A SIMPLE METHOD TO EVALUATE YIELD LOSSES DUE TO RICE GALL-MIDGE, ORSEOLIA ORYZAE WOOD MASON

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INTRODUCTION

Yield loss assessments are useful both retrospectively and prospectively, and also at the national and individual levels. The retrospective yield loss data is a record of past events. At the national level, the data can be used for crop production inventories, and to for formulate crop insurance policies, farmer subsidies after catastrophe, and policies for harvesting, transport, and pesticide supply etc. The prospective method uses information for crop improvement, and records harmful agents and weather. Prospective information leads to estimation of crop losses etc. This data can be used to time pesticide treatments, select

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emergency measures for large scale pest control; determine logistics of pesticide supply;and plan for harvesting, transportation, and storage etc.

Inspite of the practical importance of crop loss data, no systematic effort had been made to study the crop losses caused by insects and diseases. Therefore, the authors decided to study the yield losses caused by rice gall-midge (GM) on rice. Determination of crop losses due to the rice gall-midge, Orseolia oryzae was selected for this study because of its importance as a major pest of rice (Anonymous, 1986). The specific objectives of this study were:

1. To develop a simple method to determine yield losses caused by GM
2. To evaluate yield losses due to GM in the different rice cultivars.
3. To determine the economic injury level of the rice gall-midge.

MATERIALS & METHODS

Natural infestation of g idge (Maha 87/88) in the rice breeders seed plots at the Central Rice Breeding Station, Batalagoda was used in this study. There were nine breeders plots of 0.25 ha each, planted under nine cultivars. These cultivars belonged to four age classes, and were transplanted at different times depending on the age of the cultivar (Table 1). In the breeders seed plots, the planting pattern was different from that of the normal method followed by the farmers. The seed of each selected plant from the previous season, was planted in a separate plot. Each plot had three rows separated from the other 3-row plots with an unplanted border 50 cm. wide within each 3 row plots. Single seedlings of rice were transplanted at a spacing 20 X 15 cm between and within rows respectively. For each cultivar there were 100-150, 3-row plots. The fertilizer application and agronomic practices adopted were those recommended by the Department of Agriculture (DOA).

Before surveying the damage, an attempt was made to control gall-midge by the application of Carbofuran - the recommended insecticide. Preliminary investigation on the range of infestation indicated 0-100% infestation in the different cultivars.

The base of generating crop loss data was a single hill. The researchers randomly selected nearly 150 hills from the central rows of each of the 3-row plots of different breeder's seed cultivars.

In each hill the total number of tillers and the number of "silver shoots" (GM affected hills) were counted at the flowering stage. The percentage gall-midge incidence (GMI) was determined by dividing the number of silver shoots by the total number of tillers (IRRI, 1976). These hills were marked and the grain yields were recorded at harvest. After recording the GMI, each plot was treated with 0.71kg/ha a.i. of BPMC as a prophylactic treatment against possible brown planthopper infestation. Also, every plot was monitored weekly for the occurrence of pests other than GM. The researchers did not encounter any other insect or disease incidence.

For data analysis, hills that had an equal number of tillers were selected, to minimize the differences in the yield potential of the different hills. Then, the regression between yield per hill on the percentage gall midge incidence (GMI) was calculated using the 'SAS-REG' procedure of SAS computer package (SAS INC, 1986). The dependent variable Y was the yield per hill, while the independent variable was the GMI. The significance of the regression coefficient(r) was tested using the F statistic. In addition to the simple linear regression, a polynomial model $Y=f(x,x^2)$ was also fitted to see whether there was any improvement in the significance of r value. The percentage yield loss per unit area with increasing GM incidence was calculated by using the regression equation of the expected yield. The intercept of the equation gave the mean yield of the cultivar when the GMI was zero. The regression coefficient was the yield loss per unit increment of GMI. Therefore, % yield loss/unit % incidence of GM, was equal to

$$= \frac{\text{Regression (Coefficient) X 100}}{\text{intercept.}}$$

RESULTS & DISCUSSION

The negative regression coefficient indicated that the grain yield was negatively correlated with GMI in all cultivars. In all the cultivars grain yield decreased with the increase of GMI. The regression coefficient(r) between the expected yield and GMI were significant in all the cultivars with the exception of a 3 1/2 month cultivar. The 'r' value ranged from 0.24 to 0.65. Fitting a polynomial model did not increase the significance of the 'r' value. The 'r' value determines the proportion of the variability in yield that can be explained by the

GMI variable. In our study, only in two cultivars namely in Bg 379-2 and Bg 400-1, the 'r' value was higher than 0.5. According to Teng (1987) models that explain 80% of the variance in losses caused by a pest or disease variable is considered to have useful field application. In our study there was a higher variability in the grain yield caused by factors other than GM. Unlike in the other methods of yield loss assessments, single plant or hill technique allows for a quick determination of yield loss and provides a reasonable first estimate of the pest yield loss relationship. In this method the researchers relied on the natural infestation and did not use any chemical or other methods to manipulate pest population levels. Therefore, this method is simple enough to be used in the farmers fields.

In a pest management system, decisions are commonly based on the pest density or amount of damage and the crop yield, using economic threshold as a measure. Not all densities of pests or damage levels are harmful economically. There is a point where the ratio of benefit (B) to achieve a yield increase by resorting to pest control to the cost (C) of control being less than one. This is called the damage threshold or economic injury level (EIL). By taking the cost of control of GM/ha as Rs. 506/= and value of the crop at Rs. 4/= per kg of grain, the researchers calculated EIL values for different cultivars (Table 3). In the different cultivars, the EIL differed and ranged from 2.0 to 8.3. In cultivars where the EIL is high, a higher damage can be tolerated without suffering an economic yield loss.

The values obtained in this study should be tested, adjusted, and its acceptance by farmers should be examined over several years. The perception of pest attack and the expectation of good harvest by the farmers require socio-economic studies. They may differ from the expectations of the research workers. Action by the farmers depend on their background, experience of local condition, and their attitudes towards risk. Information on those aspects will enable the optimum use of research findings by the farmers.

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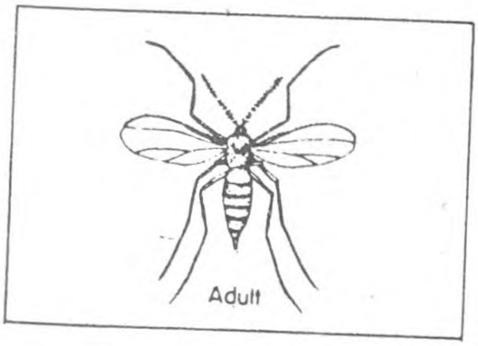

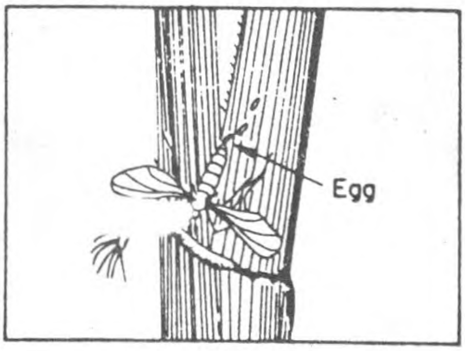

Table 1: The cultivars used in the study and time of transplanting 1987/88 Maha Season. Central Rice Breeding Station, Batalagoda.

Cultivar	Age class(M)	Time of Transplanting
Bg 3-5	5	30.09.1987
Bg 38	5-6	30.09.1987
Bg 400-1	4-4 1/2	19.10.1987
Bg 379-2	4-4 1/2	19.10.1987
Bg 34-6	3 1/2	10.11.1987
Bg 350	3 1/2	10.11.1987
Bg 94-1	3 1/2	15.11.1987
Bg 34-8	3	25.11.1987
Bg 276-5	3	25.11.1987

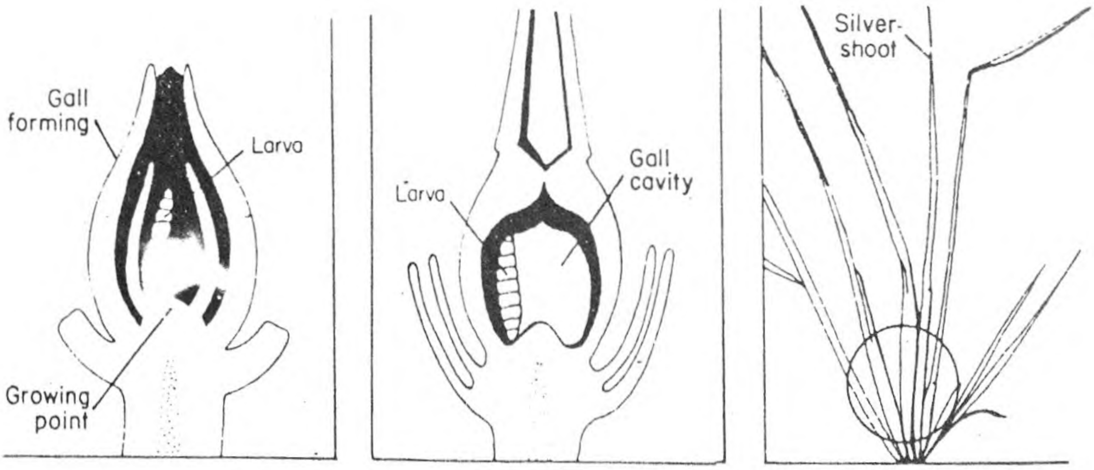

Table 2: Yield losses caused by rice gall-midge (RGM) Oreseolia oryzae, (Wood Mason) 1987/88 Maha Season. Central Rice Breeding Station, Batalagoda.

Cultivar	Regression equation expected yield	Regression 'r' value	% yield loss/unit % incidence
Bg 3-5	Y=28.08-0.265 X	0.49	0.92
Bg 38	Y=20.88-0.11 X	0.33	0.52
Bg 400-1	Y=18.61-0.20 X	0.65	1.07
Bg 379-2	Y=26.76-0.23 X	0.59	0.85
Bg 34-6	Y=10.821-0.065 X	0.43	0.60
Bg 350	Y=7.18-0.056 X	0.35	0.78
Bg 94-1	Y=9.67-0.028 x	0.24	0.29
Bg 34-8	Y=15.87-0.14 x	0.36	0.88
Bg 276-5	Y=12.56-0.11 X	0.42	0.89

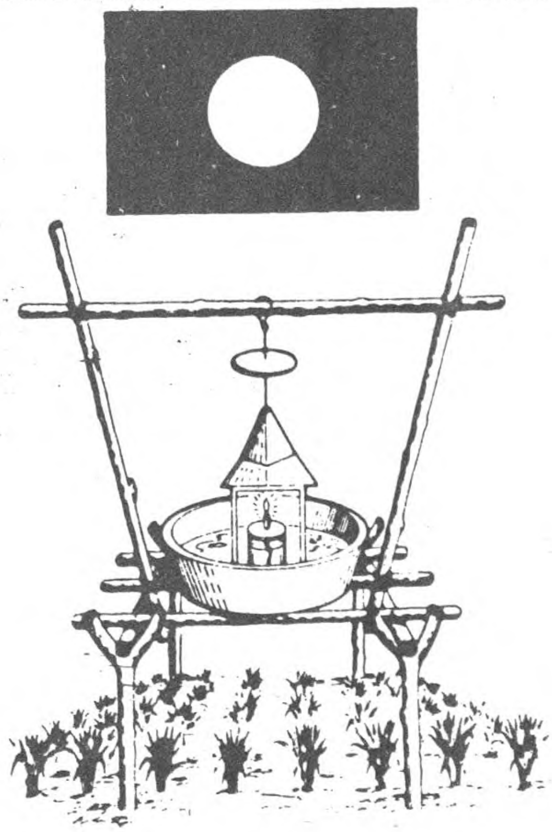

Table 3: Mean Yield, percentage loss in yield and economic injury level (EIL) of GM for different cultivars of rice 1987/88 Maha Season. Central Rice Breeding Station, Batalagoda.

Cultivar	Yield* (kg/ha)	% yield loss/unit % incidence	EIL** (% GMI)
Bg 3-5	5150	0.92	2.66
Bg 38	4783	0.52	5.11
Bg 400-1	5890	1.07	2.01
Bg 379-2	6484	0.85	2.30
Bg 34-6	4980	0.60	2.92
Bg 350	5560	0.78	4.25
Bg 94-1	5299	0.29	8.30
Bg 34-8	5015	0.88	2.88
Bg 276-5	4983	0.89	2.86

* Mean yields of 2 maha & 2 yala seasons at Batalagoda.

** EIL values are calculated by taking the cost of control of GM/ha at Rs.506/= and value of kg of paddy at Rs. 4/= where B/C = 1 (refer text for details.