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Major Insect Pests in Paddy Crop and Their Management

Jaya Sai Deepika Konda and Ashok S. Chandar
Department of Entomology, (SHUATS), Prayagraj, U.P

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Abstract:

Rice is the staple food of India. While rice production has so far kept in pace with population increase, future demand for the growing population can be met with strong research support aimed at enhancing rice productivity and sustaining the production. Among the biotic stresses that limit the production, insect pests rank second to weeds. Understanding bio-ecology of the key insect pests forms the basis of developing strategies to regulate their populations. Despite over 100 species of insects being reported to feed on rice, about 6 major and an equal number of minor pests are of economic importance.

Keywords: Insect, Management, *Oryza sativa*

Introduction:

Rice is the most important food crop in India and on research, and production priority for national food security. Rice contains protein name gluten (8.1%), Vitamins, minerals, fibers (2.2%) and lots of carbohydrates (77.1%) with a total of 349 calories. Rice crop is highly sensitive for several insect pests. The major factors that have contributed towards changes in the pest scenario are extensive cultivation of high yielding varieties, growing of varieties lacking resistance to major pests, intensified rice cultivation throughout the year providing constant niches for pest multiplication, imbalanced use of fertilizers, particularly application of high levels of nitrogen, non-judicious use of insecticides resulting in pest resistance to insecticides, and resurgence of pests and out breaks of minor pests. The number of insects pests recorded during this survey clearly shows the damage intensity caused by insects, this survey report will support for making the decision for management of major insects.

Among the biotic stresses that limit the production, insect pests rank second to weeds. Understanding bio-ecology of the key insect pests forms the basis of developing strategies to

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regulate their populations. Despite over 100 species of insects being reported to feed on rice, about 6 major and an equal number of minor pests are of economic importance.

India is the largest rice growing country with about 44-million-hectare area and second largest rice producer with over 97 million tonnes of milled rice. Rice contributes to 40% of the country's food grain production, provides 32-59% of the dietary energy; 25-44% of dietary protein besides providing livelihood for 70% of the rural population. In short rice is life for us. However, rice production has just kept in pace with the population growth and demand over the past five decades and now showing a slow down. As per some of the projections we need to produce 120 million tonnes of rice by the year 2025 (DRR 2006). Productivity of rice in India (3.0 tonnes/ha- rough rice) is far lower than that recorded by many rice growing countries including China (6-7 tonnes/ha). One of the reasons for this being the fact that rice is grown in different environments viz., rainfed uplands, rainfed shallow to deep water area with no control on water availability and in water controlled irrigated area. Rice crop in all these environments faces several biotic and abiotic stresses. In order to achieve and sustain higher productivity levels there is a need to manage these stresses.

Major Insect Pests of Rice:

Over 100 insect species have been reported in India to feed on rice plant at various stages of growth and complete their life cycle. However, not all of these may be termed pests from point of economic yield loss. Of these six groups may be termed as major insect pests in terms of their wide spread distribution and intensity of damage to cause economic loss. Besides, another six species cause serious economic loss at regional scale and infrequently. A brief description of these pests is given hereunder.

Stem Borers:

Rice stem borers from the order Lepidoptera and families Pyralidae and Noctuidae form the major group of tissue borers. Five different species are reported from different regions of the country. Based on the colour and appearance of the larvae that bore the stem or the adult moths these species are given the common names.

1. Yellow stem borer (YSB), *Scirpophagaincertulas*,
2. Pink stem borer (PSB), *Sesamia inferens*,
3. White stem borer (WSB), *Scirpophagainnotata*,

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4. Dark headed borer (DHB), *Chilo polychrysus*,

5. Striped stem borer (SSB), *Chilo suppressalis*.

The yellow stem borer is widely spread across the country and is far more abundant than any other species. Pink stem borer is next in abundance in northern parts where rice, wheat cropping system prevails. However, more than one species is being reported from different rice growing regions and relative abundance of these species vary with location, crop growth stage.

Lifecycle:

A brief description of the life cycle of yellow stem borer that follows may be generalized for other species as well with minor variations.

Adult moth (Fig. 1.1a) is large in size with a black dot on the forewings in case of female. Eggs are laid in groups as egg-masses (Fig. 1.1b) on the leaf blade or sheath by mated females that are covered by tuft of scales. A female lays 3-4 egg masses in it life time while each egg mass may contain 100-150 eggs. Eggs hatch in 8-10 days after being laid. Neonate larvae move up the plant to the tip of the tallest leaf and drop down suspended with a salivary thread to be swung out by wind in all direction. Later they crawl down the plant and enter leaf-sheath and burrow into the tissue. Grownup second instar larvae bore into the stem and feed on the tissue lining. Some of the second-third instar larvae come out of the stem if the larval population in the plant is high and move to adjacent tillers or plants. Fully grown larva (Fig. 1.1c) move internally to the base of the plant, makes an exit hole covering it with frass and enters into pupal stage (Fig. 1.1d). Pupa emerges after 8-10 days as adult moth. Feeding by larvae results in death of the tiller described as “dead heart” (Fig. 1.1e) in vegetative stage of the plant or in a dried panicle called as ‘white ear head’ in reproductive phase (Fig. 1.1f)

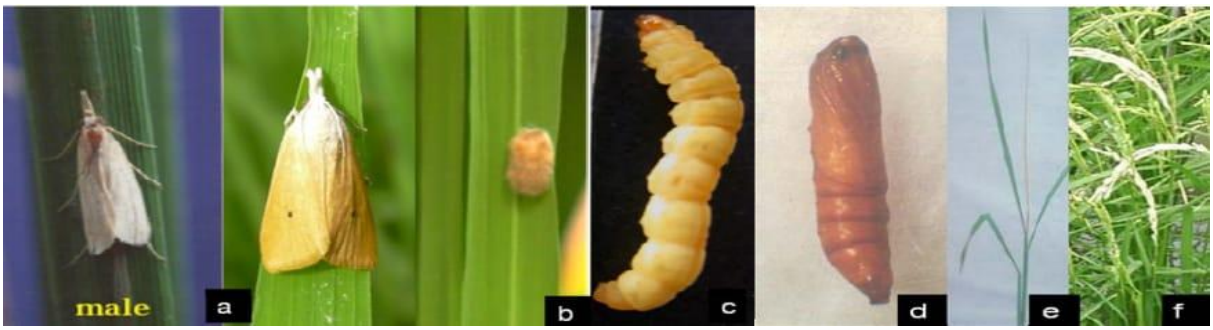

Fig. 1.1 Yellow stem borer Scirpophagaincertulas(a) Adult male & female moths (b) egg mass (c) larva (d) pupa (e) dead heart (f) white ear head.

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Nature of Damage:

The affected tillers are unproductive and result in yield loss. Early damage in vegetative stage is slightly compensated by production of new tillers while white ear head damage leads to total loss of the grains by the dried panicle. Stem borer damage may be initiated even in the nursery stage but generally seen within one month after transplanting. Dead heart damage may escape the notice of farmer when it is low to moderate scale, but white ear damage is distinct.

Management:

Among different control methods that will be elaborated in the subsequent sections, host plant resistance against the pest is not satisfactory. While natural biological control agents are active and keep the pest population in check, augmentation with egg parasites is feasible and partly effective. Novel method of pest management with sex pheromones is effective and desirable. New ecological approach with trap cropping looks promising. Effective chemical control methods are known as last resort.

Chemical control:

- Flubendamide 39.35% SC,
- Caldon 2 gm/L+Neemark1% 1 ml/L
- Coragen 0.33ml/L+ Raccaltospraywell

Plant Hoppers:

Rice planthoppers are major pests across the country especially in irrigated rice where intensive rice cropping is being done.

Three species of planthoppers reported on rice are:

- Brown planthopper (BPH), *Nilaparvatalugens*

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- Whitebackedplanthopper (WBPH), *Sogatellafurcifera* (Horvath) and
- Smaller brown planthopper (SBPH), *Laodelphaxstriatellus*Fallén.

First two of these are of economic importance. Besides direct damage to the crop, BPH and SBPH also transmit viral diseases like rice grassy stunt, rice ragged stunt, and yellowing syndrome. All the three species of planthoppers belong to the order homoptera consisting of bugs with piercing and sucking mouth parts. The planthoppers suck the plant sap from the phloem vessels through their proboscis. Due to this, plant starts wilting with outer most leaves drying first and then the entire plant dries up – a symptom often called "Hopper burn".

Adult BPH has brownish body (Fig. 1.2a), though body color may show wide range of variation from light brown to dark brown. Adult females are larger than males and bear dark brown ovipositor at the base of the abdomen. Two distinct wing forma are seen in adult stage (Fig. 1.2b). Large winged or macropterous forms have wings extended beyond the tip of the abdomen while short winged or brachypterous forms have smaller wings that do not extend beyond the tip of the body. Macropterous forms are adapted for long distance flights and are known to migrate thousands of kilometres distance across land and sea. These forms are the first to appear in the newly planted field and begin colonization. Eggs laid by these immigrants hatch into tiny nymphs. These nymphs under go four moults - with the intervening five nymphal instars - during the course of their development and turn into brachypterous adults. Such adults are not capable of flying but are more fecund. They lay 300-500 eggs per female and second-generation nymphs and adults crowd the base of the plant and their feeding results in hopper burn. When the plants start drying up, many of the third or fourth generation nymphs develop into macropterous adults and fly out of the field to neighbouring or distant healthy fields. Thus, wing polymorphism is an adaptive strategy of this pest for long distance immigration, colonization, rapid utilization of available resources and outward emigration.

WBPH adults are slightly smaller in size with greyish body with a white strip on the upper middle part of abdomen (Fig. 1.2c). Though females display wing polymorphism like those of BPH, brachypterous males are seldom seen. Life cycle is similar to that of BPH. Typical circular patches of damage associated with BPH are not seen when only WBPH infestation is found in the field. Plant drying is more random to begin with, while rapidly

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spreading to cover the entire field. SBPH has been recorded from Punjab during 1980s. However, no report of damage to the crop available so far.

There are, however, subtle differences in population dynamics and damage symptoms by these two hoppers. WBPH, generally prefers young stage of the crop and is seen in greater numbers during early tillering stage of the crop. BPH, on the other hand, builds up later during reproductive phase of the crop. WBPH preferentially feeds at the base of upper leaves, while BPH prefers base of the plant. However, when the population density on plant increases, such preference will not be seen and plant hoppers are seen feeding on leaf blade and spikelet also. Oviposition marks on leaf sheaths are less distinct in case of BPH (Fig. 1.2d) while plant tissue is slit and an open window is seen where eggs are laid by WBPH (Fig. 1.2e). Initial feeding by WBPH leads to plant leaf turning orange before turning yellow and drying, while exclusive feeding by BPH turn the leaf yellow directly.

Fig. 1.2 Rice planthoppers: BPH & WBPH (a) Adult BPH Nilaparvatalugens (Stal) (b) brachypterous (left) and macropterous (right) forms (c) white backed planthopperSogatellafurcifera (Horvath) (d) oviposition site of BPH eggs (e) oviposition site of WBPH eggs on leaf sheath.

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Nature of Damage:

Plant hoppers generally appear in the field about one month after transplanting in normal or early planted fields. However, in late planted crop adults may move from already planted crop to young crop much earlier. Pest population builds up faster after the crop leaf canopy covers the open space between the plants. This can happen early if the plant spacing is closer and higher dose of nitrogen fertilizer is used for top dressing. Population builds up is further facilitated with the use of broad spectrum or ineffective insecticides early in the season due to elimination of natural bio control agents like predators and parasitoids. Plant hoppers initially immigrate and settle down randomly on young plants. These immigrant macropterous forms produce first generation brachypterous forms in 3-4 weeks time. When these adults produce a large second-generation nymph, both adults and nymphs feed voraciously on the plant. This results in the early symptom of yellowing in patches in the field.

Plants nearing to maturity have

Brown or White Adults feeding near the base of tillers.

MANAGEMENT:

Mechanical & physical measures:

- Flood the seedbed, for a day, so that only the tips of seedlings are exposed will control BPH.
- Sweep small seedbeds with a net to remove some BPH (but not eggs), particularly from dry seed beds. At high BPH densities, sweeping will not remove sufficient numbers of BPH from the base of the plant.

Biological control -

- If natural enemies out-number BPH the risk of hopper burn is low. Even rice already damaged by hopper burn should not be treated with insecticides if natural enemies

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out-number BPH. Natural enemies of BPH include water striders, mirid bugs, spiders, and various egg parasitoids.

Chemical control -

Only apply insecticides to the seedbed, for BPH or WBPH, if all of these conditions are met:

- an average of more than one planthopper per stem,
- on average, more planthoppers than natural enemies,
- flooding the seedbed is not an option.

Spray any one of the following:

- Phosphamidon 40 SL 1000 ml/ha (or) Monocrotophos 36 SL 1250 ml/ha (or) Phosalone 35 EC 1500 ml/ha (or) Carbaryl 10 D 25 kg/ha (or) Methyl demeton 25 EC 1000 ml/ha (or) Acephate 75 SP 625 gm/ha (or) Chlorpyriphos 20 EC 1250 ml/ha Carbofuran 3 G 17.5 kg/ha (or) Dichlorvos 76 WSC 350 ml/ ha.
- Use of botanical methods : Neem oil 3% 15 lit/ha (or) Iluppai oil 6% 30 lit/ha (or) Neem seed kernel extract 5% 25 kg/ha

Gall Midge

Rice gall midge is a key dipteran pest, belonging to family Cecidomyiidae, of irrigated and rainfed shallow low land rice.

Two species of the pest are known:

1. Asian rice gall midge, *Orseoliaoryzae* (Wood-Mason) and
2. African gall midge *Orseoliaoryzivora* Gagne & Harris.

As the common name implies, the former is prevalent in the Asian countries including India. It is distributed across several states except northwestern region covering Punjab, Himachal Pradesh, Haryana, Uttarakhand, Western UP and Jammu & Kashmir. Unlike the other two pests covered earlier, gall midge damage is restricted to localized pockets and on certain years, based on the weather and the cropvarieties. Some regions like north-coastal Andhra Pradesh, Sothern Telangana, Kuttanad in Kerala, Vidarbha in Maharashtra, Sambalpur region of Orissa, Coastal Karnataka and Manipur are endemic to the pest with moderate to severe yield losses reported regularly from these regions. Occasionally, the pest has also been reported in upland and deep-water rice.

Lifecycle:

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Adult fly looks like a mosquito with pink body (Fig. 1.3a) which has a short adult life span of 1-2 days. Mated female lays 100-150 eggs (Fig. 1.3b) on leaf blade and sheath which hatch on 4th day under favourable high humid condition. After hatching, the maggot (Fig. 1.3c) crawls down the space between leaf sheaths to reach apical meristem and start feeding on this tissue by lacerating and sucking. Due to feeding the meristem forms a gall chamber surround the maggot. Maggot moults twice before pupation. The modified leaf sheath now elongates as a gall often called silver shoot (Fig. 1.3d). Pupa wriggles up the gall tube and drills an exit hole and protrudes out before the adult fly emerges. The life cycle is completed in 20-25 days.

Fig. 1.3 Rice gall midge *Orseoliaoryzae* (a)Adult female (b) eggs (c) maggot (d) silver shoots

Nature of Damage:

Due to formation of gall, the tiller becomes sterile and does not bear panicle and grain, thus causing the yield loss. Pest attack is generally restricted to vegetative stage of the crop. Initial damage leads to active tillering response by the plant to compensate the damage. If weather continues to be favorable, these tillers are also turned into galls by the next generation of maggots and the plant bears bushy appearance with galls. Occasionally, pest damage is also seen during reproductive stage turning spikelets in thepanicle into tiny galls. Since egg stage is very sensitive to humidity, cloudy weather with continuous rains favor pest build up. Early onset of monsoon followed by dry spell leading to delayed transplanting of the crop often leads to severe pest damage in the endemic areas.

Management:

ETL: 10% silver shoots

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- Release *Platygasteroryzae*parasitised galls at 1/10 m2 on 10 days after transplanting (DAT)
- Early ploughing an Harvest the crop and plough immediately
- Remove the alternate hosts and adjust the time of planting (early)
- Optimum recommendation of potash fertilizer
- Setup light trap and monitor the adult flies
- Spray any one of the following insectcides
- Phosalone 35 EC 1500 ml/ha
- Carbosulfan 25% EC 800-1000 ml/ha
- Chlorpyriphos 20% EC 1250 ml/ha
- Fipronil 5% SC 1000-1500 g/ha
- Fipronil 0.3% GR 16670-25000 g/ha
- Thiamethoxam 25% WG 100 g/ha

Leaf Folders

Leaf folders (Lepidoptera: Pyralidae&Gelechidae) have attained a major pest status with introduction of high yielding varieties. Four species in three genera have been reported as leaf folders:

1. *Cnaphalocrocismedinalis*(Guenee),
2. *Marasmiapatnalis* (Bradl)
3. *M. exigua* (Butl)
4. *Brachmiaarotraea* (Meyr)(Gelechidae

However, *C. medinalis* is the dominant and wide spread species. The first two genera can be distinguished in adult stage by the markings on the wings (Fig. 1.4a). Adult female moth lays oval, flat eggs (Fig. 1.4b) on leaf surface or on sheath which hatch on 4th day. Neonate larvae move to the tip of the leaf or into the whorl of an unopened leaf and scrape the surface. Second in star and older larvae fold the leaf and feed inside the fold (Fig. 1.4c). In cases of severe infestation, the leaf margins and tips are dried up entirely and the crop gives a whitish appearance. Larvae pupate (Fig. 1.4d) within the leaf fold and emerge as adults.

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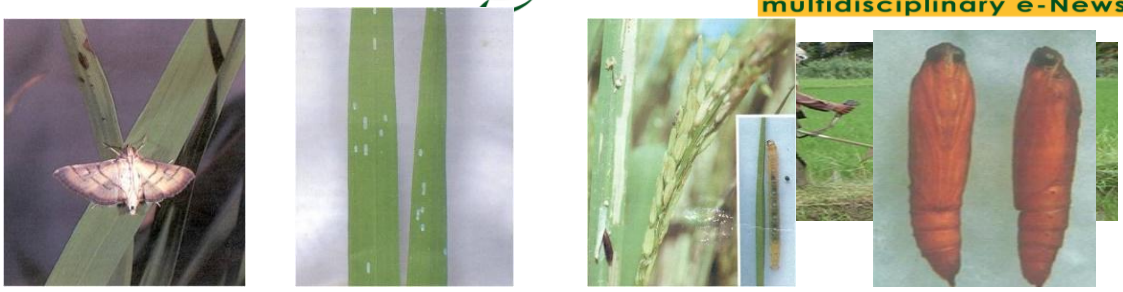

a. Adult moth **b. Flat Eggs** **c. Larvae** **d. Larvae Pupate**

Fig. 1.4 Rice leaf folder, *Cnaphalocrosismedilnalis* (a) Adult moth (b) eggs (c) larva (d) pupa

Nature of Damage:

Leaf folder damage can be observed at any stage of the crop, but generally conspicuous during active tillering to booting stage. Use of high level of nitrogenous fertilizer and cloudy weather with low sunlight favor pest buildup. Often there are overlapping generations in the field with large number of moths but not commensurate damage. Application of insecticide in early stage of the crop growth generally has more adverse effects. Low level of damage is compensated by the plant while yield losses due to severe damage at post booting stage are common.

Management:

ETL: 10% leaf damage at vegetative phase and 5% of flag leaf damage at flowering

- Release Trichogrammachilonis @5 cc (1,00,000/ha) thrice at 37, 44 and 51 days
- Avoid excessive nitrogenous fertilizers
- Keep the bunds clean
- Spray NSKE 5 % or carbaryl 50 WP 1 Kg or chlorpyriphos 20 EC 1250 ml/ ha
- Spray any one of the following insectcides
- Phosalone 35 EC 1500 ml/ha
- Chlorpyriphos 20 EC 1250 ml/ha
- Carbaryl 50 WP 1.0 kg/ha
- Acephate 75 % SP 666-1000 ml/ha
- Azadirachtin 0.03% 1000 ml/ha
- Carbosulfan 6% G 16.7 kg/ha
- CartapHydrochloride 50 %0 g/ha

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- Chlorantraniliprole 18.5% SC 150 g/ha
- Chlorantraniliprole 0.4% G 10 kg/ha
- Dichlorvos 76%SC 627 ml/ha
- Fipronil 80%WG 50-62.5 g/ha
- Flubendiamide 39.35% M/M SC 50 g/ha
- Triazophos 40% EC 625-1250 ml/ha
- Phosphamidon 40% SL 1250 ml/ha
- Flubendiamide 20% WG 125-250 g/ha
- Thiamethoxam 25% WG 100 kg/ha

Leafhoppers

A range of leafhoppers is seen in all the rice ecosystems. Most common being the green leafhoppers (Homoptera: Cicadellidae) *Nephotettixvirescens* (Distant) and *N. nigropictus* (Stal) (Fig. 1.5a). The former species is more confined to rice while the latter has broad range of host-plants. Both the species transmit viruses associated with rice tungro disease. Like their counter parts – planthoppers, the adults lay eggs in the leaf sheath while both nymphs and adults feed on phloem sap.

a.Green leaf hopper **b. Zig zag leaf hopper**

Fig. 1.5 Rice leafhopper (Glh) and zigzag hopper (a) Rice green leafhopper, Nephotettixvirescens (Distant) (b) zigzag leafhopper, Riciliadorsali

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There is no wing polymorphism but color polymorphism is reported with blue forms occasionally seen. While direct damage by feeding of these hoppers seldom cause economic loss, their pest status as vectors of virus diseases is high and they need to be controlled through chemicals. Related species, zigzag leafhopper, *Recilia dorsalis* (Mot.) (Fig. 1.5b) and white leafhopper *Tettigella spectra* are also seen in the rice fields, with former species being reported as vector for visuses.

Gundhi Bugs (Ear Head Bugs)

Gundhi bugs or earhead bugs (Heteroptera: Alydidae) (Fig. 1.6) cause serious damage to the grains during filling stage.

Three species of ear head bugs are reported:

1. *Leptocorisaoratorius*(F.)
2. *L. acuta* (Thunberg)
3. *L. pesudolepida*

Fig. 1.6 Rice gundhi bug, *Leptocoria sp*.

Recent studies have indicated that *L. oratorius* is the most common species in south, west and eastern regions of the country while L. acuta is the dominant species in the north. Since the bugs exclusively feed on filling grains, they also feed on many grasses like *Echinocloacrusgalli, E . colona*and other weeds in the rice field when suitable stage crop is not found. The bugs have also been found to feed on millets and other crops and then migrate to paddy crop. Both adults and nymphs suck the milk from the developing grains in the early stage of grain formation. Infestation is characterised by the discolouration of the panicles as well as the presence of some empty or ill-formed grains in the panicles. Though egg predators and parasites are reported to be active in containing the pest populations in the field, severe infestation demand chemical treatment.

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Besides these gundhi bugs, several other species of bugs have been reported to cause damage to rice crop. Important ones include Malaysian back bug, *Scotinophora spp.* and green bug *Nezaraviridula (L).*

Rice Hispa

Rice hispa, *Dicladispa armigera* Olivier (Coleoptera: Chrysomelidae) is occasionally a major pest of rice particularly in north eastern, eastern and central regions of India. Mainly confined to vegetative phase of the crop, this pest is also reported to migrate long distance. Both adult beetle (Fig. 1.7a) and grubs (Fig. 1.7b) feed on leaves. Entire life cycle is completed within the rice leaves. Adults lay eggs buried into the leaf. Eggs require high humidity to hatch. The grubs begin mining the leaf and feed on the mesophyll tissue keeping both the epidermal layer intact. This results in hollow papery leaves that dry up. Pupation also occur within the leaf mine. Adults cut open the mine and emerge out. Adults scrape the surface of leaf and leave white strips as mark of feeding similar to the leaf folder damage but for lack of leaf folding. Pest population build up is favored by rainy and cloudy days. In case of severe damage the entire crop bears whitish look and the leaves soon dry and turn yellow. Often the pest makes its appearance within one month of transplanting and disappears without further buildup. But occasionally under favorable weather conditions, population rapidly builds up. While no plant resistance recorded, biocontrol agents are partly effective. In case of severe buildup, chemical control may be required.

Fig 1.7a Rice hispa (Adult beetle)

Fig 1.7b (Leaves mined by grubs)

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