Evaluation and Demonstration of Economic Threshold Level (ETL) for Chemical Control of Rice Stem Borers, *Scirpophaga incertulus* Wlk. and *S. innotata* Wlk.

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ABSTRACT

An experiment was conducted to determine new ETL for chemical control of rice stem borers on Super Basmati (*Oryza sativa* L.). The treatments were artificially produced infestation levels (0-15%) by clipping of tillers. There was a significant reduction in grain yield. The economic analysis shows that cost of application of cartep (Padan) before 7.5% infestation level was more as compared to the monetary value of reduction in grain yield due to insect attack. Between 7.5 and 10% infestation levels, cost of chemical control was equal or less than reduction in yield and this level can be considered as new economic threshold level.

Key Words: Rice; Chemical control; Borer

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important and leading cereal crops in the world and is the staple food of over half of the Global population. It is the principal source of energy, carbohydrates, protein, iron, calcium, thiamine, riboflavin and ricin in Asian diet (Anonymous, 1993). In addition to meet the dietary requirements, it contributes substantially the very precious foreign exchange earnings in Pakistan and is the main livelihood of the rural population in South Asia especially Pakistan.

Rice stem borers, *Scirpophaga incertulus* Wlk. and *S. innotata* Wlk., attack the crop right from seedling stage till harvest and cause complete loss of affected tillers (Salim & Masih, 1987). The unplanned and indiscriminate use of Pesticides has, however, been blamed for side effects. Concerted efforts are, therefore, being made to develop rational basis for application of pesticides keeping in view the ecological soundness and profitability of control because of high cost of chemical insecticides and problems associated with them. It has become necessary to determine new economic threshold level for rice stem borers. ETL is a dynamic parameter, varying with a number of factors i.e., variety, geographical area and changes with change in (1) the cost of artificial control measures (2) monetary value of harvested product (3) the environmental factors i.e., tolerance of the plant and feeding of the insect (Michael & Pedigo, 1974).

Keeping in view the above facts, the present project was undertaken to establish correlation between borer infestations and yield losses in order to determine the new ETL for rice stem borers on Super Basmati at experimental area of Adaptive Research Farm Sheikhupura.

MATERIAL AND METHODS

To determine the economic threshold level for chemical control of rice stem borers on Super Basmati variety of *Oryza sativa* L. an experiment was conducted at Adaptive Research Farm Sheikhupura. The area cultivated for this purpose consisted of three kanal and six marlas. The crop was grown in a Randomized Complete Block Design consisting of seven treatments with three replications under complete control conditions.

Treatment	T1	T2	T3	T4	T5	T6	T7
Infestation Levels (%)	0.0	2.5	5.0	7.5	10.0	12.5	15.0

These different infestation levels of rice stem borers were artificially produced in the treatments so as to determine the economic losses in the paddy yield (Rubia *et al.,* 1990).

In each treatment section an area of 2 m^2 was selected. Total number of plants in selected area was counted and then total number of tillers in 2 m^2 area were also recorded in order to calculate above percentages according to the treatments for artificial clipping. Clipping is the method of mimicking losses with white heads. Clipping was done just before the emergence of panicles at the anthesis stage which was the period of maximum attack by the stem borers and clipping was done in such a way that first the panicles were exposed and then pulled out from the top node leaving the remaining tiller portion as such keeping in view the concept, it might happen that photosynthates produced in leaf might be translocated to the panicles of other tillers of the same plant (Rubia *et al.*, 1996). After harvesting paddy yield data was taken and also data of other yield component characters was taken and subjected to proper statistical analysis for

testing the significance of results following the procedure outlined by Steel and Torrie (1980). Economic analysis of yield losses was undertaken in order to determine the new Economic threshhold level for the chemical control of rice stem borers in the existing environmental and economic conditions.

RESULTS AND DISCUSSION

The average values of yield recorded in various treatments based on infestation level are presented in Table I. The mean values of grain yield vary significantly, while those of number of grains /panicle and panicle length (Table III) had no variation between them. This suggests that infestation of stem borer does not affect these physiomorphic characters of Super Basmati, but only yield.

The mean value of paddy yield shows that at 0% infestation, there is maximum grain yield which is 3083.03

kg ha^{-1}. At 2.5 and 5.0%, average grain yield is equal 2958.3 kg ha^{-1}. At infestation levels 7.5, 10, 12.5 and 15.0%, the average yield is 2900.0, 2700.0, 2080.0 and 2330.0 kg ha^{-1}, respectively indicating that stem borer attack result in significant yield reduction.

The economic analysis of average yield data shows that at levels 2.5 and 5.0%, there was yield reduction of 124.73 kg ha^{-1} and in monetary terms it was Rs. 1347. While the average cost of control was Rs. 1442.0 for one hectare with single application of granular insecticide so at this level chemical control is not economical. At 7.5% infestation level, there was reduction of 183.03 kg ha^{-1} and in monetary terms it was Rs. 1979.0 for one hectare, which was more than cost of control considering single application of granular Cartep so it may be economical.

But if we apply the pesticide twice according to the recommendations of Agriculture department, the cost of control would increase up to Rs. 2964.0 for one hectare.

Table I. Economic analysis of mean values of grain yield data

Treat. Infest. level	Average yield kg/ ha.	Gross income (Rs.)	Total expenditure (Rs.)	Net Income (Rs.)	Reduction in average yield kg/ha	Additional expenditure to save reduction (Rs.)	Reduction in monetary terms (Rs/ha)	Cost (A): Benefit Ratio
						Cost (A)	Benefit	
T1=0.0%	3083.0	33296.4	16446.0	16850.4	0.00	2964.0	0.000	--
T2=2.5%	2958.3	31949.64	16446.0	15503.3	124.73	2964.0	1347.0	2.20:1.00
T3=5.0%	2958.3	31949.64	16446.0	15503.3	124.73	2964.0	1347.0	2.20:1.00
T4=7.5%	2900.0	31320.01	16446.0	14874.0	183.03	2964.0	1979.0	1.19:1.00
T5=10.0%	2700.0	29160.0	16446.0	12714.0	383.00	2964.0	4141.0	1.00:1.39*
T6=12.5%	2080.0	22464.0	16446.0	6018.00	1003.0	2964.0	10850.0	1.00:3.66
T7=15.0%	2330.0	25164.0	16446.0	753.03	8719.0	2964.0	8142.0	1.00:2.76

LSD = 124.388

Table II. Economic analysis with single application

Treatment	Reduction in Average (kg/ha)	Additional Expenditure Cost (B)	Reduction in monetary terms (Rs/ha) Benefit	Cost (B): Benefit ratio
0.00%	0.00	1442.0	0.00	--
2.50%	124.73	1442.0	1347.0	1.01:1.00
5.00%	124.73	1442.0	1347.0	1.01:1.00
7.50%	183.03	1442.0	1979.0	1.00:1.05*
10.0%	383.00	1442.0	4141.5	1.00: 2.87
12.5%	1003.0	1442.0	10850	1.00:7.32
15.0%	753.03	1442.0	8142.0	1.00:5.49

LSD =124.388; Cost (A) =Additional expenditure for when the granular insecticides are applied twice for the chemical control of rice stem borers; Cost (B)= Additional expenditure when the granular insecticides are applied once for the chemical control of rice stem borers; Significance level = 5%

Table III. A multiple comparison of the mean values of different yield component characters of Super Basmati

Treatments	Average yield g/ 2m^2	Plant height (cm)	Panicle length (cm) n.s.	No. of filled grains/panicle n.s.	No. of unfilled grains/panicle n.s.
0.00%	616.66 a	106.66abc	24.21	85.93	14.16
2.50%	591.66 ab	105.66bc	24.30	76.63	15.06
5.00%	591.66ab	112.00a	25.28	96.66	12.73
7.50%	580.00ab	110.66ab	24.33	90.17	11.43
10.00%	540.00abc	104.00c	24.68	94.1	11.43
12.50%	416.00c	108.66abc	24.49	81.68	11.70
15.00%	466.0bc	109.33ab	25.17	85.0	11.1

LSD= 124.388; Prob.= 0.03* significant; Significance level = 0.05

(Table II) At 10.0% infestation there was a reduction of 383.0 kg ha^{-1}, in monetary terms a loss of Rs. 4141. As a result the analysis shows that control measures should be adapted before reaching this level to save the loss. According to Hrai (1999) that infestation of rice with *Scirpophaga incertulas* is negatively correlated with yield and results were similar to our findings. Wang (1994) determined the thresholds to be 2-3% infested hills, but in existing economic environment control at these percentages become uneconomical because of high cost of pesticides. Rubia (1990) also used the clipping model to estimate the losses due to stem borers and predicted that up to 20% dead hearts at the vegetative stage would cause no significant reduction in grain yield but at grain filling stage caused an almost proportionate yield reduction and this agree with our studies. The results of Parsad *et al.* (1993) also agreed with our studies while those of Arida and Heong (1989), Chen *et al.* (1993), Wang *et al.* (1994), Murthy (1996) and Heong and Escalada (1999) did not agree with our findings.

CONCLUSION

Finally, it was concluded that the chemical should be applied for the control of rice stem borers at 7.5% infestation level.

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