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Determination of Economic Threshold Level for *Sogatella furcifera* (Horv) in Gujarat

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ABSTRACT

A field experiment to assess the economic threshold level (ETL) for white backed plant hopper (WBPH), *Sogatella furcifera* (Horv) was conducted during 1990-91, 1991-92 and 1992-93, at the Main Rice Research Station, GAU, Nawagam (Gujarat). The results revealed that the differences in grain yields were significant due to control measures adopted at different levels (0, 5-10, 11-25, 26-50, 51-100, 101-200 and more than 200 WBPH/hill) of infestation. Straw yield did not show any significant difference. Maximum grain yield was recorded when plant protection measures were initiated at zero population of WBPH/hill followed by when the measures were adopted at 5-10 and 11-25 WBPH/hill. Highest ICBR was recorded at the infestation level of 11-25 WBPH/hill (1:7.16) closely followed by 5-10 WBPH/hill (1 : 6.82). There was no statistical difference in grain yields recorded in both these treatments.

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INTRODUCTION

Paddy is an important cereal crop of Gujarat. The crop is mainly attacked by stem borer, leaf defoliators and hoppers. *Sogatella furcifera* (Horv) commonly called the white backed plant hopper (WBPH) is one of the important and yield limiting pests of paddy in middle Gujarat. With the introduction of high yielding paddy varieties under high fertility levels, the insect has assumed a major pest status in central parts of the State. The heavy tillering and dwarf varieties appear to have provided a favourable microhabitat for easy multiplication of the pest (Dhaliwal and Singh, 1983). In addition to direct damage by sucking the sap and injecting toxins into the plant, role as vector of virus diseases has also been recognized (Pathak and Pawar, 1983). An endemic form of this pest causes complete crop failure. Saini (1984) estimated 10 to 14% yield losses due to this pest in Punjab.

In IPM, the main philosophy is to manage insect pests below economic threshold level and not to eradicate them. Economic threshold level (ETL) has been defined as that level of pest population were control measures have to be initiated to prevent insect causing economic losses. Although, tentative ETL of the pest has been suggested, these values need to be validated through actual experimental evidence in different paddy ecosystems. Very little work has been done of this aspect in India. None of the earlier workers of the State have tried to work-out ETL for WBPH in paddy.

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Therefore, it was planned to conduct field experiment to determine the ETL value for this valuable pest in middle Gujarat so that the farmers can be advised at which population level, control measures should be taken.

MATERIALS AND METHODS

The field experiment was carried out for three successive *kharif* seasons during 1990-91, 1991-92 and 1992-93, at the Main Rice Research Station, Gujarat Agricultural University, Nawagam (Gujarat). The experiment was laid out in Randomised Block Design with seven treatments (different levels of infestation) replicated thrice. The gross and net plot size was 6.9 m x 4.0 m and 5.7 m x 2.8 m respectively. The intra-replication gap between plots was 0.8 m and inter-replication gap was 1 m. The seeds of susceptible variety (GR. 11) of paddy were sown on 27.6.90, 29.6.91 and 26.6.92 and seedlings were transplanted at 20 cm x 15 cm. Spacing on 7.8.90, 8.8.91 and 4.8.92 during first, second and third year of experimentation respectively. The crop was fertilized with 100 kg N and 50 kg P_2O_5 per hectare. All the other recommended agronomic practices, except plant protection were followed for raising the healthy crop. Uniform plant population was maintained in all the experimental plots.

The WBPH population was surveyed in all the treatments at 3 days interval starting from 10 days after transplanting of the crop. For the purpose, number of WBPH present on 10 randomly selected plants from net plot area were recorded. Different levels (0, 5-10, 11-25, 26-50, 51-100, 101-200 and more than 200 WBPH/hill) of pest infestation were maintained by adopting plant protection measures. As soon as the WBPH population has reached at desired level in a particular treatment, suitable insecticidal applications were made at recommended doses. The insecticides *viz.*, Thimet (Phorate) 10 G and Carbaryl (Sevin) 50% WP at 1.0 kg, carbofuran (Furadan) 3 G and quinalphos (Ekalux) 25 EC at 0.750 kg, monocrotophos (Nuvacron) 36 w/w, methyl parathion (Metacid) 50 EC, endosulfan (Thiodan) 35 EC and phosphamidon (Dimecron) 85 EC at 0.500 kg a.i./ha were used to suppress the WBPH population at desired level of infestation. The cost of plant protection required in each treatment during 1990-91, 1991-92 and 1992-93 was also calculated.

The crop was harvested on 14-11-90, 19-11-91 and 18-11-92 during three years of investigation i.e. 1990-91, 1991-92 and 1992-93, respectively. At the time of harvest, grain and straw yields corresponding to infestation levels were recorded from net plot area and converted in kg/ha. The yield data thus obtained were statistically analysed.

Economics of the insecticidal application was worked out based on the net income from yields and Incremental Cost Benefit Ratio (ICBR).

RESULTS AND DISCUSSION

To initiate control measures at a lowest (0 WBPH/hill) level of WBPH population, it was necessary to have 5 to 8 (Average 6) insecticidal applications, resulting in maximum (Rs. 2380.43) expenditure for crop protection as compared to other control measures adopted for different levels of WBPH population. The cost of plant protection decreased progressively with increase in infestation level (Table 1). The data indicated that the differences in grain yields were significant due to control measures adopted at different levels of WBPH populations (Table 2). However, straw yield did not reveal any significant

TABLE 1

Cost of plant protection measures followed at various threshold levels of WBPH.

Sr. No.	Treatments WBPH/hill (nos.)	Cost of insecticide (Rs./ha)				Average No. of insecticidal application required	Labour charge* (Rs./ha)*				Cost of plant protection (Rs./ha)
		1990-91	1991-92	1992-93	Mean		1990-91	1991-92	1992-93	Mean	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
(1)	0	1607.94	1891.11	2922.23	2140.43	6.00	200	200	320	240.00	2380.00
(2)	5-10	882.94	940.00	894.00	905.65	2.67	160	80	80	106.67	1012.00
(3)	11-25	300.00	940.00	894.00	711.33	1.67	40	80	80	66.67	778.00
(4)	26-50	300.00	600.00	894.00	598.00	1.33	40	40	80	53.33	651.00
(5)	51-100	—	600.00	423.53	511.77	1.50	—	40	80	60.00	572.00
(6)	101-200	—	225.00	423.53	324.27	1.50	—	40	80	60.00	384.00
(7)	More than 200	—	—	—	—	—	—	—	—	—	—

*Labour charge Rs. 20.00/day.

TABLE 2

Effect of various threshold levels of WBPH on yield of paddy.

Sr. No.	Treatments WBPH/hill (nos.)	Grain yield (kg/ha)				Straw Yield (kg/ha.)			
		1990-91	1991-92	1992-93	Pooled	1990-91	1991-92	1992-93	Pooled
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
(1)	0	5934a	5169a	6078a	5727a	5157	4323	6842	5439
(2)	5-10	5777a	4273ab	4908b	4988b	5244	4261	6598	5376
(3)	11-25	5276ab	3947b	4647b	4624b	5182	4073	6159	5138
(4)	26-50	4493bc	3275c	4344b	4035c	4856	4010	6159	5013
(5)	51-100	3759c	3183c	3114c	3352d	4593	4135	6316	5019
(6)	101-200	3935c	3179c	3020c	3377d	4900	4261	5796	4988
(7)	More than 200	3872c	2398d	2924c	3064d	4449	4365	5952	4925
	S. Em. ±	298.31	214.01	368.91	180.88	—	—	—	—
	C. D. at 5%	919.12	659.40	1136.67	557.30	NS	NS	NS	NS
	C.V (%)	10.95	10.17	15.40	7.51	—	—	—	—

Means followed by the same letter in each column are not statistically different.
NS = Not Significant.

TABLE 3
Economics of threshold level of WBPH and ICBR.

Sr. No.	Treatments WBPH/hill (nos.)	Yield (kg/ha)		Gross income (Rs./ha)	Gross realization after deducting cost of plant protection (Rs./ha.)	Net realization over control (Rs./ha)	ICBR
		Grain	Straw				
1.	2.	3.	4.	5.	6.	7.	8.
(1)	0	5727	5439	25628	23248	8529	1:3.58
(2)	5-10	4988	5376	22640	21628	6909	1:6.82
(3)	11-25	4624	5138	21065	20287	5568	1:7.16
(4)	26-50	4035	5013	18647	17996	3277	1:5.03
(5)	51-100	3352	5019	15918	15346	627	1:1.10
(6)	101-200	3377	4988	16002	15618	899	1:2.34
(7)	More than 200	3064	4925	14719	—	—	—

Market price : Paddy grain Rs. 400/q.
Paddy straw Rs. 50/q.

difference. Maximum (5727 kg/ha) grain yield was recorded when plant protection measures were initiated at zero level population of WBPH/hill followed by when the control measures were adopted at 5-10 (4988 kg/ha) and 11-25 (4624 kg/ha) WBPH/hill. Reduction in grain yield was found to be 2.66 t/ha when population exceeds more than 200 WBPH/hill. This is in accordance with the earlier report of Anonymous (1990).

The regression equation Y=5019.55-13.89 x was computed where 'Y' and 'X' indicate grain yield and pest population level, respectively. It explains that increases in WBPH population by one unit, would result in decrease in grain yield by 13.89 times.

Inspite of maximum gross income (Rs. 23248) resulted from higher grain and straw yield, the high cost involved in plant protection resulted lower ICBR (1:3.58) in the treatment of zero WBPH/hill (Table 3). Maximum ICBR was recorded in the treatment when control measures were initiated at 11-25 WBPH/hill (1:7.16) closely followed by 5-10 WBPH/hill (1:6.82). There was no significant difference in grain yields in both these treatments. Hence, based on productivity and economics, it is very clear that to harvest optimum and economical yield of paddy, control measures for WBPH should be initiated at the population of 5-10 WBPH/hill. The findings, therefore confirm the earlier results of Khatri *et al.* (1983), who reported the ETL for WBPH at or below 15 insects/hill in Madhya Pradesh. Similarly in case of brown plant hopper, Anonymous (1988) and Anonymous (1990), the ETL was found to be 5-10 insects/hill at Aduthurai (Tamil Nadu) and Maruteru (Andhra Pradesh), respectively. The report of Naba (1992) from Japan, is also in partial fulfilment of the present findings, who estimated 10-20 WBPH/hill as threshold value during panicle formation stage.

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