Efficiency of plant extracts to suppress population of yellow stem borer, *Scirpophaga incertulas* (Walker) of rice

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Abstract: Study was made to determine the efficiency of different plant extracts to suppress population of yellow stem borer, *Scirpophaga incertulas* (walker), a major pest of rice in Bangladesh. Plant extracts such as neem, nisinda, biskatali, urmoi and virtako 40WG (a chemical insecticide) were used for controlling yellow stem borer in different rice season during 2013 to 2014 in Bangladesh Institute of Nuclear Agriculture (BINA). Leaves and small branches of neem, nisinda, biskatali and urmoi (5 kg) were cut into small pieces and mixed with 10 liter of water. The water was boiled for 30-40 minutes. All these plant extracts were sprayed on rice crop at vegetative growth stage (45 days after transplanting) at the rate of 40 ml/liter of water. Virtako 40WG (Chemical control) was used at a rate of 1.5 ml/10 liter of water. The pretreatment dead hearts were counted 25 days after transplanting. After 15 days of spray, post-treatment dead hearts were counted. White heads were noted at 70 days after transplanting. Results showed that the plots treated with neem, nisinda and biskatali produced significantly higher yield of rice than untreated plot. The predator found in the experiments were almost same in number in the year 2013 and 2014 in both treated with neem extract and non-treated plots. The least number of the predator were recorded in plots treated with virtako 40WG. In terms of yield, higher yield was obtained in case of neem extract (6.65 t/ha). Considdering infestation of stem borer, yield and conservation of predators, neem extract can be regarded as alternative of the insecticide in rice pest management system.
Key words: Yellow stem borer, rice, neem, nisinda, biskatali, urmoi and virtako 40WG.

Introduction

Rice (*Oryza sativa* L.) is one of the most important crop in the world, providing food for nearly half of the global population (Khuhro, 1988; FAO, 2004). Rice is grown on over 145 million hectares in more than 110 countries. It occupies one fifth of the world crop land under cereal (Pathak and Khan, 1994). Almost 90 % of the rice is grown and consumed in Asia. It is used as a food more than two billion people in developing countries of Asia (FAO, 1995; Khush and Brar, 2002).

The rice plant is subjected to attack by more than hundred species of insects, twenty of them can cause economic damage (Chatterjee and Maiti, 1979). They infest all parts of plants, at all growth stages (Pathak and Khan, 1994). Among them, the rice stem borers are the main devastators, which are responsible for economic crop losses in Bangladesh (Mahar and Hakro, 1979). Among the stem borers, yellow rice stem borer, *S. incerulas* (Walker) is the most destructive insect pests of rice crop (Mahar *et al.,* 1985). Globally, yellow rice stem borer alone causes yield losses of 10 million tones and accounts for 50% of all insecticides used in rice field (Huesing and English, 2004). The stem borer attacks rice crop from the seedling stage to the harvesting stage and thus causes complete loss of affected tillers (Salim and Masih, 1987). Dead hearts are produced when the insect attacks at vegetative stage while white heads occur when the stem borer attack at the time of heading (Mahmood-ur-Rehman *et al*., 2007). Ukwungwnu (1990) reported yellow rice stem borer as an important insect pest of rice in most part of the world. It has been implicated as the major constraint to rice production worldwide. Yellow rice stem borer (*S. incertulas*) is responsible for a steady annual damage of 15-10 % of the rice crop with local catastrophic outbreaks of up to 60 % damage (Pathak and Khan 1994; Daryaei, 2005). Yellow rice stem borer remains active from April - October and passes 4-5 generations in this period. The larvae of the last generation hibernate in rice stubbles from November to the end of March and early April (Rehman *et al*, 2002). The hibernating larvae enter in diapauses and remain in their hibernation until pupation (Mahar and Hakro, 1979). The cycle behaviours of the yellow rice stem borer, its period of activity, infestation and growth trends are peculiar to plan a sound pest management program. Sonatakke *et al.,* (1997) recorded more incidence of yellow rice stem borer in the farmer's practice than the field subjected to Integrated Pest Management.

Indiscriminate use of chemical pesticides has caused major outbreaks of insect pests. In the last three decades, only attention was paid to chemical control of pests in Bangladesh. Integrated pest management (IPM) offers promise to reduce dependence on pesticides. Pest management is an intelligent selection and use of pests management tactics by taking into consideration appropriate economics, ecological and sociological factors (Salim *et al.,* 2003).

The use of chemical insecticides has created many problems such as environmental hazards, resistance in target species (Hollomon, 1993). A part from environmental hazards, the import bill of pesticides impose additional burden on Bangladesh economy. In addition, poor farmers can not afford to apply expensive insecticides. In Bangladesh insecticides are not applied at the right time or at right places. Non judicious uses of pesticides leave residues in food and increase the resistance of pest populations (Markham *et al*., 1991). Resistant insect populations can destroy the effectiveness of pesticides. The wrong use of chemical insecticides can also be harmful to human beings and the environment (Schwab, 1989).

In Bangladesh, use of insecticides has been the common practice for controlling stem borer and no alternative method has yet been developed to control this damaging pest. Implementation of integrated pest management emphasizing mainly on use of some important plant extract namely neem, nisinda, biskatali and urmoi in rice field to manage yellow stem borer may reduce the traditional uses of insecticides. Therefore, the present study was undertaken to evaluate the performance of some plant extract in controlling yellow stem borer of rice.

Materials and Methods

The experiment was conducted in the experimental field of BINA Mymensingh, during the year 2013 and 2014 in Randomized Complete Block Design (RCBD), having six treatments and the treatments were (i) T_1 = Neem, (ii) T_2 = Nisinda, (iii) T_3 = Biskatali, (iv) T_4 = Urmoi, (v) T_5 = Virtako 40WG (Chemical control), and (vi) T_6 = Control (Without insecticide). Experiment was repeated thrice in a net experimental area of 20 m^2. Seedling of aman rice variety Binadhan-7 was transplanted on 20 July 2013 and 22 July 2014. Nursery of aman rice variety Binadhan-7 was sown 20 June 2013 and 22 June 2014. Line transplanting was done on 20 July 2013 and 22 July 2014 at plant to plant 15 cm and row to row 20 cm spacing. Plant extracts were prepared with following procedures. Leaves and small branches of neem, nisinda, biskatali and urmoi (5 kg) were cut into small pieces and mixed with 10 liter of water. The water was boiled for 30-40 minutes. The solution was kept to become cool for about 2 hours then filtered. All these plant extracts were sprayed on rice crop at vegetative growth stage (45 days after transplanting) at the rate of 40 ml/liter of water. Virtako 40WG (Chemical control) was used at a rate of 1.5 ml/10 liter of water.

The collection and identification of predators of yellow rice stem borer was started after 25 days of transplanting, at 7 days interval, which was continued up to 100 days after transplanting to record the availability of predators. The predators were collected by sweep method (Dhuyo, 1986).

The diameter of the net was 33.5 cm with 1.0 meter long handle. The collection was made in each treatment and replication for 25-30 minutes. The collected predators were kept separately, and identified in the laboratory.

The pretreatment dead hearts (D.H.) were counted 25 days after transplanting. After 15 days of the spray, post-treatment dead hearts were counted. White heads (W. H.) were noted at 70 days after transplanting. The dead hearts and white heads percentages were calculated on Abbott's formula (Abbott, 1925). Tiller count was determined from randomly selected 10 hills in each treatment and replication. Filled grain and unfilled grains were counted in laboratory on 10 selected panicles from each treatment and replication, the sterility percent was counted by Total grains minus (-) filled grains divided (/) total grains multiply (x) 100. The area of 1 x 1 m from each treatment and replication was harvested to obtain paddy yield, which was calculated as kg/ha. The data were averaged, tabulated and statistically analyzed using statistical program MSTAT. The mean differences among the treatments were adjudged as per tested with DMRT and LSD test, when necessary (Gomez and Gomez, 1984).

Results and Discussion

Pre-treatment dead hearts were recorded before the application of plant extracts / chemical pesticides (30 days after transplanting). Pre-treatment dead heart count aimed to determine the availability of yellow rice stem borer, extent of damage caused by them and effectiveness of treatments to control targeted insect. Pre-treatment dead heart count for the year 2013 and 2014 showed that 5.10 to 8.23 and 6.05 to 9.54 % respectively tillers were damaged by yellow rice stem borer (Tables 1 &, 2) which witnessed the availability of yellow rice stem borer larvae in the experiment.

Table 1. Pre- and post-treatment dead hearts (%) and white heads (%) in rice variety Binadhan-7 in different treatments for the year, 2013

Treatment	Pre- treatment (Dead heart %)	Post-treatment (Dead heart %)	White head %
T_1 - Neem	5.10	3.15b	3.77b
T_2 - Nisinda	4.07	3.98b	4.23b
T_3 - Biskatali	5.45	4.11b	4.45b
T_4 - Urmoi	6.33	4.01b	4.74b
T_5 - Virtako 40WG (Chemical control)	8.23	3.27b	3.89b
T_6 - Control (Without insecticide)	7.54	8.98a	9.54a

Table 2. Pre- and post-treatment dead hearts (%) and white heads (%) in rice variety Binadhan-7 in different treatments for the year, 2014

Treatment	Pre- treatment (Dead heart %)	Post-treatment (Dead heart %)	White head %
T_1 - Neem	6.05	3.74b	3.09b
T_2 - Nisinda	6.89	3.91b	3.75b
T_3 - Biskatali	7.01	4.11b	3.22b
T_4 - Urmoi	7.69	4.25b	4.75b
T_5 - Virtako 40WG (Chemical control)	9.54	4.01b	3.82b
T_6 - Control (Without insecticide)	8.11	10.18a	10.54a

Comparable but significantly higher number of productive tillers produced in treated than non-treated plots revealed that plant extracts have controlled yellow rice stem borer as efficiently as chemical pesticides. The result also showed that more number of filled gains / panicle was obtained from treated plots than non-treated (Tables 3 and 4). The results of paddy yield depicted in Table 4 and 5 showed that the plots treated with Neem, Nisinda and Biskatali produced significantly higher yield than untreated plot. In terms of yield, higher yield was obtained

in case of neem extracts (6.65 t/ha), nisinda (5.88 t/ha), biskatali (5.97 t/ha), urmoi (5.45 t/ha), virtako (6.05 t/ha) and control (3.74 t/ha) for the year, 2013.

Table 3. Paddy yield and yield attributing characters of rice variety Binadhan-7 in different treatments for the year, 2013

Treatment	Productive tillers	Filled Grain	Sterility %	Yield (t/ha)
T_1 - Neem	17a	157	3.98	6.65a
T_2 - Nisinda	19a	158	3.61	5.88a
T_3 - Biskatali	18a	148	4.54	5.97a
T_4 - Urmoi	16a	167	5.44	5.45b
T_5 - Virtako 40WG (Chemical control)	18a	171	3.91	6.05a
T_6 - Control (Without insecticide)	14b	138	10.55	3.74b

Table 4. Paddy yield and yield attributing characters of rice variety Binadhan-7 in different treatments for the year, 2014

Treatment	Productive tillers	Filled Grain	Sterility %	Yield (t/ha)
T_1 - Neem	19a	156	4.34	6.31a
T_2 - Nisinda	20a	148	3.98	5.88a
T_3 - Biskatali	18a	159	4.75	5.53a
T_4 - Urmoi	17a	149	3.85	6.01a
T_5 - Virtako 40WG (Chemical control)	18a	160	4.05	5.62a
T_6 - Control (Without insecticide)	15b	140	9.89	3.98b

The results on the availability of predators in different treatment are shown in Tables 5 & 6. The predators found in the experiments were almost same in number in the years 2013 and 2014 in the both treated with neem extract and non-treated plots, which were more than the number of predators available in other treatments. The least number of the predators were recorded in plots treated with Virtako 40WG. Dragon flies and Damsel flies were abundant in the experimental area. The results indicated that the plant extracts had no adverse effect on predators than Virtako 40WG.

Table 5. Population of different predators in rice variety Binadhan-7 in different treatments for the year, 2013

Treatment	Predators				
	Lady bird beetle	Carabid beetle	Long horn grasshopper	Dragon flies	Damsel flies
T_1 - Neem	15	11	10	5	4
T_2 - Nisinda	10	7	5	2	2
T_3 - Biskatali	9	8	6	2	2
T_4 - Urmoi	8	8	5	3	1
T_5 - Virtako 40WG (Chemical control)	1	2	1	1	0
T_6 - Control (Without insecticide)	18	19	11	6	5

Table 6. Population of different predators in rice variety Binadhan-7 in different treatments for the year, 2014

Treatment	Predators				
	Lady bird beetle	Carabid beetle	Long horn grasshopper	Dragon flies	Damsel flies
T_1 - Neem	17	15	12	5	6
T_2 - Nisinda	11	9	10	3	4
T_3 - Biskatali	15	10	11	4	4
T_4 - Urmoi	13	11	9	3	3
T_5 - Virtako 40WG (Chemical control)	2	1	2	1	2
T_6 - Control (Without insecticide)	20	18	14	7	8

The results of this study indicate that the lowest dead hearts, white heads % and maximum paddy yield were recorded in the neem extract treatment than other treatments. More number of predators was also found in the neem extract treated plots than the other plant extracts. These results are in line with the findings of Dodan and Roshanlal (1999), Kaul and Sharma (1999), Rath (1999 & 2001), Bora *et al.* (2004) and Prasad *et al.* (2004) who found Neem products to control yellow rice stem borer. Therefore, it is concluded that neem extract is the most suitable alternate of chemical pesticide to be sprayed on rice crop for controlling yellow rice stem borer without disrupting agro-eco-system.

References

Abbott, W.S. 1925. A method for computing the effectiveness of an insecticide. J. Econ. Entomol. 18; 265-676.

Bora, D.K.; Bhuyan,U.; Katti,G.; Pasalu, I.C. 2004. Quantification of insect pest and natural enemy incidence vis a vis yield. Uttar Pradesh Journal of Zoology VL: 24 SS: 2 pp. 187-190

Chatterjee, B.N. and Maiti, S.1979. Rice production technology manual. Oxford and 1BH publishing Co. New Delhi Bombay Calcatta., pp. 63.

Daryaei, M.G. 2005. Assessment yield loss in rice due to yellow stem borer *Scirpophagha incertulas* using simulation

models. Caspion Journal of environmental science, vol.3 pp 59-62.

Dhuyo, A. R. 1986. Insect pollinator complex of Cotton crop *Gessypium hirsutum* (L) at Tanojam. *Cotton* 30 (3) 45-47.

Dodan, D.S. and Roshan Lal 1999. Integrated management of neck blast and stem borer in scented rice. Haryana Agricultural University Journal of Research VL: 29 SS: 1/2 PP: 47-49.

FAO 1995. (Food and Agriculture Organization of the United Nations) FAO Quarterly Bulletin of Statistics, Vol 8, No.1-2.

FAO 2004. (Food and Agriculture Organization of the United Nations) The state of food security in the world, p. 30-31.

Gomez, K.A. and Gomez A.A. 1984. Duncan's Multiple Range Test. Statistical Procedures for Agricultural Research 2nd End. John Wiley and Sons, pp. 207-215.

Hollomon, D. W. 1993. Pesticide Resistance. Chemistry and Industry, 15,892-895.

Huesing, J. and English, L. 2004. The impact of Bt. Crops on the developing world. Ag Bio forum vol. 7 No.1-2, P.84-95.

Kaul, B.K. and Sharma, P.K. 1999. Efficacy of neem based insecticides against the major insect pests of rice in the hills of Himachal Pradesh (India). Journal of Entomological Research VL: 23 SS: 4 PP: 377-379.

Khuhro, G.A. 1988. Effect of methods and time of threshing on grain losses and milling recovery of IR-6 variety of rice. Pak, J, Agri. Engg., Vet. Sc.4(1-2).

Khush, G.S. and Brar, D.S. 2002. Biotechnology for rice breeding: Progress and potential impact. In proceeding of the 20th Session of the International Rice Commission (23rd -26th July, Bangkok, Thailand). Available from internet. http:/www fao.org/docrep/006/Y475E/y 4751e04.htm.

Mahar, M.M. and Hakro, M.R. 1979. The prospects and possibilities of Yellow Rice Stem Borer Eradication, under Sindh Condition. Paper presented at the Rice Research and Production Seminar held at Islamabad From 18-22 February.

Mahar, M.M., Bhatti, I.M. and Dhuyo, A.R. 1985. Stem borer infestation and yield loss relationship in rice and cost-benefits of control. Paper presented at 5th National Seminar on Rice and Production. Kalashakaku, April 23-25, 1985, Pakistan.

Mahmood-ur-Rehman, Hamza Rashid, Ahmed Ali Shahid, Khurram Bashir, Tayyab Hussain and Shaikh Riazuddin 2007. Insect resistance and risk assessment studies of advanced generation of Basmati Rice Expressing two genes of *Bacillus thuringienses* , Electronic Journal of Biotechnology Vol.10 No.2, Page No 1-13

Markham, R. H., Wright, V.F. and Rios Ibarra, R.M. 1991. Selective review of research on *Prostephanus truncatus* (Coleoptera : Bostrichidae) with in an noted and up dated bibliography. *J. CEIBA*, 32 (1): 3 - 90.

Pathak, M.D and Khan, Z.R. 1994. Insect pests of rice. International Rice Research Institute, P.O box 933, 10999, Manila, Philippines. Page 1-17.

Prasad, S.S, Gupta, P.K, Singh, R.B. and Kanaujia, B. L. 2004. Evaluation of neem products was tested against yellow rice stem borer, *Scirpopapha incertulas* on deep water rice. Annals of Plant Protection Science. VL. 2, Pp 426-428.

Rath, P.C.1999. Evaluation of some *Bacillus huringiensis* and neem formulations against yellow stem borer of rice under rainfed lowlands. Oryza VL: 36 PP: 398-399.

Rath, P.C. 2001. Efficacy of insecticides, neem and Bt ormulation against stem borer on rice yield in West Bengal. Journal of Applied Zoological Researches VL: 12 PP: 191-193.

Rehmam. A., Ehsan-ul-Haq and Inayatullah, C. 2002. Impact of tillage practices and cropping patterns on the survival of yellow rice stem borer, *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyraliade). Pak. J. Agri. Res. 17(3): 282289.

Salim, M. and Masih, R. 1987. Efficacy of insecticides against rice stem borer at NARC, Islamabad Pakistan Journal of Agricultural Research, Vol.8 no.4, P.477-479.

Salim, M., Akram; M. Ehsan Akhtar. and Ashraf, M. 2003. Balance Fertilization for Maximizing Economic Crop Yield. Rice. A production hand book. Pakistan Agricultural Research Councal, Islambad.

Schwab, A. 1989. Pestizideinsatz in Entwicklungslandern; Gefahren und Alternativen. *PAN,* Pestizid Aktions -Netzwerk e.v. -Weikersheim, Margraf, 1989. 274 pp.

Sonatakke, B.K., Panda, S.K. and Rath, L.K. 1997. Effect of date of planting, varietal resistance and chemical control on rice stem borer incidence in Western Orissa. Indian Journal of Entomology vol. 59, PP: 423-429.

Ukwungwnu M. N. 1990. Influence of seedling age at transplanting on stem borer infestation and yield of rice Nig. J. Plant Prot. 13.19-22.