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IMPACT OF RICE HARVEST ON DIAPAUSING YELLOW STEM BORER, *SCIRPOPHAGA INCERTULAS* (WALKER) POPULATIONS

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Abstract

The effect of transplant aman and deepwater rice harvest on diapausing populations of rice yellow stem borer, *Scirpophaga incertulas* (Walker), were studied during 1983-85 in Bangladesh. Harvestivng of deepwater rice removed only 12% of borers from the field with straw of 83 cm long but had no effect at all on borers in transplant aman harvested at 15 cm height. It might be possible to reduce 20% of *S. incertulas* diapausing larvae from the field by increasing the harvested deepwater rice straw length from 83 cm to 100 cm without affecting the straw quality as cattle feed, but reduction would not be possible by the manipulation of harvested straw length in transplant aman rice. During the winter, *S. incertulas* remained in the stubble on an average 110 cm away from the base of deepwater rice but below the soil surface in transplant aman stubble. The present practice of destroying most deepwater rice stubble by burning during March-April has little effect on borer populations as moths emerge earlier (February-March). To derive benefit, stubbles are to be destroyed in a large scale by the end of January. An easy and economic method of destruction of short and isolated transplant aman stubble is needed.

Key words : Rice, Yellow stem borer, Cultural Control, Harvest, Stubble destruction

Introduction

The stem borers are the major and consistent pest of rice in South and South East Asia including Bangladesh. Among the three borer species active in Bangladesh, the yellow stem borer, *Scirpophaga incertulas* (Walker) (Pyralidae: Lepidoptera), is predominant in all four rice crops (Alam *et al.*, 1885). It usually passes through five to six generations per year. The matured larvae of the sixth and some of the fifth generations enter diapause from mid-October onwards (Islam, 1987). They remain in diapause during winter in deepwater rice (DWR) and transplant aman (T. Aman) rice stubble. Moths emerge from diapause populations during February and March and establish the first annual generation on boro rice (winter rice).

The DWR is harvested by cutting only the top 50-100 cm of the stem with the panicle, leaving 100-400 cm long stubble in the field. This is in contrast to other rice crops, where plants are cut near the base leaving about 10-20 cm high stubble in the field. The traditional method of threshing and drying of harvested paddy, and stacking of straw for cattle feed virtually kills all immature borers in the straw (Catling, 1980). Therefore, any increase in the populations of borers in the harvested straw may be regarded as greater mortality so that a

smaller population will survive to establish its first annual generation on the succeeding boro crop. Experiments were conducted, therefore, to evaluate the effects of harvest on the populations of diapausing *S. incertulas*.

Methods

The effect of harvesting of DWR (variety *Chamara*) on *S. incertulas* populations was investigated in a field at Mirzapur upazila of Tangail district during 1983-85. The crop was harvested during the third week of November. At harvest, all the plants were removed from 1.0 m^2 area, and stubbles were separated immediately by cutting off such lengths of straw as permitted by the local practice. The sample size was 4-5 m^2/ year. All the straw and stubble were dissected to assess yellow stem borer populations in them, and average lengths of straw and stubble were measured. Stubble from 3-12 m^2 area were sampled from the same field at 2-3 week intervals during the 1983-84 winter and dissected to determine the position of diapausing larvae in relation to the stubble base and the nearest node.

The effect of increasing harvested straw length on the yellow stem borer populations in DWR was investigated in a farmer's field at Mirzapur, Tangail in 1985. Experimental treatments were 50, 100 and 150 cm long straw. At harvest (variety *Bawalia Digha*) on November 1, all the plants from twelve 1.0 m^2 area were removed and the samples were randomly assigned to the treatments. The terminal parts of the stems were separated according to the straw lengths of the treatments and both straw and stubble were dissected to assess *S. incertulas* population. The heights of 30 randomly selected plants were measured.

The effect of harvest of T. Aman rice leaving different stubble heights on *S. incertulas* population was investigated in 1984 in the Bangladesh Rice Research Institute (BRRI) farm at Gazipur. At harvest, (2nd week of December), a T. Aman rice field (variety BR11) was divided into nine equal plots (6 x 12 m). The plots were randomly assigned to the treatments, 5, 15, and 30 cm stubble heights. Twenty randomly selected rice hills were harvested from each plot according to the treatment, and straw and stubble were dissected. Stubble hill density was estimated by quadrat (1.0 m^2) counts, 8 per plot. In January 1985, 90 stubble hills were dissected to determine the position of diapausing larvae in the T. Aman stubble during winter.

Results

On average, the harvested DWR straw were 82, 88 and 80 cm and stubble were 262, 306 and 271 cm long in 1983, 1984 and 1985, respectively. The population density of yellow stem borer was significantly higher in 1983 (15.5/m^2) than those in 1984 (1.6/m^2) and 1985 (2.6/m^2) ($p<o.05$, F-Test). Harvested straw had only 8, 13 and 15% of diapausing borer populations in 1983, 1984 and 1985 respectively, while the rest of them were in the stubble (Figure 1). During winter, larvae were present inside the stubble but on average 109.6±7.03 (n=79) away from the base and 1.0±0.03 cm from a node.

At the time of harvest of another DWR variety, *Bawalia Digha* in 1985, the plants were on average 337 cm long (n=30) and *S. incertulas* population density was low (1.83 /m^2). About 10, 20 and 29% of the borer larvae were removed from the field with 50, 100 and 150 cm long harvested straw respectively (Figure 2). Simple linear regression analysis revealed a positive linear relationship ($y=0.933 + 1.86x$, $r=0.996$, $p<0.05$) between the percentage of borer population and the harvested straw length indicating a greater proportion of borer in the straw with an increase in its length.

The T. Aman rice hill density was about 25/m^2. At the time of harvest (December 10), yellow stem borer density was 7.8/m^2. Harvest leaving 5 cm stubble height removed only 15% of the borer population with the straw from the field, while harvest leaving taller stubble (15 and 30 cm) left the entire population in the field stubble (Figure 3). During the winter (January 1985), all the larvae in the T. Aman stubble were below the soil surface (n=17).

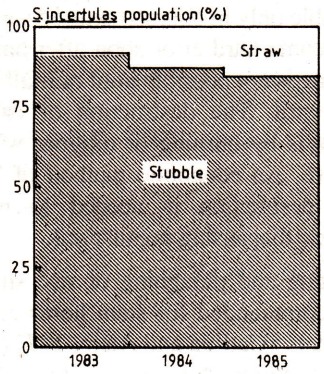

Figure 1: Proportion of *Scirpophaga incertulas* population in deepwater rice straw and stubble at harvest (variety *Chamara)* Tangail, Bangladesh 1983-85

Discussion

Harvesting of DWR removing standard straw lengths (83 cm weighted mean) eliminated only 12% of *S. incertulas* population from the field (Figure 1). On the other hand, the standard harvesting procedure for T. Aman (stubble height about 15 cm) left the entire population in the field stubble (Figure 2). At the time of harvest of T. Aman rice, most of the diapausing yellow stem borer larvae remained close to the plant base and harvesting had very little effect on them. Although the traditional threshing, straw drying and stacking methods had drastic effect on the live borers in the straw, their position in the stem during harvest at both T. Aman and DWR greatly reduced the impact of harvesting on them. The downward movement of larvae starting from mid- October, in response to diapause induction (Islam, 1987), saved them from the severe effect of harvesting, threshing and straw processing.

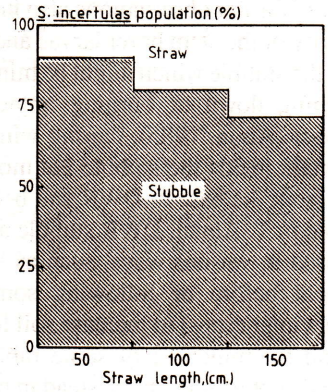

Figure2: Proportion of *Scirpophaga incertulas* population in deepwater rice straw and stubble as affeted by different straw lengths (variety *Bawalia Dîgha*),Tangail, Bangladesh, 1985.

The proportion of the stem borer larvae in the straw increased with the increase in the length of harvested DWR straw. There is a scope of reduction of about one-fith of *S. incertulas* populations from the field by increasing harvested DWR straw length from 83 cm to 100 cm (Figure 2). Rice straw is the major cattle feed and to avoid its toughness, the harvested straw length should not exceed 100-110 cm. Long straw (longer than 110 cm) will also make harvesting and threshing more difficult. On the other hand, the manipulation of harvested straw length had little effect on borer populations in case of T. Aman rice. The impact of harvest at the ground level had not been investigated and the operation was likely to be too labor-intensive and thus uneconomic. Therefore, the control of yellow stem borer in T. Aman rice stubble by the manipulation of

harvested straw length did not seem to be feasible.

The study revealed that a great majority of diapausing *S. incertulas* larvae remained in the field stubble of both T. Aman (100%) and DWR (88%) crops. So stubble destruction might play an important role in the population suppression. Earlier observations also indicated that majority of the stem borer larvae and pupae remain in the stubble which might be minimized by ploughing down or burning immediately after harvest (Anon. 1985). During winter, the larvae remain inside the stubble but more than 1m away from the base in DWR and below the soil surface in T. Aman. DWR stubble are long and are used in various ways, such as burning in the field before or following some rabi (non–rice winter crops) to increase soil fertility, as fuel and for mulching of some rabi crops. The stubble kept near the homestead in heaps to be used as fuel often remain so until March-April. The destruction of stubble following rabi crops usually takes place during March-April, later than the time of emergence of moths

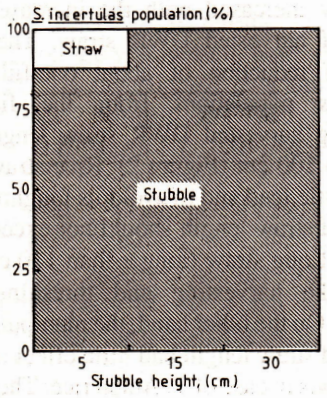

Figure 3: Proportion of *Scirpophaga incertulas* population in transplant aman rice straw and stubble as affected by different stubble height (variety BR11), Gazipur, Bangladesh 1984.

(February-March) from diapause populations. So it appears that the traditional method of DWR stubble destruction is not much effective for the reduction of *S. incertulas* populations.

On the other hand, the short T. Aman stubble have no economic importance, so these usually remain undisturbed in the field until the onset of the rainy season in March-April. But by that time the moths emerge and establish the first annual generation in boro rice fields. The destruction of stubble hills by ploughing may be possible only in course-textured soil but clay soils become hard at or soon after harvest and ploughing is not possible until rainfall begins in March-April. The destruction of isolated T. Aman hills by burning or digging will be too expensive. An economic method of T. Aman stubble destruction is needed to reduce *S. incertulas* diapausing populations.

Burning and ploughing of rice stubble has been recommended for stem horer control for many years (Catling and Alam, 1977) but these recommendation did not mention the precise time of destruction. Considering the ecology of the yellow stem borer, the stubble have to be destroyed by January before the emergence of moths. The DWR stubble do get burned, but usually after the emergence of moths from diapause. Farmers are unaware of the benefits of timely burning. Since moths can migrate to considerable distances, stubble destruction would be necessary in a large scale to derive benefits. United and coherent efforts for timely destruction of DWR and T. Aman stubble over large areas could crush *S. incertulas* diapausing populations to a very low level which in turn may result in a low damage to the succeeding boro and aus rice crops.

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