

farm women through innovative strategies by considering their vulnerability and closeness to nature will strengthen farm women and seed bonding for sustaining agricultural productivity. It provides an unprecedented opportunity to refocus women's role in seed production and management. Hence, developing well-trained, self-reliant, self-motivated and visionary women seed producers who can contribute to reduce the quality seed scarcity of our country is the greatest challenge ahead.

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LAXMI PRIYA SAHOO^{1,*}
SHIVAJI ARGADE¹
ANANDA CHANDRA SASAMALA²

¹ICAR-Central Institute for Women in Agriculture,
Bhubaneswar 751 003, India

²Directorate of Agriculture and Food Production,
Government of Odisha,

Bhubaneswar 751 001, India

*e-mail: laxminrcwa@yahoo.co.in

Tea mosquito bug (*Helopeltis theivora*) and mealy bug (*Paraputo theaecola*) – new threats to large cardamom

Large cardamom (*Amomum subulatum*), a member of the family Zingiberaceae under order Scitaminae, is the most important cash crop in the eastern Himalayan region including Sikkim and the Darjeeling hills in India, the eastern part of Nepal and southern Bhutan¹. Sikkim is the largest producer covering 16,010 ha area, with a production of around 3842 MT and productivity of 240 kg/ha. It is the second largest producer in the world, next only to Nepal². Large cardamom is a perennial, shade-loving crop found at elevations between 600 and 400 m amsl. It requires a high level of humidity (>90%) with annual rainfall of 2000–4000 mm (ref. 1). Large cardamom forms a substantial part of people's livelihood and food security. It is the only source of cash income for many families in the Sikkim Himalaya. Recently, large cardamom cultivation in Sikkim has been facing threat due to several factors, viz. pests and diseases, soil erosion and climate change, presence of old and senile plantations, lack of quality planting materials, drought during winter, preference of government job among youth, lack of migratory labour, lack of proper management, etc. Among these, occurrence of insect pests and diseases is the major factor for low production and productivity of the crop. Stem borer (*Glyphipterix* spp.), shoot fly (*Merochlotops dimorphus* Cherian), leaf eating caterpillar (*Artona chorista* Jordon) and white grub

(*Holotrichia* spp.) are considered as destructive pests of large cardamom³. Since 2014, infestation of tea mosquito bug, *Helopeltis theivora* Waterhouse (Hemiptera: Miridae) and mealy bug, *Paraputo theaecola* (Green) has been recorded in Sikkim. If not addressed properly, they can become a major threat to large cardamom industry.

H. theivora is a major pest in tea plantations. In recent years it is seen damaging large cardamom plants by sucking the sap from the leaves. The affected parts of the plant develop a streak stain that is dark brown (Figure 1). The young shoots become curled, dried and black, thus slowing down the growth of the plant and ultimately affecting the yield. Badly damaged plants produce less shoots and thus the plant loses vigour and becomes stunted. The female lays eggs inside the tender stem, petiole and midrib. After hatching, nymphs complete their nymphal period through four instars. The size of spots increases gradually with the development of instars. First or second instar nymphs can produce more than 140 spots in a day. The fully mature nymph or adult can produce at least 100 spots/day. The first and second instar nymphs prefer mostly the shoots and younger leaves, whereas the later instars and adults prefer comparatively mature leaves. The abundance of the pest is seen from April to November; but in Sikkim it causes major damage

during June–September. Initially the damage starts from a small area and then spreads to the entire area. It causes 30–35% damage in the leaves with symptoms resembling the leaf streak disease. Tea mosquito bug is a destructive polyphagous pest and has wide host range, viz. cashew nut (*Anacardium occidentale*), guava (*Psidium guajava*), mango (*Mangifera indica*), bitter vine (*Mikania micrantha*), kadam (*Anthocephalus cadamba*), jasmine (*Gardenia jasminoides*), Malabar melastome (*Melastoma malabathricum*), jambu (*Eugenia jambolana*), rose (*Rosa sinensis*), etc.⁴. Recently, besides large cardamom, 13 more hosts have been identified in Sikkim, viz. red cherry pepper (Dalle Khorsani), red hibiscus (*Hibiscus* spp.), *Dahlia*, *Solanum* spp., *Salvia* spp., *Duranta* (*Duranta* spp.), ornamental sweet potato (*Ipomoea batatas*), bathua (*Chenopodium album*), *Chlerodendron* spp., *Houtoenia cordifolia*, *Chrysanthemum* spp., *Ficus hookeri* and ridge gourd (*Luffa acutangula*).

P. theaecola (Green) has been recorded in Kerala on small cardamom plant, *Elletaria* spp. as a destructive pest (Figure 2). It was recorded for the first time in large cardamom in 2014 at ICAR Research Complex, Sikkim Centre, Tadong. The specimen of mealy bug has been identified at ICAR-NBAIR, Bengaluru. The body of mealy bug is round, orange-brown and covered by a thin layer of white mealy wax allowing body segmentation



Figure 1. Infestation of (a) later instar nymphs; (b) initial instar nymphs; (c) adult *Helopeltis theivora*.



Figure 2. Infestation of (a) mealy bug and (b) mealy bug in capsules. (c) Mealy bug-infested plant.

to be visible. Damage is caused by sucking the sap from the roots, rhizomes and fruits. Due to continuous loss of sap, the infested plants get debilitated. The most common symptoms are slow plant growth, lack of vigour, browning of leaves, reduction of capsule size and deformed capsules, and subsequent death of the plant. The mealy bug is not evident unless the rhizome is examined by uprooting the plant from the soil. White, waxy substance and adult females were noticed in the rhizome of the infested plants. Plants that are slow-growing, root-bound, or under environmental or nutritional stress, are more susceptible to mealy bug infestation. The incidence of the pest is observed to be more in August and September. The highly mobile crawlers are in the dispersal stage. Once crawlers find a suitable spot, they settle down and begin to feed on the roots with their sucking mouthparts. The spreading of infestation occurs mostly by irrigation water, reuse of previously infested plots

for transplanting, and crawlers moving from infested plants to other plants.

Considering the intensity of damage caused by these two pests, they have the potential to create havoc in the near future for large cardamom cultivation. During the survey, infestation of *H. theivora* has already been observed in almost all the large cardamom plantations of different districts in Sikkim. As this pest has a wide host range, it may create havoc in future in organic state like Sikkim. The body of mealy bug is also covered with a waxy layer, which makes it difficult to control it even by application of conventional insecticides. Therefore, biological control will be the only option for managing this pest. It is the appropriate time to make an in-depth study on its biology, life cycle and also management through organic methods before these pests reach alarming proportions to cause severe damage and destruction to large cardamom plantations not only in Sikkim, but also in other states in the North East

India, which have recently initiated cultivation of large cardamom.

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H. KALITA
R. K. AVASTHE
R. GOPI*
ASHISH YADAV
M. SINGH

*ICAR-Research Complex for NEH Region,
Sikkim Centre,
Tadong 737 102, India*

*e-mail: ramaraj.muthu.gopi2@gmail.com