

A brief overview of nutri-millet's insect pests and their management

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Millets are nutritionally important crops traditionally grown in tropical and semi-arid regions of Asia and Africa. They are rich in several nutrients and minerals, and are very helpful in tackling health issues like hyperglycemia and anemia, which are becoming a regular companion of most of the people of this era. Still, they are yet to be adopted as daily members of our supper. In spite of being one of the hardiest crops, these are not devoid of the attack of insect pests. There are several insects like stem borers, shoot flies, caterpillars, cutworms, armyworms, grasshoppers, bugs, aphids, midges, white grub, termites, etc which attack millets and cause huge yield loss. It is important to know these enemies and their management in order to protect nutri-millets from loss of production. This article aims to discuss the immediate need of shifting our focus to these crops and the identification and management strategies for the insect pests attacking them.

Keywords: Insects, Management, Millets, Production

MILLETS are coarse grain cereals that are nutrient-rich, drought-tolerant and short-duration crops. India is the highest producer of millets, with a production of 10 lakh tonnes/year. They are cost-effective and provides food and fodder security to dryland and rainfed agriculture. Millets are the most secure crops for small farmers as they are the hardiest, most resilient and climate-adaptable crops in harsh, hot (up to 50°C), and drought environments. The majorly grown millets in our country are sorghum, pearl millet, finger millet, foxtail millet, kodo millet, little millet, proso millet and barnyard millet. The Sorghum is grown to a 4.6 mha (million hectare) area in the country with a production of 4.5 million tonnes and productivity of 1 tonnes/ha. India produces 19.85 lakh metric tonnes of finger millets from 11.94 lakh ha area. Foxtail millet and kodo millet are grown in 0.87 lakh ha and 1.96 lakh ha with the production of 0.66 lakh tonnes, 0.84 lakh tonnes, and

productivity of 762 kg/ha and 429 kg/ha, respectively. Little millet, proso millet and barnyard millet are grown in 2.34 lakh ha, 0.41 lakh ha, 0.146 million ha with the production of 1.27 lakh tonnes, 0.22 lakh tonnes, 0.147 million tonnes and productivity 544 kg/ha, 531 kg/ha, 1034 kg/ha respectively.

Health benefits and nutrient composition

These grains are nutrient-rich and cereal substitutes. Due to their high digestibility, health benefits and mineral composition, they are highly recommended for diabetic and anemic patients. They

regulates the blood glucose level, helps in weight loss, and is good for heart functioning. The nutrient composition of the majorly grown millets is enlisted in Table 1.

Insect pests of millets

Insects are major constraints in the production of millets. Correct identification and timely management of insects are important to protect the crops. It is very important that we should adopt an integrated pest-management approach and not spoil our miraculous crop with pesticide residues. Keeping this



Chilo partellus larvae and adults

Table 1. Indian millets and their nutrient composition

Millet	Available nutrient
Sorghum (Great millet, Indian millet, milo, durra, orshall)	B vitamins, magnesium (Mg), potassium (K), phosphorus (P), iron (Fe) and zinc (Zn)
Pearl millet	15.6% protein, 5% fat and 67% carbohydrate
Finger millet (Ragi, mandua, nagli and kapal)	5–8% protein, 1–2% ether extractives, 65–75% carbohydrates, 15–20% dietary fibre and 2.5–3.5% minerals, calcium (344 mg/100 g)
Foxtail millet (Kakun, kangni, navane, thinai, kang, rala)	10–12% protein, 4.7% fat, 60.6% carbohydrates, 2.29–2.7% lysine and 0.59 (mg) thiamine
Kodo millet (Kodo millet varagu, haraka and arikalu)	8.3% protein, 1.4% fat, 65.6% carbohydrates, and 2.9% ash. The anti-oxidant potential is much higher than any other millet and major cereals
Little millet (Sawai, samalu and same, kutki)	8.7 g protein, 75.7 g carbohydrate, 5.3 g fat and 1.7 g mineral, and 9.3 mg iron/100 g of grains
Proso millet (Cheena, panivaragu, variga and baragu)	Magnesium, manganese and phosphorus. It prevents high blood pressure and provides adequate zinc, vitamin B6 and iron. It is gluten-free and rich in fatty acids and carbohydrates
Barnyard millet	Source of protein, carbohydrates, fibre and most notably, contains more micronutrients (iron and zinc) than other major cereals

*Sesamia inferens* larvae and adults

in mind we have discussed here some of the important insect pest of millets and their management with an integrative approach. The millets pests are classified as

Stem borer

Among them spotted stem borer; *Chilo partellus* and pink stem borer; *Sesamia inferens* are the important pests.

Spotted stem borer [*Chilo partellus* Swinhoe (Crambidae: Lepidoptera)]: Sorghum, Pearl millet, finger millet, sugarcane and rice are the important hosts. It infests the crop from the

second week after sowing till the crop maturity. Initially, the larvae feed on the upper surface of whorl leaves, leaving the lower surface intact as transparent windows. As the severity of the feeding increases, blend of punctures and scratches of epidermal feeding appears prominently. Dead hearts, peduncle tunnelling and partial chaffy panicle are the prominent symptoms.

Pink stem borer [*Sesamia inferens* Walker (Noctuidae: Lepidoptera)]: Sorghum, maize, rice, wheat, sugarcane, pearl millet and ragi are the important hosts. The pink larvae



Shoot fly adults and damages

are gregarious in nature, congregate inside the leaf whorls, and feed on the central leaves, causing typical 'pinhole' symptoms. The central shoot turns brownish and dries out, although the lower leaves remain green and healthy, called as 'dead heart'. The empty panicles become very conspicuous in a field because they remain straight and whitish.

Shoot flies

Sorghum, finger millet, pearl millet, proso millet, kodo millet, fox tail millet, barnyard millet, little millet are the main hosts. It is a seedling pest normally occurring in the 1st–6th week after germination. Maggot feeds on the growing tip causing wilting of leaves and dead hearts. It produces side tillers at the boot leaf stage.

Foliage pests

Red hairy caterpillar [*Amsacta albistriga* Walker (Erebidae: Lepidoptera)]: Sorghum, ragi, pearl millet, maize, barley, cotton, castor, cowpea are the main hosts. Crops grown in red soils are prone to attack. Due to gregarious habits and voracious feeding, complete defoliation of millet plants or destruction of seedlings may occur in a short time. Dark larvae feed gregariously on the lower surface of leaves scraping for 4–5 days and in 10 days, they turn ashy brown. The larvae migrate from one field to other for feeding.

Cutworms and armyworms [*Mythimna separata* Walker, *Spodoptera litura* (Fab) (Noctuidae: Lepidoptera)]: Sorghum, ragi, pearl millet, foxtail millet, maize and members of Poaceae are the major hosts. The larvae feed on the leaves, especially in the nursery of ragi. It scraps the green matter of the leaf tissue and the leaves show a skeletonised appearance. They emerge at night to feed on the roots and shoots of ragi plants and hide in the soil during day time. The affected field looks as if grazed by cattle.

Grasshoppers [*Hieroglyphus nigrorepletus* (Bolivar), *H. banian* (Fab), *Colemania sphenarioides* (Bolivar), *Chrotogonus* spp.



Amsacta albistriga larvae and adults

(Acrididae: Orthoptera)]: It feeds on all millets and other members of Poaceae. The nymphs and adults feed on the leaf by consuming large amounts of leaves and defoliates which gives the grazed appearance. Grasshoppers and locusts feed on foliage and destroy the crop.

nymphs suck sap from the tender leaves and spikelet's, and spread to entire plants leading to stunting and reduced vigor. The base of the plant is attended by ants, such plants when pulled out show aphid colonies. Whereas *R. Maidis* transmits the mosaic virus.

and feed on the grains. Ear heads are partially eaten and appear chalky.

Earhead bug: *Calocoris angustatus* (Lethiery) cause damage to pearl millet, sorghum, maize, tenai, sugarcane and grasses. The adults and nymphs damage the ear heads by sucking the juice from the grains at the milky stage. The sucked-out grain, shrink and turn black in colour and become ill-filled or chaffy. Older grain shows distinct feeding punctures that reduce grain quality.

Soil dwelling insects

White grub: (*Holotrichia* sp, *Anomala* sp): It devastates the pearl millet crop in large areas in central



Mythimna separate larvae and adults



Spodoptera litura larvae and adults

Sucking pest and ear head pest

Shoot bug [*Peregrinus maidis* Ashmead (Delphacidae, hemiptera)]: Sorghum, millets, maize and other members of Poaceae are the important hosts. Infestation in *kharif* crop (summer) begins 30 days after germination. However, a heavy infestation is seen on the *rabi* crop (winter) at the seedling stage. Heavy infestation at the vegetative stage may twist the top leaves and prevent either the formation or emergence of panicles. It is also known to be a vector for transmitting stripe disease of maize.

Aphids (Ragi aphid; *Hysteroneura setariae*, *Rhopalosiphum maidis*, and ragi root aphid; *Tetraneura nigriabdominalis*): Adults and

Sorghum midge (*Stenodiplosis sorghicola*) and **Pearl millet midge** (*Geromyia penniseti*): Sorghum, pearl millet and wild graminaceous are the hosts. The maggot feeds on the developing grains and pupates there. Maggots destroy the ovaries seriously, affecting the development of seeds, leading to chaffy panicles. White pupal cases protruding out from the spikelet and cause chaffy grains with exit holes are seen.

Gram caterpillar (*Helicoverpa armigera*): It is a polyphagous pest. However, Cotton, sorghum, pearl millet, lablab, soybean, pea, safflower, chillies, tomato, groundnut, tobacco, gram, okra, maize, etc. are the major hosts. Larvae hide within the ear heads

India. The grubs cut the roots resulting in wilting of plants in patches and die. Among Termites, *Odontotermes* spp, and *Microtermes* spp, mostly damage crops. Termites also attack the roots of maize and sorghum, and the damaged plants topple. They eventually disrupt the movement of nutrients and water through the vascular system resulting in the death of the plant. The dead plants are sheathed with soil.

Integrated pest management (IPM) in millets

Cultural methods

- Collect and burn stubbles, chaffy ear heads and feed the



Shoot bug



Aphids



Sorghum midge



Gram caterpillar



Earhead



White grub



Termite

stalks to cattle before the onset of monsoon. This will prevent the carry over of over wintering pests. Deep ploughing one month prior to planting will expose the immature stages of insects and serve as food for predators.

- Adopt synchronous and timely/early sowing to reduce the damage of shoot fly, midge and head bugs, and crop rotate of sorghum and other millets with cotton, groundnut and sunflower, to reduce the damage by shoot fly, midge and head bugs. Intercropping sorghum with pigeon pea, cowpea or lablab also reduces the damage by stem borers.
- High seed rate (1.5 times more) and delay thinning minimize shoot fly damage.

Mechanical method: Set up of light traps till midnight and fishmeal traps impregnated with arpocarb insecticides @12/ha till the crop is 30 days-old helps to monitor, attract and kill adults of stem borer, grain midge, june beetle and other moth pests.

Biorational methods: Balanced fertilizer reduce shoot fly populations and stem borers can be managed by setting up of sex pheromone trap at 12 ha. For white grub adult control, place 3 pheromone (synthetic pheromone-Anisole) dispensers per tree at 15 meter radius for 3 consecutive evenings after the first monsoon rains. Collect and destroy the adults fallen near the base of trees by putting them in kerosene solution.

Chemical methods

- Treat the seeds with thiamethoxam 70 WS @3 g/1 kg of seeds to reduce the damage of shoot fly and to some extent stem borer and sucking pest.

- At the time of planting 20 kg/ha of carbofuran 3 g granules may be applied in furrows before sowing to protect seedlings against shoot fly. When the shoot fly damage reaches 5–10% of plants with dead hearts, the crop may be sprayed with cypermethrin 10% EC @1 ml/litre.
- Stem borer: Carbofuran 3 g granules may be applied in the whorls @12 kg ai/ha or the entire field can be sprayed with Metasystox @2 ml/litre.
- Midge: The crop may be sprayed at the 50% flowering stage (1 midge/panicle) with cypermethrin 25 EC @0.5 ml/litre. Carbaryl 10% dust @20–25 kg/ha at 50% flowering and grain formation stage is also suggested in midge endemic areas.
- Ear head bugs and head caterpillars: At the milky stage when 1–2 bugs/panicle and head caterpillars (2–3 larvae/panicle), are noticed the crop may be sprayed with cypermethrin 25% EC @0.5 ml/litre.
- Cutworms (*Mythimina*, *Spodoptera*), red hairy caterpillars, *semilooper*: For managing these gregarious pests, apply poison baits comprising 10 kg rice bran + 1 kg jaggery + 1 litre quinalphos (25% EC). Prepare small balls and broadcast in the fields preferably in the evening. Another way to kill moving hairy caterpillars, dig out a trench about 1 feet deep, add quinalphos 2% powder at the rate of 25 kg/ha.
- Sucking pest (shoot bug, aphids): Apply dimethoate 30% EC @1.5 ml/litre.
- Termites: For areas of regular termite occurrence the soil should be mixed with chlorpyrifos 5% dust @35 kg/

ha at the time of sowing and on standing crop mix chlorpyrifos 20% EC @4 litre/ha with 50 kg of soil and broadcast it evenly in 1 ha followed by a light irrigation.

- White grub: Incorporate carbofuran 3 g @33.0 kg/ha in the soil before sowing. Seed treatment with chlorpyrifos 20 EC @6.5–12.0 ml/kg or imidacloprid 17.8 SL @2.0 ml/kg seed can be done. Take up early sowing if an irrigation facility is available. Drench the root zone of the crop with chlorpyrifos 20 EC @4.0 litre/ha or quinalphos 25 EC @3.2 litre/ha 3 weeks after the adult emergence.

SUMMARY

With all their nutritive richness and hardy nature to sustain in unfavourable conditions during growing periods, millets prove themselves a potent choice for future agriculture. Several schemes have been undertaken by the Government of India for increasing the production of millet. However, in millets incurring much cost on pest management is not economically feasible especially on chemicals since it reduces benefit/cost of crop produced. Community level adoptions of Indigenous Technical knowledge (ITK's) and cultural methods such as early sowing, resistant varieties, judicious nutrient usage etc can help restrict the pest population build-up and the damage caused. The pest scenario also expected to change owing to their dynamic nature, hence, early detection and prompt management actions are needed to be taken-up. It is required that, up-to-date Economic Threshold level (ETL) for each major pest should be determined. Host plant resistance, ecology, evolutionary pest biology, knowledge of the local agro-ecosystem and utilization of natural enemies must become the components of new IPM strategy for holistic management of pests in millets.

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