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Impact analysis of stem borer on rice

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Abstract
At two stages of plant growth, namely early tillering and booting, greenhouse investigations were undertaken by artificially infesting potted rice plants with first instar larvae of *Maliarpha separatela* and *Sesamia botanephaga* Tarns and Bowden. *M. separatella* infestation caused a drop in plant height and the number of full grains. The quantity of filled grains and their weight were higher in uninfested plants during the booting stage. The number of productive tillers was primarily influenced by *S. botanephaga* infestation at both phases of plant growth. The weight of the grains was unaltered. This review paper analyses the individual hill field studies providing variable results in the case of rice.

Keywords: booting, rice, infestation, larvae

Introduction
Scirpophaga incertulas, often known as the yellow stem borer or rice yellow stem borer, is a Crambidae moth species. Francis Walker first characterised it in 1863. Afghanistan, Nepal, north-eastern India, Sri Lanka, Bangladesh, Myanmar, Vietnam, Thailand, Malaysia, Singapore, Sumatra, Java, Borneo, Sumba, Sulawesi, The Philippines, Taiwan, China, and Japan are all home to this species. The male's wingspan is 18–22 mm, while the female's is 34 mm. Males are smaller than females as adults. Males have a brownish ochre coloration. Dark scales irrorated (streaked) the forewings, and the veins were somewhat streaked with fuscous. A dark speck was discovered at the cell's bottom angle. From the apex to the vein, there is an oblique fuscous line. A sequence of little black specks can be noticed. Ochreous white hindwings. Fuscous brown females with pale fuscous hindwings Oryza sativa is the larvae's food. It is considered a major rice pest in India and Sri Lanka, decimating harvests every year. They eat the stem of the plant they're eating. Larvae attain a length of 20 mm when fully grown, and are pale yellow to yellowish green with a brown head. A white silk cocoon is used during pupation. Early instars bore into the leaf sheath after hatching, resulting in longitudinal yellowish-white blotches caused by eating. It then infiltrates the rice plant's stem and remains in the pith, feeding on the inner surface of the stem wall. These are not visible signs on the outside. Severe feeding results in a deep circular cut through the parenchyma tissue, revealing deadhearts in vegetative phases and whiteheads in reproductive stages. During the vegetative stage, stem borer larvae bore at the base of the plants. They penetrate through the higher nodes of older plants and feed toward the base.
Deepwater rice is afflicted by the yellow stem borer, which is a pest. It's found in areas where there's a lot of water and there's a lot of floods. Second-instar larvae wrap themselves in body leaf wrappings to form tubes, then release themselves from the leaf and descend to the water's surface. They cling to the tiller and burrow into the stem.
The striped stem borer is more common in temperate nations and locations that are not inundated. During the winter, their terminal instars are dormant in temperate locations.
Upland rice, which is planted near sugarcane or allied grasses, is home to the pink stem borer. During the winter or dry season, the presence of alternate hosts enables the pink stem borer to proliferate, spread, and survive.
The pink stem borer, unlike other species of stem borers, lays exposed eggs between the leaf sheath and the stem. A high nitrogenous field encourages the growth of stem borers. Fields planted later are more susceptible to insect pests that have accumulated in fields planted earlier. Stem borer larvae and pupae can be found in stubs left in the field.

Methods of identification of pest
Check the field for the following damage symptoms:

- During the vegetative stages, deadhearts or dead tillers that can be readily plucked from the base
- Whiteheads appear when the developing panicles are pale and empty during the reproductive stage.
- On the stems and tillers, there are tiny holes.

Frass or faeces might be found inside the wounded stems. Symptoms of deadhearts and whiteheads might be mistaken for damage caused by rodents, neck blast, and black insect infections.
Visually inspect the rice crop for deadhearts in the vegetative stages and whiteheads in the reproductive stages to indicate stem borer damage. To confirm the presence of stem borer damage larvae and pupae, stems can be plucked and dissected.

Fig 1: Stemborer larvae

Fig 2: Whiteheads caused by stemborer

Boring too deeply into the sheath can kill the crop. The quantity of reproductive tillers may be reduced as a result of its injury. Plants with a late infection develop whiteheads.

- Yellow stemborer damage can result in yield losses of up to 20% in early-planted rice and up to 80% in late-planted rice.
- White stemborer is a major pest in rainfed wetland rice. It has the potential to spread disease and ruin rice farms.Gold-fringed stemborer can cause yield loss of about 30%.

Rice stem borer species

1. Dark-headed stem borer (*Chilo polychysus*)

The egg is flat and scale-like, with no hairs on it. White egg masses are observed around the base of the leaves and leaf sheaths. Larvae are grayish-white in hue with five grayish-violet or purplish-brown longitudinal bands and huge black heads. Adults have a brownish-yellow coloration.

2. Gold-fringed stem borer (*C. auricilius*)

The gold-fringed stem borer's fresh eggs are white. They resemble scales in appearance. They age from pale yellow to brown. The eggs turn blackish when they are ready to hatch. The larva has a black head and five longitudinal pinkish stripes that run the length of its body. The discal cell of the forewings of the adult moth is straw-colored to light-brown, with silvery flecks.

3. Pink stem borer, Violet stem borer (*Sesamia inferens*)

The pink stem borer's egg looks roughly spherical or bead-like and is laid in rows between the leaf sheath and the stem. An egg that has just been laid is creamy white and hairless. It turns pale yellow after a day. It turns pink and black as it ages. Newly born larvae have a golden hue to their skin and black head capsules. Mature larvae develop pinkish purple head capsules that are brown or orange-red in colour. A larva is 2.5 to 3.5 centimetres long and 3 millimetres broad. The adult is a muscular creature with dark brown patterns on a tan background. From the forewing's centre point to the wing tip, a purplish-red band radiates. The pink stem borer is a member of a different stem borer family than the others. Cutworm and armyworm are both connected to it.

4. Striped stem borer (*C. suppressalis*)

The striped stem borer's eggs are disc-shaped. White eggs are those that have just been deposited. They turn yellow as they get older, then black when they're ready to hatch. The head of a larva is big and lustrous brown or orange in colour. Its body is light brown or pink in hue, with five rows of longitudinal stripes running the length of it. The adults are brownish yellow in colour, with silvery scales and a row of 7 or 8 little black spots on each forewing's terminal border. The forewings are lighter in colour than the hind wings.

5. White stem borer (*Scirpophaga innotata*)

The eggs are identical to yellow stem borer eggs. White stem borer larvae are whitish to light yellow in hue. A fully grown larva measures 2.5 cm in length. There are no body markings on the larva. Adults resemble yellow stem borers in appearance, but they are completely white. On the thorax, they feature a clump of lengthy hair.

6. Yellow stem borer (*S. incertulas*)

The eggs are white, round, flattened, and coated with the female moth's brownish anal hairs. The larva has a little orange head and a pale hairless yellow body. The female's colouring ranges from pale to yellowish. Each forewing contains a pair of distinct black dots in the centre. The male is smaller and has a drab appearance. The forewings have two rows of black specks towards the tip.

Methodology

A trial was conducted by Hendarsih Suharto (2005) which aimed at proving stem borer infestation at different planting times. The first planting time (PT) was 14 days before farmers' PT, the second PT (simultaneously with farmers' PT), and the thirdPT (14 days after farmers' PT) were all examined. Fatmawati (new plant type cultivar), Gilirang (old plant type cultivar), and other rice cultivars were employed in this experiment, representing three types of rice cultivars (semi-new plant type cultivar), Hybrid rice cultivars Maro and Intani-3, as well as three inbreed rice cultivars with varying levels of stem borer tolerance, namely IR72 (susceptible to white stem borer) (Hendarsih *et al*. 1992), IR62 (susceptible

to yellow stem borer) (Rubia *et al*. 2001), and Cilosari (resistant to yellow stem borer) (Ismakin, personalcomm.). Rice seedlings that were 14 days old were transplanted at 25 cm × 25 cm distance. Weeding and fertilisation were carried out according to the instructions. There was no insecticide used. On 20-sample hills on each plot, observations were made at 3, 5, 7, 9, and 11 weeks after transplanting (WAT). The hills for the samples were picked diagonally. We counted the number of healthy and infested tillers, as well as the number and kind of egg parasitoids. A formula was used to calculate the percentage of stemborer infestation which is as given below:

$\frac{a}{b}$ x 100%
I = percentage of stem borer infestation
a = number of infested tillers
b = total tillers

Egg clusters from each plot were collected for observation of the egg parasitoids. To determine the parasitoid's species and the quantity of emerging stemborer larvae, an egg cluster was kept in a test tube. After that, the egg cluster was immersed in 10% KOH for 24 hours before being dissected to count the parasitoid larvae. The Kim and Heinrich (Rauf 2000). formula was used to calculate the percentage of egg parasitization Water traps with a synthetic sexpheromone to entice the male were used to study stem borer fluctuation and species. The water trap had a diameter of 33cm and contained surfactant-supplemented water as well as a pheromone lure dispenser (Hen-darsih and Usyati 1999). Each trap was outfitted with a pheromone lure dispenser, and each species was replicated with three traps. White, yellow, pink, and stripe stem borers were all caught using four different pheromone lures. The water traps were set up in a fixed position 25 metres apart at the height of the rice canopy. Twice a week, the number of moths caught in the trap was counted. Periodic dissections of the damaged rice stems were performed to confirm the species and stage of the stemborer. Using IRRISTAT 3, the effect of planting periods and rice cultivars on stemborer infestation and egg parasitoid was determined. 1 versions were examined, and the mean difference was calculated using DMRT 5%. A graph was created to show the number of moths caught.

$$I = \frac{a}{b} \text{ x } 100\%$$

Results

Planting period influenced stem borer infestation, according to analysis of variance. The first PT had much more stem borer infestation at 3 WAT than the other two planting periods (Table 1). Pest infestation grew to 5WAT during the first PT, then began to diminish. At the second PT, stem borer infestation was consistently low from 3 to 7 WAT, then increased significantly until reaching a peak (40 percent stem borer infestation) at 9 WAT, before declining at 11 WAT. Stem borer infestation was low at the third PT and rose with the greatest infestation (20%) occurring at 7 WAT, then declining (Fig. 1) The interaction impact between planting timings and cultivars on stem borer infestation was noticeable at 5, 7, 9, and 11 WAT. At the first PT, stem borer infestation was high on all cultivars at 5 WAT, with Fatmawati and Maro having the highest levels. At the second PT, however, stemborer infestation on all cultivars decreased, but it increased again at the third PT. At the second and third PT, the degrees of stem borer infestation on all cultivars were not significant (Fig. 1). Fatmawati cultivar grown at the first PT was heavily infested by the stem borer at 7 WAT, but only differed from Maro cultivar in terms of stem borer infestation. There was no discernible variation in stem borer infection among cultivars at the second PT. Maro was the most contaminated cultivar at the third PT, much higher than Fatmawati and Gilirang, which were the least infested cultivars. Fatmawati was the most contaminated cultivar at the first PT, and it was higher than the third PT. At the first PT, Gilirangcultivar was likewise heavily infested by stem borer, but this did not differ from the second PT. Infestation was lower in Maro and Intani-3 at the first and second PTs than at the third PT. There was no discernible variation in planting times between the IR72 and IR62 cultivars. At the third PT, Cilosari was heavily infested, and at the second PT, it was even worse.

Table 1: Effect of planting time on stem borer infestation at 3 weeks after transplanting

Planting time (PT)	Average stem borer infestation (%)
First (14 days before farmer's PT)	37.90a
Second (simultaneously with farmers')	0.65b
Third (14 days after farmers' PT)	0.54b

Source: Suharto *et al*. (2005)

Population fluctuation of stem borer

Yellow stem borer, white stem borer, stripe stem borer, and pink stem borer were the four kinds of stem borer male moths captured during the experiment. The yellow stem borer had the highest catch rate (50 moths/trap), whereas the other stem borers had the lowest (less than 5 moths/trap).

Yellow stem borer is the prevalent species in Karawang's irrigated rice fields. This was in contrast to Manwan *et al*. (1990) and Rauf *et al*. (1992a; 1992b), who found that white stem borer was the most prevalent in Karawang in 1990. This indicates that the dominant species has shifted from the white to the yellow stem borer. On 5-14 June, 14-25 June, and August 2003, three significant peaks of yellow stem borer male were discovered, but the last was lower than the previous two. The initial peak occurred during the wetseason of 2002/2003, due to a moth infestation from prior rice crop. The low quantity of yellow stemborer caught in July indicated that the insects were in the larval and pupal stages, before emerging as moths in August 2003. Lower yellow stem borer catch in August (10 moths/trap) is thought to be related to a wider dispersion of yellow stem borer moths in August than in June because larger rice crops were accessible.

The high capture rate of yellow stem borer coincided with the seedbed and early vegetative stage at the first PT (Figs. 1 and 2), resulting in significant infestation in the rice crop's vegetative stage. Indeed, the rice crop at the first PT was an offseason planting, taking place 14 days before the farmers' agricultural season began. The majority of rice fields were still fallow at the time.

As a result, stem borers were attracted to the rice plants growing at the first PT and concentrated there.

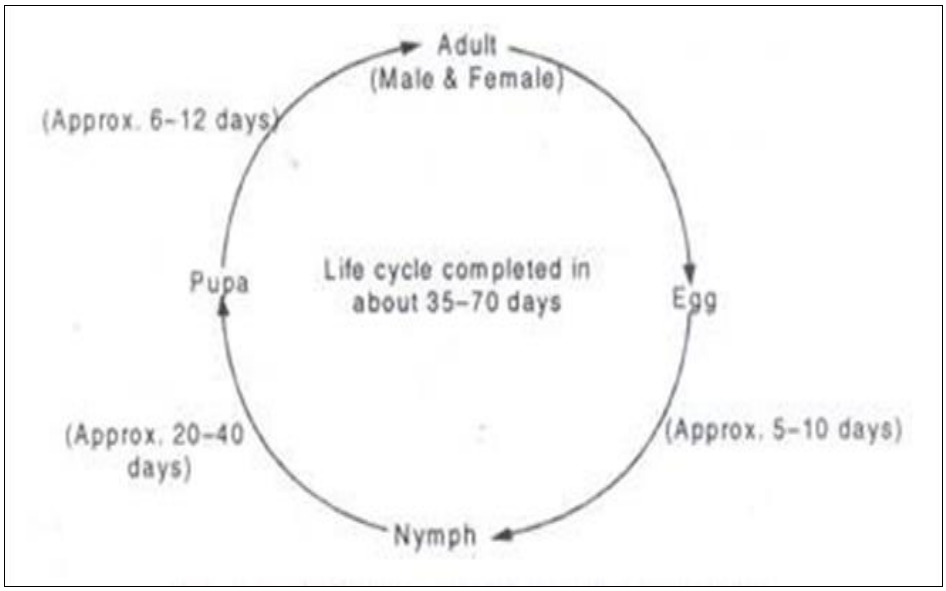

Fig 1: Life Cycle of *Sciropophaga incertulas*

Management of Stem borer in Paddy

During the vegetative stage, stem borer larvae bore at the base of the plants. With constant flooding, the stem borer insect infestation is more prevalent in deepwater rice.

- During the vegetative stages, dead tillers or dead hearts that can be easily plucked from the base
- During the reproductive stage, whiteheads cause developing panicles to be whitish and empty.
- On the stems and tillers, tiny holes can be detected.
- Frass or faeces will be used to fill the injured stems.

Fig 2: Attacking mechanism of stem borer in rice plant

Conclusion

The yellow stem borer (Scirpophaga incertulas) was the most common type of stem borer found in most of the studies. The severity of the infestation is determined by the number of stem borer moths present or the planting season. A cultivar's yield is determined by its yield potential. However, biotic and abiotic challenges may limit its potential production. As illustrated in the first PT, stem borers are a possible concern when their population is higher. Stem borer infestation is generally higher in the first planting period (average 37.90%) than in the second and third planting periods (65 and 54 percent, respectively).

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