Reference 23 Rice stem borers

Summary

This reference presents the life-cycle of rice stem borers and how to implement integrated control management. Because of the damage they produce on rice crops, this reference is entirely devoted to stem borers. This reference complements Reference 22 dealing with African rice gall midge and Reference 21, which presents an overview of insect pests and useful insects.

Stem borers collected in African rice fields are from the orders Lepidoptera and Diptera.

Lepidopteran borers

Biology

In general, the eggs of lepidopteran borers stick to the leaves or are sunk between the leaf sheath and the stem in more or less aligned groups. Adults are active at night and hide during the day. The caterpillars move on the surface of the plant and migrate to neighboring plants by hanging down from a silk thread attached to the leaf tip. They first feed on the leaf blade, then quickly penetrate in the main nerves of the leaf, enter the leaf sheath and soon enter inside the hollow stems.

Some species complete their larval development in one stem; others start in one stem and continue in another. The passage from the larval to the pupal stage takes place inside the stem or in the folds of the leaf sheaths; rarely on the ground.

Symptoms of stem-borer damage

There are two main types of damage:

- In young plants at the beginning of, and during, tillering, caterpillars enter the leaf sheaths at the base of the young stem. The damage can cause 'dead heart' (*see* Photo pages: Photo 23.1). New tillers are grown, but with a delay, affecting heading and resulting in heterogeneity at maturity. 'Dead hearts' are the dried up central shoots of tillers on the rice plant.
- At flowering, young caterpillars meet some centimeters below the panicle inside the flower stalk. The stalk dries up entirely, resulting in a completely 'white panicle' (*see* Photo pages: Photo 23.2). Stem borer can also induce abortion or drying up of a part of the panicle, when an older caterpillar settles in the lower parts of the stem, which hinders the feeding of the panicle, resulting in a reduced number of filled grains.

Reference 23

Rice stem borers

Chilo zacconius Blez.

The most common and most destructive lepidopteran borers in Africa are *Chilo zacconius* Blez. (syn. *Proceras africana* Auriv.; family Pyralidae). *Chilo* is common in West Africa in Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Mali, Niger, Nigeria and Senegal.

Description

The life-cycle of stem borers, and many other insects in general, consists of four stages: egg, caterpillar, pupa and adult.

- Eggs: the egg batch is elongated and consists of several lines of flat, light-yellow eggs, overlapping like fish scales.
- Caterpillar: the body of the caterpillar is ivory colored, and has seven longitudinal pink stripes. The ventral stripes are incomplete and partly absent. The head is dark brown.
- Pupa: is dark brown, elongated (11–12 mm); the head shows two humps above the eyes, protruding spiracles, and the wing buds slightly protrude in the middle of the body.
- Adult: has pale yellow wings with small irregular black dots on the tips. The male is darker than the female. The female is 9–11 mm long and the male 11–13 mm. The adult flies generally only at night (*see* Photo pages: Photo 23.3).

Biology and damage

Two generations can develop on the same plant. The first feeds on the leaves and the leaf sheaths, living between the sheaths. From flowering onwards, the second generation penetrates the floral stalk, resulting in white or dried panicles. Subsequently, the caterpillar moves down the stem perforating it at various places. A single stem can host several caterpillars. During the dry season, the caterpillars continue their development on rice stubbles and on weeds, e.g. *Echinochloa* spp., *Oryza barthii, Sorghum arundinaceum*. There are several other *Chilo* species, including *C. diffusilineus* J. de Joannis and *C. aleniellus* Strand.

Maliarpha separatella Rag. or white borer

Description

- Egg batch: a cluster of overlapping eggs, glued to the upper side of the leaf by strong cement, which causes a characteristic pinch of the leaf blade wrapping the complete batch as it dries.
- Caterpillar: small shell-colored head; the mouth and borders are brown-black. The body is elongated, pearly white to yellow.
- Cocoon: elongated (20 mm), light brown. The ends of the leg buds do not extend beyond the ends of the wing buds. The abdomen is simple, without spines or crests, with three pairs of long, fine hairs at its end.
- Adult: a straw-yellow butterfly whose first wing pair shows a marked brown line.

Biology and damage

Maliarpha separatella is a specific pest of the *Oryza* genus. It can be found only on cultivated and wild rices (*O. barthii*, *O. longistaminata* and *O. punctata*). The female lays eggs on mature leaves only, during tillering (from 15 days after transplanting). Egg-laying is rare from heading onwards. As soon as it hatches in the morning, the caterpillar moves actively from one plant to another, hanging from a silk thread and transported by the wind. At the end of the first day, it penetrates between a leaf sheath and the stem, moves down and goes deeper into the sheath, and then into the stem above an internode, entering the inside of the stem. It will complete the larval stage in the same stem, digging small circular cavities in its wall, but never piercing it, moving from one internode to another, piercing the nodes one after the other. Pupation takes place, about 30 to 50 days after hatching, in the first big internode above the crown. In the meantime, the caterpillar has prepared a conical silky pipe allowing the young adult to move towards the wall of the stem. It is exceptional to have more than one caterpillar or chrysalis (cocoon) in one stem. It is difficult to estimate the damage. There is no mortality comparable to 'dead heart.' An early infestation results in 'white panicles.' However, if the panicle is developed, the larvae affect neither maturation nor grain fertility, but reduce grain weight.

Sesamia sp. (pink borer)

Description

- Egg: flattened at the poles, and has numerous longitudinal stripes. It is grooved and yellowish; the batch is inserted, without particular alignment, in the leaf sheaths that will protect them.
- Caterpillar: generally pink, especially on the darker abaxial face, the adaxial face being lighter. When fully developed, the caterpillar is 30–40 mm long, it has false legs with hooks shaped in a wide-open arc. The anal scuttum of the last abdominal segment is yellow with brown spots.
- Cocoon: 17 mm long, chestnut brown, paler on the adaxial face. The leg and antenna buds never exceed the end of the wing buds. The tip of the abdomen has two dorsal spines and a small ventral bump.
- Adult: light beige and has faint brown stripes; the forewings are speckled with darker small spots and have a big whitish fringe. The back wings are pearly white.

Biology and damage

The nocturnal adults can cover large distances. The young caterpillars feed first on the leaf sheaths and then dig cavities between sheaths and stems. The damage is very variable, depending on the age of the plant and on the abundance of the insect, and looks like the damage caused by *Chilo*. Early infestation on rice is rare. At heading stage, the young caterpillars active in the upper parts of the stem cause the 'white panicle' symptom. When young, the caterpillars live in small groups, they then disperse and move down to the lower internodes that they can sever completely even at the base. The cycle is

almost continuous in humid tropical regions, where the number of generations varies between 5 and 6 per year, compared to 3 in the Sahel.

Dipteran stem borers

Dioposis thoracica W. (Syn. *D. macrophthalma* Dalman)

Description

- Egg: elongated, with nerves, with a small fleshy excrescence at one end.
- Larva: yellowish with two elongated abdominal prolongations, with black hooks, folded forward.
- Cocoon: elongated, brown-red, with well-marked segments.
- Adult: can measure 10 mm, the thorax is shiny black, the wings transparent, the abdomen is red-orange and covered with fine, dense hair (*see* Photo pages: Photo 23.4).

Biology and damage

Each female lays 30 isolated eggs, spread over 20 days, with a maximum of 4 to 5 eggs a day. Hatching takes 2 to 3 days. Duration of larval life is 25 to 33 days. Pupa, 10–12 days. Adult stage, 14 days.

The adult gets through the dry season when still immature, adults swarm in the vicinity of permanent pools or wet inland valleys, preferably in the shade. When the first rains begin, sexual maturity is reached and the females start laying eggs on young tillers. During crop development, depending mainly on the rainy season, *Diopsis thoracica* is only common in rice fields or on wild rice.

Soon after hatching, the larva penetrates the stem at the sheath level and feeds on healthy tissue. There is usually only one larva per stem; the stem's 'heart' is cut wedge-like about 10 cm above the soil. When decomposition due to this cutting begins, the larva leaves the stem to go on to another one, and thus destroys an average of three stems during its development. Pupation begins inside of the last stem visited, unless the stem is too small. The larva lives exclusively in stems that are still flat when tillering. Exceptional late attacks can affect heading. There is only one generation developing in a given plot, as the adults from the first generation look for younger stems.

Evaluating damage by estimating the number of stems infected is not sufficient. Moreover, a compensatory tillering results from the loss of destroyed tillers. This mechanism depends on the precocity and intensity of infestation, on the tillering capacity of the variety, and on development conditions. The visible 'dead hearts' are often numerous, but 80% of the tillers can be infested without considerably affecting the yield.

The losses—difficult to estimate—are essentially visible when there is a high concentration of egg-laying at the beginning of tillering on early varieties. However, for the same level of infestation, differences are considerable depending on the resistance of the variety and on its tillering capacity.

Methods to control stem borers

While it is possible to control some kinds of insects after visible signs of infestation have appeared, stem-borer control needs to be preventive. Indeed, the larvae are very young and hardly visible when they penetrate the stems and it is too late for control when the damage begins. Given that stem-borer losses do not change a lot year after year, it is possible to establish systematic intervention procedures adapted to each agricultural and economic complex.

Chemical control

Only improved irrigated rice crops, with highly productive varieties, justify the use of insecticides against stem borers. The application of insecticides on rainfed, less-productive rice, is not cost-effective. When the farmer decides to apply an insecticide, he/she has to be sure that this operation is cost-effective and, most of all, he/she has to follow the recommendations to guarantee the efficiency of the treatments and his/her own safety. In areas at high risk of stem-borer infestation, carbofuran, diazinon or lindane at a rate of 2 kg a.i./ha can be recommended to be applied 20 days after planting to combat *Diopsis* spp., and 50 to 70 days after planting to combat lepidopterous stem borers.

Crop management practices

Early sowing, narrow spacing of plants and maintaining weed-free fields can minimize stem-borer infestation. It is possible to limit infestation by *Chilo zacconius* by synchronized planting over large areas.

Several tillage practices can interrupt the life-cycle of stem borers:

- *Stubble plowing* kills the caterpillars in the stalks and crop residues.
- *Fallowing* (interruption of cultivation).
- *Destroying* intermediate host plants to eliminate breeding sites.
- *Flooding* the rice fields after harvest.

These solutions require sufficient time, labor and adequate water control. Tillage practices and manure application favor good plant development and the resistance of the crop, but they can increase infestation at the same time.

Biological control

There are a variety of earwings, dragonflies and spiders that feed on larvae and adult stem borers.

Among the numerous parasitoids on *Sesamia* spp., the braconid *Cotesia* (= *Apanteles*) *sesamiae* Cameron and the eulophid *Pediobus furvus* Gahan are the most important.

Reference 23

Rice stem borers

Research on biological control has just begun in Africa. Based on the inability of the indigenous natural enemies to suppress insect populations, *Cotesia flavipes* Cameron was imported from Asia and released in Côte d'Ivoire and Senegal against *Chilo zacconius* in rice, but with no lasting success. Further biological programs must be considered with caution, since there is a need to know more about interactions of indigenous natural enemies before embarking on classical biological control by the introduction of parasitoids.

Varietal resistance

This is using varieties that are resistant or tolerant to insect pest damage. The following resistant *O. sativa* lines have been identified:

- ITA 121 (tolerant to *Diopsis* spp.).
- LAC 23, IR 4625-132-1-2, IR 2035-120-3, Colombia 1, N 21-1 (tolerant to *Chilo zacconius*).
- IR 1108-3-5-2, SML 140/10, SML 140/5 ´ TN 1, SML 140/5 ´ IR 8, IR 2871-53-2, TOS 4153, B2850, BS-1-2-2, IET 5905, IR 9872-144-3-3-3 (tolerant to *Maliarpha separattela*).

Several promising lines that show appreciable resistance have been identified, particularly among African rices *O. glaberrima*. NERICA4, an upland interspecific (*O. sativa* × *O. glaberrima*) shows good tolerance to stem borers. However, no commercial varieties resistant to *C. zacconium* and *M. separatella* suitable for West African lowland conditions have been released yet.

Integrated stem borer control

Integrated control aims at keeping the populations of stem borers as low as possible without disturbing the ecosystem's stability. Integrated control views the different control measures as complementary and not as alternatives.

Bibliography

This reference has been adapted from:

Brenière, J., 1983. *Manuel sur les principaux ennemis du riz en Afrique de l'Ouest et leur contrôle.* ADRAO, Bouaké, Côte d'Ivoire.

Nwilene F. E, Sanyang S., Traore A. K., Togola A., Goergen G. and Agunbiade T. A., 2008. *Rice Stem Borers: Biology, Ecology and Control – Field Guide and Technical Manual*. Cotonou, Benin: Africa Rice Center (WARDA). 28 pp.