Pak. j. sci. ind. res. Ser. B: biol. sci. 2023 **66B**(1) 52-57

Prevalence Position of Stem Borer Species in Rice Ecosystem in Lower and Upper Sindh

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(received July 6, 2020; revised March 29, 2021; accepted April 6, 2021)

Abstract. Rice occupies the prime place among the World's most important food crops. More than half of the human population depend upon rice and limiting factors of stem borers is prime importance. In order to manage these pests, it is essential to understand their population fluctuations, incidence, infestation to determine authentic, easiest and economically viable strategies for stem borer management. In this regard, a field study was conducted in upper and lower Sindh in district Larkana and Badin in the south east of Pakistan for the year Kharif (autumn season) 2017 and 2018 with crop surveys carried out at maximum tillering (60 days after transplant (DAT)). The results found that four species of stem borers were prevalent across the two years, namely White stem borer, *Scirpophaga innotata* (Walker), Yellow stem borer *Scirpophaga incertulas* (Walker) Pink stem borer *Sesmia inferens* (Walker) and dark-headed stripped borer, *Chilo polychrysus* (Meyrick). Collectively results of both years White stem borer was found dominant over other species of stem borers with the higher population was recorded at crop growth stages.

Keywords: monitoring, stem borer, rice crop

Introduction

Among the leading foods crop of the world, the rice ranks the third in production after wheat and maize, rice 741.5 million tons in 2014 (FAO STAT, 2017; Awan and Alam, 2015). Approximately 90% of rice is produced and consumed in Asia, while the rest 10% in other parts of the world except Antarctica) with a total production of 685 million tons and productivity 4328 Kg/ha (Saxena and Murty, 2014; Ampong and De Datta, 1991). Rice is the staple food for approximately half of the World's population, In Pakistan rice is second in consumption and cultivation and is major Kharif crop of Pakistan, mainly grown in Punjab and Sindh (Memon, 2013; Abedullah *et al*., 2007). The area under cultivation for the year 2014-15 was 2890.6 thousand ha, the major was of Punjab 1877 thousand ha, Sindh 781.7 thousand ha and total yield was 7002.8 thousand tons and province share were 3648.0, 2552.6, 131.0 and 571.2 tons/ha and yield was 2423, 1943, 3393, 2302 Kg and 3227 Kg respectively (Shah *et al*., 2019). A complex of stem borers (Lepidoptera) occurs widely and cause severe yield loss in rice crop and reported 24 species in Sindh (Sarwar, 2012; Mahar, 1986). The Yellow stem borer (*S. Incertulas* (Walker), White stem borer (S. *Innotata* (Walker), Stripped borer *C. Polychrysus* (Meyrick) and Pink stem borer (*S. Inferens* (Walker) are the destructive pests of paddy crop from seeding to maturity (Salim *et al*., 1991; Inayatullah *et al*., 1986). Stem borer larvae lose initially the inner sheath of leaves (Alinia *et al.,* 2000; Moiz, 1967). The crop infestation occasionally goes up to 90% (Saleem *et al*., 1991; Mahar *et al*., 1986). The boring of the stem by caterpillars often leads to severing of the epical parts of plant and as a result the central leaf whorl does not open, turns brown

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(commonly referred to as dead heart) and affected tillers do not bear panicles, being erect and white (white heads). If infestation persists through to the ripening stage of crop, then plant bear chaff ears (panicles without grain), a condition commonly referred to White Ear Head (WEH).

In Asia stem borers occur widely cause severe yield losses in paddy crop (Rahman *et al*., 2004). According to (Sarwar, 2012: Chaudhary *et al*., 1984) the yield losses in rice crop by stem borers 20-30% by GFSB up to 60% by DHSB, 2-100% by SSB, 1-19% in early crop and 38-80% in late crop by Yellow stem borer, upto 95% by White stem borer and 50-60% by Pink stem borer. If the attack takes place during the booting stage the yield losses could be as high as 90-95% and White stem borer, *S. Innotata* is reported in all rice corners of Pakistan, Australia and south east Asia (Rehman, 2002).

However, the use of insecticides against stem borer of rice has a significant detrimental impact on the ecosystem and has created environmental pollution, health disorders and hazards to food (Chang *et al*., 2020; Chang *et al*., 2019; Uddin *et al*., 2019; El-Wakeil, 2013). Keeping in view the economic importance of stem borer of rice, field studies were conducted in the lower and upper belt of Sindh Pakistan at district Badin and Larkana for the year Kharif 2017 and 2018, in the response of rice stem borers, the outcome is important to understanding borers response to rice crop and efforts to develop management strategies that minimize degradation of the rice crop.

Materials and Methods

The study site was a block of farm land which was prepared by first plowing and followed by cold crushing, and leveling using Gobal plow, Cultivator, Rotavator and Lazar leveler were used. In this regard, four acre land in each location, one acre at each sub-location was prepared and sown in a randomized complete block design (RBCD) with the main variety of Sindh Irri-6. Plants were sown by hand with 15 cm (plant to plant) and 20 cm (row to row spacing) in one acre at each sub location. All the plots were kept of equal size and de-laminated with channels and bunds (1m). Before transplanting, the fertilizer NPK 120:60 was applied per ha, while the nitrogen in the form of urea 88 Kg/acre. Phosphorous in the form of super phosphate 150 Kg/acre and potassium in the form of muriate of potash 26.56 were utilized. Half of the nitrogen was applied 30 days of transplanting, while the remaining half was given at the panicle initiation stage. All the standard agronomical and cultural practices were managed and pesticides were not used throughout the crop season.

Observations were taken at the maximum tillering stage (60 DAT) by randomly collecting and dissecting 50 infested tillers (dead heart and white ear head) from each sub-location and were dissected. Hence, 100 larvae were collected from each location A (Badin), lower Sindh and location B (Larkana), upper Sindh and larvae were kept under observation to examine the species of stem borer of rice. Total 200 samples from both districts were collected and dissected with any larvae recovered identified based on characters described by Kok and Varghese (1966). For the identification of stem borers of rice same morphological parameters were also used by (Rehman *et al*., 2002; Hattori and Siwi, 1986). After identification, the number of larvae were counted and computed in the form of the percentage of each species regarding the crop growth stage.

Trails were established in spring (July), with measurements at 60, 90 DAT, which occurred in late spring (September) and undertaken in 2017 and 2018. Species abundance was calculated by the formula used by Fleming and Ratnakaran (1985).

$$\text{Abundance of species} = \frac{\text{Number of the same species}}{\text{Total number of moth}} \times 100\%$$

Results and Discussion

Prevalence of rice stem borer species in Sindh Pakistan. Stem borer prevalence in lower belt of Sindh. The results of the trial undertaken in 2017 and 2018 in the lower Sindh for prevalence of stem borers, are presented in Fig. 1.0 (2017), 1.1 (2018) and 1.2 (combined 2017-2018), respectively. Similarly, results from the trails carried out in upper Sindh for 2017 and 2018 are shown in Fig. 2.0 and 2.1 respectively. The two years data is presented in Fig. 2.2.

All four species of stem borers were found in the lower belt of Sindh (Fig. 1.0), namely White stem of rice, *C. innolata,* Yellow stem borer of rice, *C. incertelas*, Pink stem borer of rice, *S. inferens* and Dark headed stripped borer *C. polychryus* were prevalent during Kharif-2017. White stem borer was found to be the dominant species, representing 73% of the four species collected and was found to be at higher population at all the stages throughout the crop growth from tillering (60 DAT)

through to the rice heading stage. Yellow stem borer was found to be the second most prevalent species (17.5%), followed by Pink stem borer (6.5%) and lastly Dark headed stripped stem borer (3%) from population prevalence or build up position. The results from 2017 strongly indicate that white stem borer is the dominant species over other stem borers during Kharif 2017, while Fig. 1.1 shows the pest population for the year Kharif-2018. In the same region, the same four species of stem borer were also recorded and the White stem borer of rice also remained dominant over other species of stem borer and showed higher population through all crop stages i.e. tillering, maximum tillering and heading stage, it is evident from the data White stem borer recorded high population (78%), Yellow stem borer (20%), Pink stem borer (2%) and Dark-headed striped stem borer (1%) respectively at 60 days after transplanting, the data investigated that White stem borer remained dominant with a higher population (78%) followed by Yellow stem borer, Pink stem borer and Dark-headed striped stem borer with the population as described above. Furthermore, the pooled mean population for the year 2017 and 2018 in respect of the lower belt of Sindh (Fig. 1.2) points out that four species of stem borer, Pink stem borer, and Dark-headed stem borer remained prevalent during both the years 2017 and 2018 and White stem borer also remained dominant with a higher population of (77.5%) followed by Yellow stem borer (17.5%), Pink stem borer (4.5%) and Dark-headed stem borer (2%) respectively.

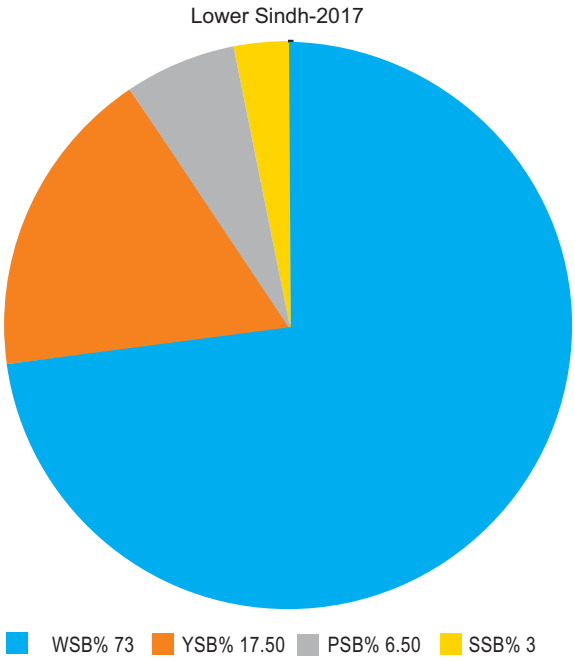

Fig. 1.0. Prevalence of the four stem borer species reared from rice tillers collected 60 DAT in lower Sindh in August, 2017.

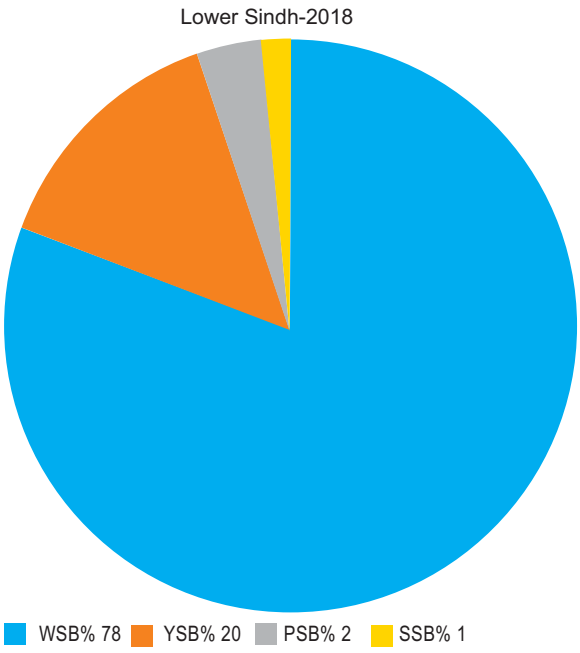

Fig. 1.1. Prevalence of stem borer species reared from rice tillers collected 60 DAT in lower Sindh in August, 2018.

Stem borer prevalence in the upper belt of Sindh. Results of the sampling in the upper belt of Sindh found four species of stem borer during Kharif 2017 namely White stem borer, Yellow stem borer and Pink stem borer, and Dark-headed striped stem borer (Fig. 2.0).

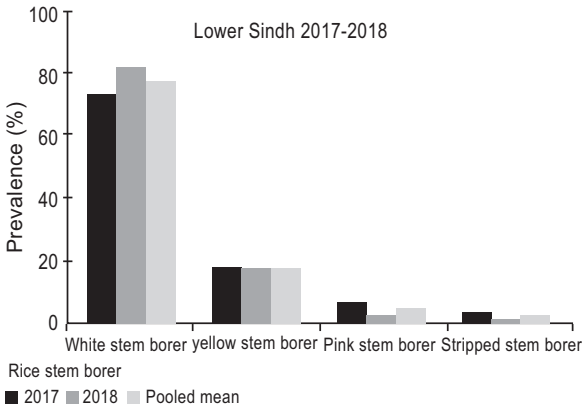

Fig. 1.2. Prevalence of stem borer species reared from rice tillers collected 60 DAT in lower Sindh 2017-2018.

Amongst the four species, Yellow stem borer was found dominant over other species of stem borers and higher population throughout all stages of the crop growth *viz*: tillering, maximum tillering and heading stage of the crop. The White stem borer was found to be the 2nd, 3nd and 4th remained the Pink stem borer and Dark-headed striped stem borer respectively from population prevalence or build-up point of view. The Yellow stem borer being the dominant one its population was recorded (70%), White stem borer (26%), Pink stem borer (4%) and Dark-headed striped stem borer (2%), respectively at 30 days after transplanting, from the above mentioned data it is prevalent that Yellow stem borer remained dominant during Kharif -2017 in the upper region of Sindh.

Results from the same region in Kharif-2018, indicated that the pest complex comprised the same four species (Fig. 2.1) Yellow stem borer of rice remained the dominant species and showed higher population through all crop stages such as tillering, maximum tillering, and heading stage. The results at 60 DAT showed that Yellow stem borer was prevalent at 69.0%, followed by white stem borer (26.0%), Pink stem borer (3.5%), and Dark-headed stem borer (1.5%). Furthermore, the pooled mean population for the year 2017 and 2018 in respect of the upper belt of Sindh (Fig. 2.2), shows that all the four species of stem borer *viz* White stem borer, Yellow stem borer, Pink stem borer and Dark-headed striped stem borer remained prevalent during both the years 2017 and 2018. Overall, the Yellow stem borer remained the dominant species, followed by the White stem borer then Pink stem borer and Dark-headed stem borer 3nd and 4th, respectively. The Yellow stem borer being a dominant one with higher population (66.75%), White stem borer (28%), Pink stem borer (7%) and Dark-headed stem borer (3.5%) respectively.

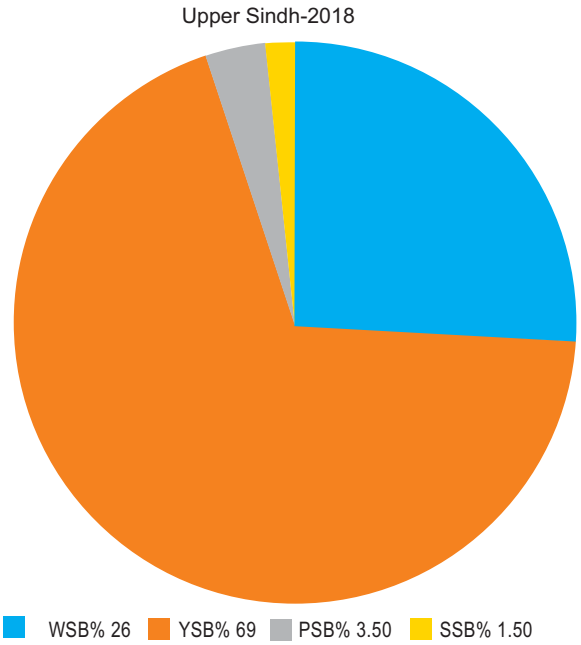

Fig. 2.1. Prevalence of stem borer species in rice sown 2018 in the upper Sindh at 60 DAT.

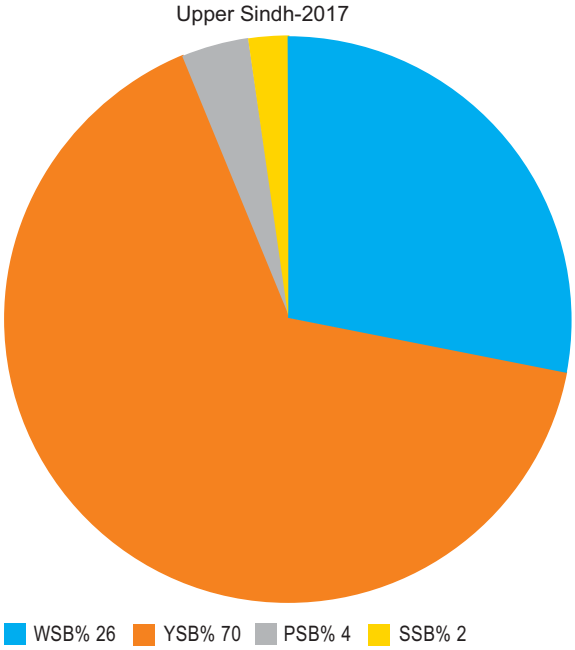

Fig. 2.0. Prevalence of stem borer species in rice crops sown 2017 in the upper Sindh at 60 DAT.

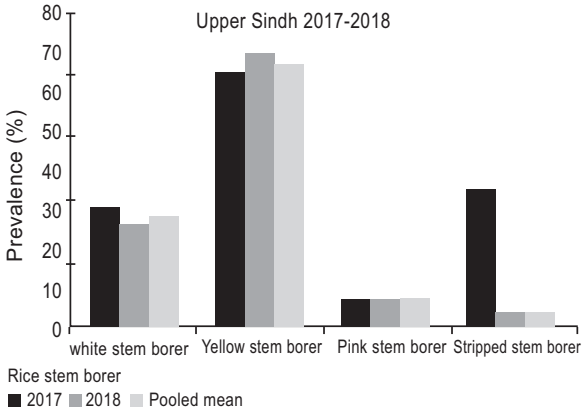

Fig. 2.2. Prevalence of stem borer species in lower Sindh at 60 DAT, through the collection (Pooled mean) - 2017 and 2018.

Rice stem borers are the most abundant and devastating pest of rice crop, their severe attack can economic loss. To control the borers of the rice, it is mandatory to understand the factors that lead to outbreaks. We conducted the field study to monitor the borers of the rice. The results of this study revealed that White stem borer was dominant over other species of stem borers and higher population was recorded on 60 DAT. These findings consistent with the results of (Shyamro, 2019; Tandon, 2019). The stem borer caused yield reduction in basmati varieties has been estimated at 20-30% and crop infestation occasionally goes upto 90% (Salim *et al*., 1991; Mahar *et al*., 1986). The destructive stage of rice borer in the vegetative stage of rice plant larvae start their attack by boring the inner portion of leaf sheath (Alinia *et al*., 2000; Moiz, 1967) and ultimately bore and feed inside the stem, the boring of the stem by caterpillars often leads to severing of the epical parts of the plant as a results the central leaf whorl does not open, turns brownish and die bringing the condition commonly referred to as dead hearts and affected tillers do not bear panicles and may not emerge at all (Atwal, 1976), during the reproductive stage of rice plant the stem borers larvae cut the growing parts leading to a condition known as white heads do not produce grain and become conspicuous, erect and white and empty ear heads (Satpathi *et al*., 2012; Gupta and O Toole, 1986). Studies have found that the White stem borer population was dominant at the heading stage (Kalita, 2008; Gupta *et al*., 2002), which are in conformity with our findings.

In conclusion, our results collectively elucidated that White stem borer of rice dominant in lower Sindh, while the Yellow stem borer was found dominant in upper Sindh, Pakistan during both years of study.

Acknowledgment

We would like to thanks to anonymous reviewers for critical comments for further improvement of this specific work. We are also thankful to Prof. Dr. Zhang Zehua (Chinese Academy of Agricultural & Sciences, Beijing, China) and Dr. Hidayat Ullah (Department of Agriculture, The University of Swabi, Pakistan) for their invaluable suggestions on manuscript organization and linguistic revision.

Conflicts of Interest. The authors declare they have no conflict of interest.

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