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Assessment of extent of damage and yield loss caused by stem borer in rice

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Abstract
A field experiment was conducted at Krishi Vigyan Kendra, Basuli, Maharajganj, to assess the extent of damage and yield loss due to the infestation of Stem borer in rice during *kharif* 2018. Seven popular high yielding strains viz. Arize 6444 Gold, NDR 359, MTU 7029, BPT 5204, 27 P 63, Gorakhnath 509 NDR 2065 and local popular variety, Kalanamak were used as test variety. Among several species of stem borer infesting rice crop, yellow stem borer *Scirpophaga incertulas* (Walker) was found relatively in high abundant at all the stages of crop growth. Among tested rice varieties Kalanamak was found most susceptible to Stem Borer attack resulted in higher% dead hearts (15.45%) at tillering stage and higher% white year (27.30%) at maturity stage. Quantitative yield loss increased with the increase of the borer's infestation. Highest yield loss was quantified for the rice variety, Kalanamak (34.37%) followed by BPT 5204 (20.48%) and NDR 2065 (17.35%).

Keywords: stem borer, *Scirpophaga incertulas* (Walker), dead heart, white ear, yield loss

1. Introduction
Rice (*Oryza sativa* L.) is the 2nd widely grown cereal crop of the world. It is not only the staple food crop of more than half of the world population but also the chief source of dietary energy for the rice eating population of the Asia and South East Asia. India is the 2nd largest producer and consumer of rice just after China contributes 21.19% of total world rice production. In India rice was grown in about 43.90mha with an annual rice production of 157.0 million tons during 2014 (Agricultural Statistics at a glance 2016). Rice cultivation is the backbone of agriculture economy of the country and provides nearly >50% of rural employment, about two-third of total calorie supply and about half of the total protein intakes of an average person in the country. Uttar Pradesh is the 2nd largest rice producing state of country just behind West Bengal and it is in cultivation in all the 70 districts of the state. The annual rice production of the state is about 12.17 million tons from an area of 5.87 million hectares (Agricultural Statistics at a glance 2015). The average rice productivity of state is 2.072 t/ha which much below the national average (2.391 t/ha). The Main rice growing season of the state is kharif (Aman) while in tarai region Boro rice is also being in cultivation. Rice production and productivity is severely affected by many biotic and abiotic factors. Insect Pests are the major biotic factors limiting rice productivity. The hot and humid environment of the irrigated rice ecosystem is very conductive for proliferation of insect pests and diseases. More than 175 species of insect pests were reported infesting rice crop at different crop growth stages. Among these 20 species of insects are considered as rice pests of economic importance that include stem borers, gall midge, defoliators and vectors like leafhoppers and plant hoppers that cause direct damages and transmit various diseases (Pathak *et al*., 1994) [22]. Eighteen species of rice stern borers have been recorded so far among these five are of economic importance in Asia viz. Dark headed stem borer (DHSB), *Chilo polychrysus* (Meyrick); Yellow stem borer (YSB), *Scirpophaga incertulas* (Walker); Pink stem borer (PSB), *Sesamia inferens* (Walker); Stripped stem borer (SSB), *Chilo supressalis* (Meyrick) and White borer (WB), *Scirpophaga innotata* (Walker). Among them, the yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyralidae) is the dominant species in India and rice plants are most prone to stem borer infestation at the tillering and flowering stages. Stem borer infestation at vegetative stage of crop produces dead heart symptoms while infestation at reproductive stage produces white ear. Infestation of *Scirpophaga incertulas* at reproductive stage causes severe yield loss and full potential of the variety can not be achieved. Yellow stem borer is a monophagous insect pest of rice. It is highly host specific and found 1n diversified and emphemerals. YSB causes 1% to 19% yield loss in early planted and 38% to 80% in late transplanted rice crops. In general yield loss due to insect pests of rice has been estimated about 25% (Dhaliwal *et al*.

2010). For the control of leaf folder and yellow stem borer, many methods have been adopted but insecticides are still playing a key role for its control. Non judicial and repeated application of insecticides at improper doses may causes several problems such as disrupting natural enemy complexes, secondary pest outbreak, pest resurgence, development of insecticide resistance and environmental pollution.

Estimation of extent of damage and crop losses by the stem borer is essential for quantification of the potential yield of the variety, identification/ isolation of resistant strains, classification of the pests, which warrant control measures, and evaluation of the efficacy of various control measures. The varietal resistance is considered as the most effective method of controlling rice stem borers infestation and has a great economic potential, since it helps cumulative reduction of pest populations and lessens the need for chemical control. Several workers reported yield loss due to the infestation of stem borer at various crop growth stages from tillering to maturity. But neither actual loss nor careful statistics maintained or any regular survey was made. Plant type, crop vigour, and the pest complex can play a large role in determining eventual yield loss by yellow stem borers. Low tillering varieties have less ability than profuse tillering varieties/ hybrids to compensate for 'dead hearts'. Yield losses attributable to rice stem borer infestation is affected by various factors viz intensity of attack, species of borers and time of attack and rice varieties. Therefore, this study was aimed to assess the yield loss on rice due to stem borer infestation, which will be helpful to develop a management strategy to control stem borer outbreak in rice crop.

2. Material and Methods

An experiment was conducted during *kharif* 2018 to assess the yield loss due to infestation of stem borer at Krishi Vigyan Kendra, Basuli, Maharajganj, which lies in the eastern plain zone of Uttar Pradesh. The experimental site was located at 27^0 9'Nof Latitude and 83^0 34' E. The climate of the experimental site is sub humid to humid with an average rainfall of 1202.8 mm. The soil of the experimental field was alluvial loam in texture having pH 7.4. The experiment was laid out in randomized block design with three replications. The plot size of the experimental plot was 20 m^2. Each plot was divided into two equal parts. One part was selected for natural infestation of stem borers and the remaining part for controlled condition. The controlled plots were kept completely free from stem borer infestation by using three application of standard dose of insecticides (Chlorpyriphos @ 2ml/litre) at 20 days interval. Standard agronomical practices such as time of planting, row spacing, seed rate, irrigation and weeding were adopted to raise the crop. Fertilizer was applied as per the soil tests data (SSNM). Seven high yielding rice varieties/ hybrids (Arize 6444 Gold, NDR 359, MTU 7029, BPT 5204, 27 P 63, Gorakhnath 509 and NDR 2065) and one local popular variety, Kalanamak were used as test variety to assess the extent of yield loss due to stem borer infestation. The nursery was sown in raised beds and 30 days old seedlings were transplanted keeping two seedlings/hill in the 1st week of July. Observations on the incidence of dead hearts (DH) were taken on 20 randomly selected hills per plot from each replication at 50 days after transplanting. The white ear head (WEH) was counted on 20 randomly selected clumps from each plot just before harvest. Percent dead hearts and white ears were calculated and transformed into arc sine transformation for statistical analysis and presentation in table.

$$\% \text{ Dead Hearts} = \frac{\text{Total no. of Dead Hearts}}{\text{Total no. of tillers}} \text{ X } 100$$

$$\% \text{ White Ears} = \frac{\text{Total no. of White ears}}{\text{Total no. of ear bearing tillers}} \text{ X } 100$$

Yield loss was calculated by using the formula,

$$L = \frac{Yp - Y0}{Y0} X100$$

Where,

L = Percentage of yield loss due to borer

Yp= Yield of protected plot per m^2

Yo= Yield of unprotected part of the plot per m^2

3. Results and Discussion

The detailed experimental result was depicted in the table – 1. Observation on the relative abundance of different species of Stem Borer revealed that Yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) is the major species of Stem Borer infesting at all the growth stages of rice crop while the other species of stem borers viz. Dark headed stem borer (DHSB), *Chilo polychrysus* (Meyrick); Pink stem borer (PSB), *Sesamia inferens* (Walker); Stripped stem borer (SSB), *Chilo supressalis* (Meyrick) and White borer (WB), *Scirpophaga innotata* (Walker) were observed in traces at tillering stage of crop growth. Among tested rice varieties Kalanamak was found most susceptible to Stem Borer attack resulted in higher% dead hearts (15.45%) at tillering stage and higher% white year (27.30%) at maturity stage. Minimum stem borer damage was recorded in rice hybrid Arize 6444 Gold (%DH – 3.35% and% WE – 5.10%). The avoidable losses were worked out on the basis of yield under both protected and unprotected conditions in eight varieties. It varied from 10.26 to 34.37%. The yield loss increased with the increase of the borer's infestation. Highest yield loss was observed in on the variety, Kalanamak (34.37%) followed by BPT 5204 (20.48%) and NDR 2065 (17.35%). Similar finding were also reported by earlier workers viz. Saxena *et. al.*, (1972) [28] and Rubia *et al.* (1998) [25]. Israel *et. al.* (1967) estimated 21.6% yield loss due to stem borers at early stages of plant growth and 26.9% yield loss at heading. Extent damage due stem borer infestation and yield loss may be influenced by several factors viz. pest population density, stage of crop growth borer and growing conditions. (Feijen, 1979) [12]. Rubia *et al.* (1997) reported that infestation of stem borers caused lower white heads in shorter panicle and higher white heads in longer panicle producing varieties.

Table 1: Extent of damage and percentage yield loss due to stem borers on rice varieties during *kharif* 2018

Variety	% Dead Heart	% White Ear	Yield of Protected plot (t/ha)	Yield of Unprotected Plot	% Yield Loss
Arize 6444 Gold	3.35	5.10	5.85	5.25	10.26
NDR 359	7.25	10.65	5.25	4.55	13.33
MTU 7029	10.75	13.40	4.70	3.90	17.02
BPT 5204	11.20	15.15	4.15	3.30	20.48
27 P 63	5.72	7.35	5.50	4.85	11.82
Gorakhnath 509	6.45	8.35	4.75	4.00	15.79
NDR 2065	7.85	10.65	4.90	4.05	17.35
Kalanamak	15.45	27.30	27.35	17.95	34.37
CD (P=0.05)	6.05	8.17	12.25	9.15	

4. Conclusion

On basis of the results obtained, it was concluded that yellow stem borer *Scirpophaga incertulas* (Walker) is the most important species of stem borer and relatively abundant in the agro climatic condition of Maharajganj district of Uttar Pradesh. Sub humid to humid climatic condition of the district is congenial for the growth of stem borer of rice, flaring of this pest to epidemic proportion cannot be ruled out. Development of good management practices and cultivation of resistant varieties will be helpful in minimizing yield loss due to stem borer attack in rice crop.

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