Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 9, No. 5, p. 105-109, 2016
http://www.innspub.net

INNSPUB

RESEARCH PAPER OPEN ACCESS

Alarming presence of three rice stem borer species in irrigated lowland rice agroecosystem in Midsayap, North Cotabato, Philippines

Gina D. Balleras*[1], Marjie S. Doverte[1], Leah E. Endonela[2]

[1]*Philippine Rice Research Institute, Department of Agriculture, North Cotabato, Philippines*

[2]*College of Agriculture, University of The Philippines Los Banos Laguna, Philippines*

Article published on November 25, 2016

Key words: Population dynamics, Rice stem borer, IR 77186-122-2-2-3, Philippines

Abstract

The population of the three RSB species namely, white stem borer (WSB), *Scirpophaga innotata* (Walker), striped stem borer (SSB), *Chilo suppressalis* (Walker) and pink stem borer (PSB), *Sesamia inference* (Walker) was monitored in a five ha irrigated lowland rice field planted with medium maturing rice variety IR 77186-122-2-2-3 (NSIC 158) during the 2015 wet season cropping. Field sampling was done at 21 days and then at fortnightly interval thereafter. A total of 100 hills with RSB damage were collected per sampling. Infested tillers were dissected and the number of RSB larvae present was recorded. WSB and SSB were present throughout the crop growing season, while PSB was only recorded during the flowering stage. SSB was the most dominant species followed by WSB and PSB. Interestingly, co-occurrence of RSB species in a single tiller was prevalent from seedling to maturity. At vegetative stage, 52% of the "deadheart" was attributed to combined effects of WSB+SSB larvae feeding. At reproductive stage, 44% of the "whitehead" was due to WSB+SSB and WSB+PSB. The extent of damage posed by mutualistic association of two RSB species is much greater than the average individual effects. There were no records of SSB and PSB occupying the same tiller. This complex population dynamics exhibited by RSB species and the extent of crop losses accounted to RSB infestation should be considered in rice research and development programs in the Philippines.

***Corresponding Author:** Gina D. Balleras ✉ gdballeras@gmail.com

Introduction

Rice stem borer (RSB) is one of the major economic insect pest of rice in Southeast Asian countries (Litsinger *et al*., 2011). RSB is dificult to manage due to its ubiquity, high adaptability to wetland rice and continuous generation cycle throughout rice growing season. The present modern rice varieties can compensate RSB damage at certain level without affecting yield potential (Litsinger, 1991). However, multiple crop stresses accentuate from RSB larval feeding injury which often result to significant annual production losses. Moreover, RSB has developed adaptive mechanisms to resistant varieties and an array of synthetic pesticides making them resilient to innovations across the rice agro-ecosytem landscapes.

Different RSB species invade specific regions and rice agroecosystem. In the Philippines, the five RSB species namely, yellow (YSB) *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyralidae), white (WSB) *Scirpophaga innotata* (Walker) (Lepidoptera: Pyralidae], pink (PSB) *Sesamia inferens* (Walker), (Lepidoptera: Noctuidae], stripped (SSB) *Chilo suppressalis* (Walker), (Lepidoptera: Pyralidae) and gold-fringed (GFSB) *Chilo auricillus* (Dudgeon) (Lepidoptera: Crambidae) have distinct distribution pattern (Litsinger *et al*., 2011). YSB have dominated, over SSB and PSB, rice growing areas in Luzon particularly the upland rices; while WSB in the irrigated low land rice fields in Visayas and Mindanao (Cendana and Calora, 1967). Recently, however, Balleras and Endonela (2014) have accidentally documented overlapping population of YSB, PSB, SSB and WSB while doing field survey on upland rices in North Cotabato Province in Mindanao. Despite the alarming RSB infestation in rice growing province, development of areawide control meassures is of less priority.

Studies on major rice insect pests in the Philippines is hampered by limitted research materials. Information on the biology of rice stem borer by rice insecct pest species have varied generation cycles from egg deposition to moth emergence ranging from 35-70 d (Litsinger *et al*., 2011). Larvae share common structural fearures hence are diffiicult to identify (Islam 1990a and 1990b). Whitehead and deadheart caused by RSB larval feeding are also difficult to distinguished for each species. So far, huge amount of information has been generated on individual species, including damage, area-wide distribution, and plant interaction, and the role of natural enemies (Noorozi *et al*., 2015; Singh *et al*., 2014; Sarwar, 2012; Cheng *et al*., 2010. Bandong and Litsinger, 2005;). However, reports on population dynamics and interspecific interactions of RSB species present at given geographical and temporal scales are still fragmentary. Hence, this study was undertaken to assess larvae population dynamics and potential interspecific interaction among RSB species under irrigated lowland rice fields in Midsayap, North Cotabato, Philippines.

Materials and methods

Study site

The study was conducted at the Midsayap Experimental Station (MES), Philippine Rice Research Institute (PhilRice), Department of Agriculture (DA), Midsayap, North Cotabato, Philippines (37 25.818'N; 122 05.36'W). Midsayap experience the Type IV climate which is characterized by more or less even distribution of rainfall throughout the year. The soil type in the lowland is best suitable for irrigated rice and seasonal vegetable production. Midsayap has been one of the beneficiaries of the National Irrigation System since its construction in 1978. The area is less affected by typhoon and other extreme climatic events. Such conditions favour the double or triple cropping of rice depending on rice varieties cultivated. However, rice industry is hampered by insect pests. Severe infestation of rice stem borer (RSB) in has been a perennial problem of local farmers and rice growers in North Cotabato and adjacent provinces in Mindanao.

Plant materials

The medium maturing rice variety NSIC Rc 158 (IR77186-122-2-2-3) was used in the study. NSIC Rc 158 mature in 113 days after seeding and produce an average yield of 6.01 t ha^{-1}. This variety has moderate resistance to "deadheart" and resistant to "whitehead".

Field sampling techniques and data analysis

Field monitoring and sampling was conducted in a 5-ha irrigated lowland rice field at the PhilRice-DA, North Cotabato, Philippines during the 2015 wet season cropping. Sampling was done starting at 21 DAT and fortnightly interval thereafter. A total of 100 hills were collected randomly per sampling. Infested tillers were excised longitudinally to assess the RSB feeding behaviour and damage pattern. All the collected RSB larvae were identified up to species level based on the description provided by Barrion and Litsinger (1994 and 1995).

The total larvae count per sampling was recorded. Mega Stat version 10.0 (Orris, 2005) was used in all statistical analysis.

Results and discussion

Population dynamics of RSB species

The presence of the three rice stem borer (RSB) species namely, white stem borer (WSB, *Scirpophaga innotata* Walker), striped stem borer (SSB, *Chilo suppressalis* Walker) and pink stem borer (PSB, *Sesamia inference* Walker) in PhilRice, MES, Midsayap, Cotabato, Philippines was first recorded this the study. Different RSB species dominate at varying crop growth stages (Fig. 1).

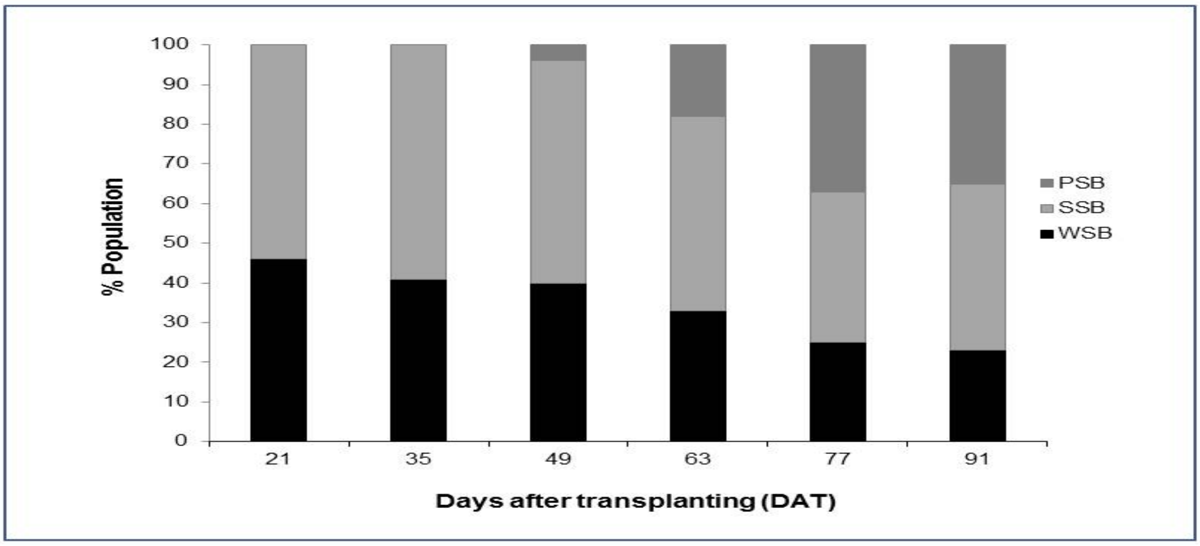

Fig. 1. Percent population of three rice stem borer species (RSB) namely, white stem borer (WSB), striped stem borer (SSB) and pink stem borer (PSB) at recorded from 21 to 91 days after transplanting (DAT) using NSIC Rc 158 grown under irrigated lowland rice paddy at Philippine Rice Research Institute, Midsayap Experimental Station, Midsayap, North Cotabato Philippines, wet season 2015.

Incidence of WSB and SSB was recorded from seedling to harvesting, while PSB arrived only at the onset of flowering stage. At 21 DAT, neonate WSB and SSB larvae bore into the stem through the leaf sheath stay in the pith and feed on the inner surface of the stem wall. A single tiller with 5-7 leaves can accommodate 2-5 larvae. Each species makes individual entrance whole on different internodes. During severe infestation, when the septa are damaged, WSB and SSB larvae may group together without harming each other. As the larvae grow and develop, the food and space became limiting, the larvae will either stay on the original tiller or will transfer to another tiller (Chen and Romena, 2006). Usually, WSB larvae preferred to stay and positioned itself on the lowermost internode until it reaches the pupal stage (Cohen *et al.*, 2000; Dirie *et al.*, 2000.). The SSB larvae, on the other hand, used to find new effective tiller on the same or adjacent hill. At maximum tillering stage (35 to 49 DAT) larval feeding may cause minimal visible symptoms (Catling *et al.*, 1987; Islam, 1990), most of the larvae are located on the 5th to 7th internode and feed on the developing panicle. Damaged panicles will no longer develop and the central whorl will slowly dry as also reported by Bandong and Litsinger (2005). The increase of PSB larvae population at 63 to 77 DAT (17%) has triggered competition for food and space resulting to 19% decrease in SSB (11%) and WSB (8%) population. This illustrates that interspecific interactions between and among RSB species have varying effect on population dynamics at a given spatial and temporal scale.

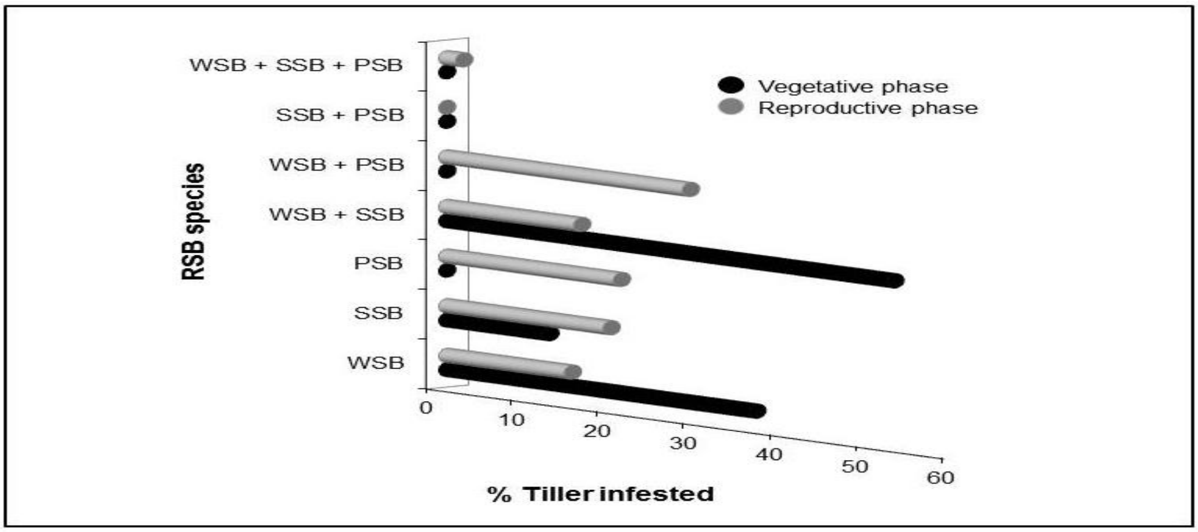

Fig. 2. Percent tiller infested of three rice stem borer (RSB) species namely, namely, white stem borer (WSB), striped stem borer (SSB) and pink stem borer (PSB) at vegetative and reproductive phase using NSIC Rc 158 grown under irrigated lowland rice paddy at Philippine Rice Research Institute, Midsayap Experimental Station, Midsayap, North Cotabato Philippines, wet season 2015.

Interspecific association between and among RSB species

Interspecific interaction among RSB species was assessed based on the frequency of co-occurrence of RSB larvae in a single tiller (Fig. 2). At seedling stage, WSB and SSB larvae disperse individually such that the total number of infested tiller examined was equal to the total number of larvae collected. However, as the tillers grow in size and increase in internode diameter, two to five RSB larvae could clump inside a tingle tiller.

At vegetative phase, 36% of the “deadheart” was accounted to WSB, 12% to SSB and 52% to WSB+SSB larvae feeding damage. At reproductive phase, 28.3% of the “whitehead” was attributed to combined WSB+PSB damage, 15.7% to WSB+SSB and 2% to WSB+SSB+PSB; the remaining 53.7% was due to individual species damage.

Remarkably, there were no records of SSB+PSB occupying the same tiller. The data above illustrates that SSB and WSB exhibit mutualistic relationship, while PSB exhibit positive relationship with WSB but might be antagonistic to SSB. The possibility of such interaction among these phytophagous rice insects was described by Kaplan and Denno (2007).

Conclusion

The presence of WSB (*S. innotata*), SSB (*C. suppressalis*) and PSB (*S. inference*) was recorded in irrigated rice production in North Cotabato Province, Mindanao, Philippines during the 2015 wet season cropping. Percent population of the three RSB species vary at given rice growth and developmental stage. SSB was the most dominant species throughout the cropping season, followed by WSB and PSB. The presence of WSB+SSB in a single tiller was prevalent during the vegetative phase while, WSB+PSB during the reproductive phase. Co-occurence of RSB larvae in a single tiller caused severe damage to IR77186-122-2-2-3. IR77186-122-2-2-3 has moderate resistance to "deadheart" and resistant to "whitehead".

This information is fundamental in developing ecological control measure against RSB infestation particularly in North Cotabato, Mindanao, Philippines.

Acknowledgement

The authors are grateful to Rolly O. Quiman and Leny Jean D. Pedregosa for technical assistance and the Department of Agriculture, Philippine Rice Research Institute, Midsayap Experimental Station, Midsayap, North Cotabato, Philippines for the financial support.

References

Balleras GD, Endonela LE. 2014. Aboveground arthropod composition, abundance and guild structure in upland rice at Matalam, North Cotabato, Philippines. IAMURE Journal of Ecology and Conservation **9(1),** 61-76.

Bandong JP, Litsinger JA. 2005. Rice crop stage susceptibility to the rice yellow stemborer *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyralidae). International Journal of Pest Management **51,** 37-43.

Catling HD, Islam Z, Patrasudhi R. 1987. Assessing yield losses in deepwater rice due to yellow stem borer *Scirpophaga incertulas* (Walker) in Bangladesh and Thailand. Crop Protection **6(1),** 20-27.

Chen YH, Romena A. 2006. Feeding patterns of *Scirpophaga incertulas* (Lepidoptera: Crambidae) on wild and cultivated rice during the booting stage. Environmental Entomology **35(4),** 1094-1102.

Cheng X, Chang C, Dai SM. 2010. Responses of striped stem borer, *Chilo suppressalis* (Lepidoptera: Pyralidae), from Taiwan to a range of insecticides. Pest Management Science **66**, 762–766.

Cohen M, Romena A, Gould F. 2000. Dispersal by larvae of stem borer *Scirpophaga incertulas* (Lepidoptera: Pyralidae) and *Chilo suppressalis* (Lepidoptera: Crambidae) in plots of transplanted rice. Environmental Entomology **5,** 958.

Dirie AM, Cohen MB, Gould F. 2000. Larval dispersal and survival of *Scirpophaga incertulas* (Lepidoptera: Pyralidae) and *Chilo suppressalis* (Lepidoptera: Crambidae) on cry1Ab-transformed and non-transgenic rice. Environmental Entomology **29**, 972-978.

Kaplan I, Denno RF. 2007. Interspecific interactions in phytophagous insects revisited: a quantitative assessment of competition theory. Ecology Letters **10,** 977-994.

Malhi BS, Brar DS. 1998. Biology of yellow stem borer, *Scirpophaga incertulas* Walker on Basmati rice. Basmati rice**.** Journal Insect Science **11,** 27-129.

Noorozi M, Sabertanha BA, Zebardast MA, Mohammandi MO, Fakheri B, Sattari A. 2015. Breeding for stem borer in rice. International Journal of Farming and Allied Sciences **4(6),** 510-513.

Orris JB. 2005. Megastat version 10.0. Butler University, College of Business Administration, 4600 Sunset Ave, Indianapolis. Distributed by McGraw-Hill.
http://www.mhhe.com/support

Pathak MD. 1968. Ecology of rice pests. Journal Insect Science **13**, 257-294.

Sarwar M. 2012. Management of rice stem borers (Lepidoptera: Pyralidae) through host plant resistance in early, medium and late plantings of rice (*Oryza sativa* L.). Journal of Cereals and Oil seeds **3(1)**, 10-14.

Singh D, Singh AK, Kumar A. 2014. On-farm evaluation of integrated management of rice yellow stem borer (*Scirpophaga incertulas* Walk.) in rice-wheat cropping system under lowland condition. Journal of AgriSearch **11(1),** 40-44.