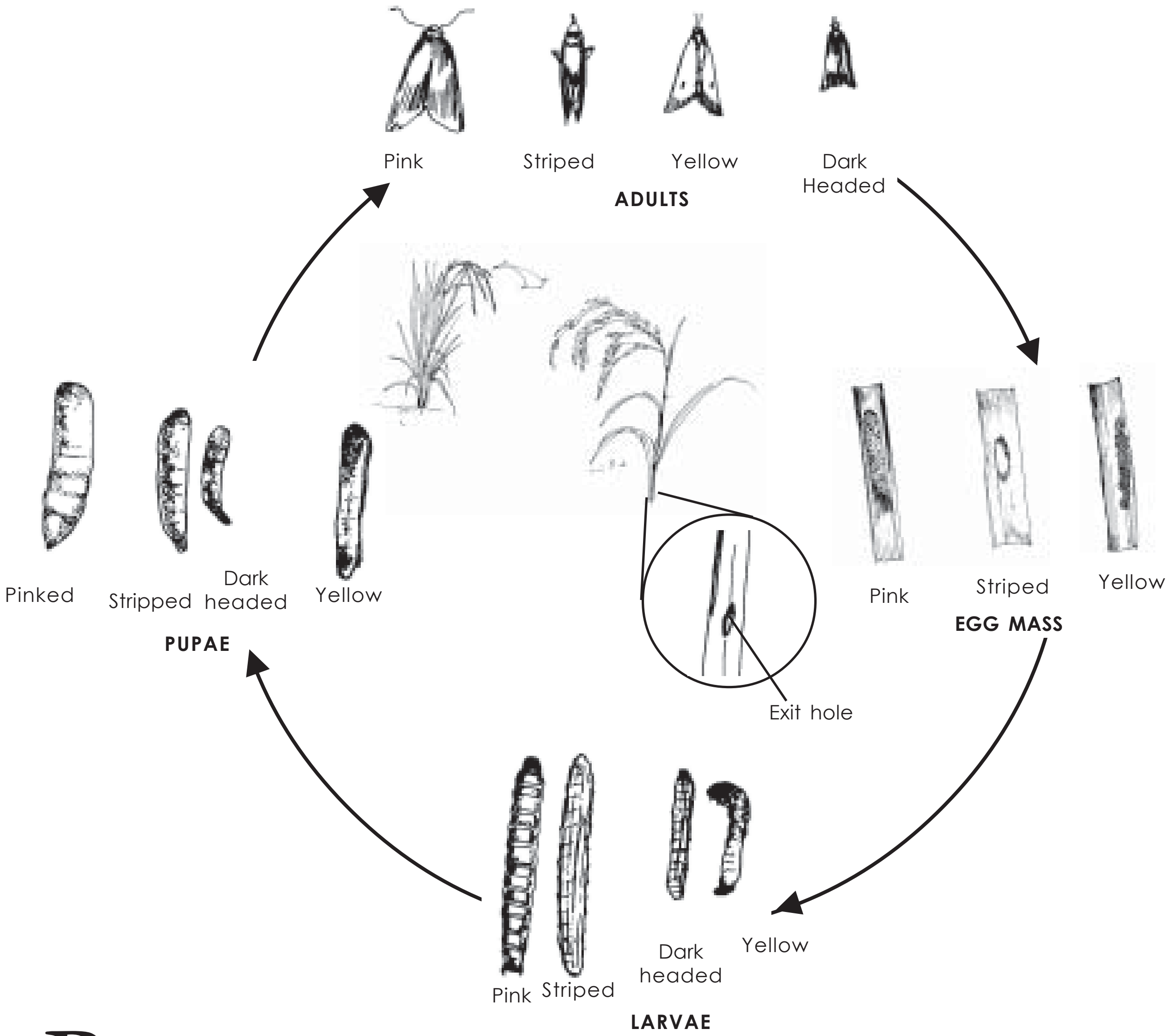
Managing Rice Stem Borers in Rice-Wheat Systems



Rice stem borers are serious pests and of regular occurence infest the crop at all stages of crop growth. The rice plants can compensate the damage caused by the borers during the vegetative phase up to the stage of maximum tillering. Infestation by stem borers during the reproductive phase, specially during panicle initiation and ear head emergence, causes loss in yield. All important stem borers which affect rice come under the Order Lepidoptera. Important stem borer species of Bangladesh, India, Nepal and Pakistan belong to genera *Scirpophaga* and *Chilo* of family Pyralidae, and genus *Sesmia* of family Noctuidae.

The life cycle is represented by complete metamorphosis in which the larva must find suitable food during its life of 16 to 56 days, pupa must be protected from enemies and adverse physical conditions for four to 11 days, and the adult, which lives for just two to six days, must again find food (generally different from that of larva). If it does not feed, it must at least find a suitable place to deposit its eggs to perpetuate itself.

Pupation in rice stem borers usually takes place in the stem, straw, or stubble. Sometimes *S. inferens* also pupates between leaf sheath and stem. Pupae of *Scirpophaga* are covered with whitish silken cocoon, while *C.suppressalis* pupae are without cocoon. Before pupating, the full-grown larva cuts an exit hole in the rice internode and plugs it with a fine web through which emerging moth escapes.

Name of Stem Borer Species	Common Name	Life Cycle Duration (days)	Feeding Habit
Chilo auricilius Dudgeon	Gold–Fringed Rice Borer, GFSB	42-52	Polyphagus
Chilo partellus (Swinh.)	Spotted Stem Borer, SSB	30-52	Polyphagus
Chilo polychrysus (Meyrick)	Dark-headed stem borer, DHSB	26-61	Polyphagus
Chilo suppressalis (Walker)	Rice striped Borer, RSB	41-70	Polyphagus
Scirpophaga incertulas (Walker)	Yellow Stem Borer, YSB	52-71	Monophagus
Scirpophaga innotata (Walker)	White stem Borer, WSB	30-51	Monophagus
Sesmila inferens (Walker)	Pink Stem Borer , PSB	46-83	Polyphagus

Egg laying sites on plants are: GFSB - mainly on foliage of underside of rice plants and occasionally on leaf sheaths: SSB - as overlapping rows on all parts of plants; DHSB - in longitudinal rows along shallow furrows on both surfaces at the basal portion of leaves; and RSB - on basal half of leaves. Occasionally on leaf sheaths along mid rib of either the upper or lower surfaces, YSB - near the tip of leaf blade; WSB - on underside of young leaves, and PSB between leaf sheaths and stems.

Larvae live gregariously during the first three instars. In gregarious phase if young larvae are isolated from each other, they suffer high mortality.

The newly emerged larvae show a strong tendency to disperse. They are negatively geotropic and crawl upward, reach leaf tip and aided by silken thread reach other plants. Those falling directly on water catch air layer and swim safely. Later instars cut leaf tips, wrap, form tubes and swim swiftly.

Larvae of *C.suppressalis*, which remain between four and 7 inches above the soil are thus removed in the straw at harvest. Larvae of *Scirpophaga* spp, which have a tendency to feed in the basal part of the plants, are usually left behind in the stubble. During dormancy or diapause the larvae in the stubble move down into the plant base and most stay 1-2 inches below the ground level. Overwintering *T.innotata* larvae move into the root and construct tunnel up to 4 inches deep. On the return of the optimum conditions, overwintering larvae of most species pupate in the stubble. Some larvae of *C.suppressalis* may also pupate in the harvested straw.

Survival and Carry-over

During period when there is no rice crop and the temperature is not optimal for larval development, mature larvae undergo dormancy or diapause in the stubble after moving down into the plant base to stay 1 to 2 inches below the ground level. However, larvae of *C. suppressalis* have a tendency to dispause between 4 inches and 7 inches above the soil and are thus removed with the straw and overwinter in the heaped straw. Larvae of *T. incertulas* cannot survive in the straw, so they go down into the stubble and also in the root zone to diapause; in the floating rice the diapause site is the mid-section of stem near a node. Overwintering *T.innotata* larvae move into the root and construct tunnels up to 4 inches deep.

The moths of these stem borers are strong fliers and, with the help of wind, may cover three miles (5 km) in a single flight. They thus have little difficulty in locating the early rice nursery or summer crop. Further, where two or more rice crops are grown in a year, larvae have adapted to undergo only a temporary diapaude or to discard diapause nature. Polyphagus species of borers have ample opportunities to remain active throughout the year under the diversified cropping system.

Factors of Abundance

Due to the availability of cheap irrigation water, cultivation of rice in summer is profitable. Use of high doses of nitrogen, closer spacing, indiscriminate use of pesticides (killing natural enemies), lack of attention to selection of resistant varieties, possible depletion of silica from soil, heaping of rice straw in the corner of plots, contribute to an increase borer population. Lack of follow up of practices to destroy diapause larvae in stubble and straw is also an important factor which is responsible for the increased infestation of these pests, particularly from 1980s.

Borers Disaster

In Pakistan, stem borers are a great threat to traditional basmati growing areas of Punjab province. Reduction in basmati yields has been estimated at 20%–25% by yellow and white stem borers. During an outbreak season, 70% to 90% of crop may be damaged and, in certain cases, crop is left unharvested in the field due to the cost of harvesting being higher than the yield obtained (Baloch, 1975). It is also reported that the attack of rice stem borers in late transplanted crop is as high as 80% in some parts of Lahore district. Recently, NARC, Pakistan has also expressed concern regarding the increased incidence of stem borer in wheat under rice-wheat cropping system.

Serious Pests

In India, *S.incertulas* is reported to cause 1% to 19% yield loss in early–planted and 38% to 80% in late transplanted rice crops. In the north India's hilly tracts, low infestation on rice occurs in early July, when larvae cause dead hearts in seedlings. Severe infestations occur in September, with maximum whiteheads reaching upto 50%-60% in the field. In the zonal workshop of Krishi Vigyan Kendra at Meerut, India, scientists who are responsible for transferring technologies on farmers' fields voiced grave concern that stem borer under rice-wheat cropping system have come under the category of 'one of the most important' pests. In some farmers' fields, losses were 40%-50%.

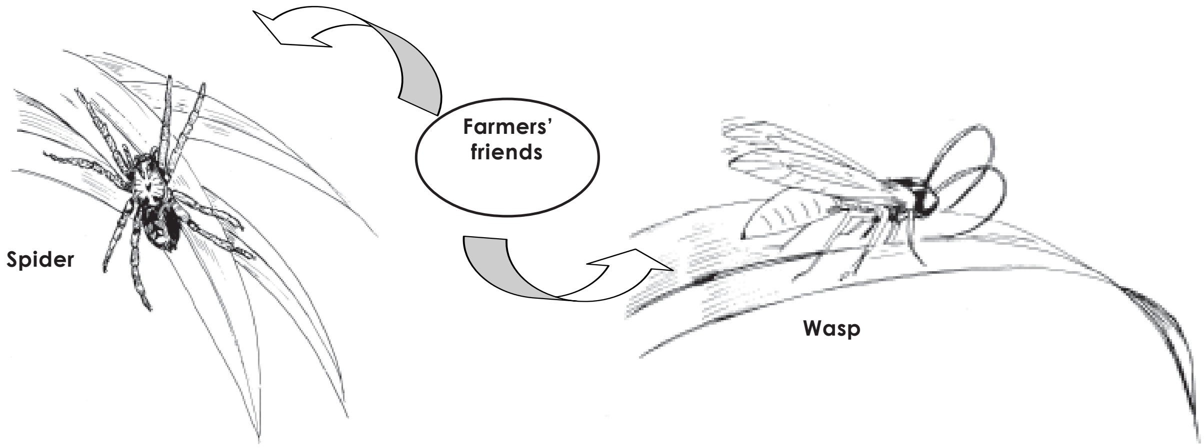
Management Strategies

Resistance Management

Use of pest-resistant rice varieties, maintenance of soil organic matter level at desired level, balanced use of nitrogen, phosphorous and potash by using both organic and inorganic sources of nutrients, amelioration of micronutrient deficiencies, and silicon enrichment of soil by incorporating straw, help plants to resist insect attack. Varieties containing more layers of lignified tissues, a greater area under sclerenchymatous tissues, and large number of silica cells have been found more reisistant to stem borers. Several rice varieties have now been transformed with toxic genes from *Bacillus thuringensis* (BT), and have been shown to have enhanced resistance to stem borers.

Conservation of Natural Enemies of Stem Borers

Recent collaborative studies by Rice-Wheat Consortium reveal that retention of rice stubble in no-till wheat fields immensely enhanced the diversity and population density of natural enemies of rice pests, particularly the predatory crickets, beetles, bugs, ants and spiders. The predators were seen in abundance in the rice stubble as also in or on the nearby grasses and weeds in the early stages of wheat crop. This fauna, however, was found almost absent in wheat fields sown with conventional tillage or on raised beds.



Habitat Diversification

Introduction of plant diversity, crop rotation, cover crop, etc. also improve biological control because diverse agroecosystems tend to enhance abundance of natural enemies due to availability of alternate prey, food and suitable microclimate. The population of predators was higher in rice nurseries and transplanted crops located near Egyptian clover, alfalfa and sorghum fields. Cutting these fodder crops in appropriate manner, i.e., cutting that begins at the farthest end and proceeds towards rice nurseries or the transplanted crop encourages biocontrol agents to gradually move from the harvested portion of the field to the standing crops. They concentrate on a small unharvested portion of fodder crops and then move to rice nurseries or the transplanted crop once this portion is also harvested.

Managing Sowing Periods

Studies show that timely sowing (November 10-25) of wheat reduces the infestation by borer, but in late sown conditions (>December 10) infestation was recorded up to April. Zero-tillage technology helps in early sowing of wheat crop.

Direct Seeding of Rice

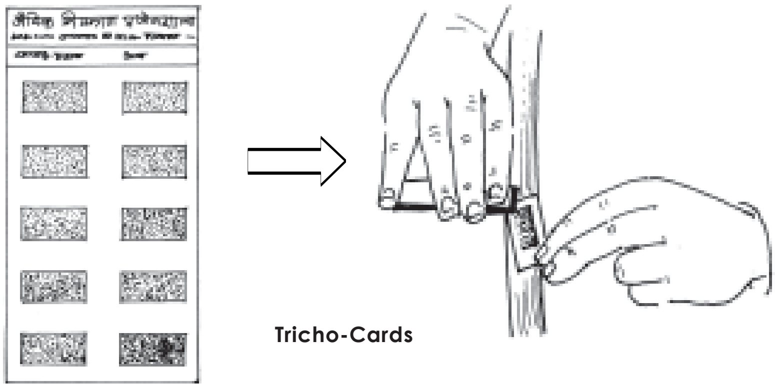
Direct seeded rice without standing water during the vegetative stage often grows less vigorously making it less attractive to Yellow stem borer.

Management of Rice Transplanting and Irrigation

Delayed transplanting at the beginning of the monsoon season using early maturing cultivars over a large area causes a suicidal flight at stem borers while still allowing a timely harvest. Seedling that are bundled for transplanting can be held back for two days to drive out stem borer larvae. Alternate flooding and draining of irrigation water enhances the degree of control of both stem borers and weeds.

Management of Egg Masses

Around 40% of yield loss due to stem borers in rice can be avoided by removing egg masses. Removal of egg masses must be timed to coincide with the susceptible growth stages. Application of ovicides either cost effective strategy. However, YSB eggs are covered with heavy matrix that prevents insecticides penetration and hence the ovicidal action is nullified. In *C suppressalis* eggs, cholinesteerase activity starts at 60 hours after oviposition, and thus action of organic phosphate insecticides are nullified on freshly laid eggs. Among the natural enemies, egg parasitoids *Trichogramma spp* are mass produced and supplied as "Tricho-Cards" with each card containing over 20,000 parasitoids distributed in ten segments. Each segment is cut and stapled on the underside of the leaves. On hatching, the parasitoids emerge and disperse in search of host (stem borer) eggs. *Trichogramma* spp. can also be released as adults at the rate of 50,000 wasps per hectare. It is not effective against eggs of *S. inferens* as these are always concealed by the leaf sheath.



Tricho-Cards

Use of Pheromone Traps

Pheromone lures are a cost-effective strategy to reduce the population of male insects and the subsequent generation of the pest. These lures are fixed in the field at a distance of 20m to 25m from each other. Application of insecticide is needed only when 5% dead hearts or one female insect or one egg mass per square meter is seen.

Formulation of Integrated Location-Specific Schedule

Proper level of soil to avoid low-lying patches and use of balanced dose of both organic and inorganic nutrient supplements reduces infestation by borers. Depending upon the nature and prevalence of stem borers along with other pests and diseases, a strategy needs to be formulated for selection of resistant varieties, selection of weed control strategy as weeds harbor both insect pests and their natural enemies, selection of cultural methods like flooding and raking to kill stem borer larvae, giving priority to biological methods like pheromone traps and use of Trichocards. It also needs to consider insecticide, keeping in view their safety against natural enemies, giving priority to pesticide application methods like seed treatment, seedling treatment and root zone application, which require least quantity of chemicals, and use of chemicals only on the basis of economic and environmental thresholds.

Adapted from:

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