches and assessment of square damage were the sampling techniques used in the study. The lygus bug threshold level of 10-15 per 50 sweeps and a mean lygus bug: square ratio of 0.09 - 0.15 using a sample of 30 plants could be used during the critical period of square set, 7-12 week after germination (WAG), in the two regions. Two insecticide sprays were required to maintain lygus bug populations below the A T Ls, which is half the current recommendation of four sprays. At the same time a 2-3 fold increase in yield was obtained from the ATL plots relative to the average in both areas.

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