Pesticide scenario and reduction strategies in Indian cardamom farming – present and future perspectives

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Small cardamom (*Elettaria cardamomum* (L.) Maton; Zingiberaceae) is one of India's most export oriented spices. Insect pests and diseases are major threats to the sustainable cultivation of cardamom in India, and this crop alone consumes 26.21 kg a.i. ha^{-1} of pesticides per year. Shoot and capsule borers, thrips and root grubs are the major insect pests, and capsule rot, clump rot and leaf blight are the major diseases demanding more pesticides in the cardamom production system. The frequency of pesticide application in the system is nearly three times more than the recommended frequency. Various management strategies are advocated to reduce the load of pesticides and their residues. By considering the unique nature of the agroforestry system, varietal replacement, shade and nutrient management, exploitation of bioagents, organic initiatives, cultural and mechanical methods, biotechnological approaches, judicious application of synthetic chemicals and use of less toxic pesticides are the available employable strategies to minimize the pesticide load in the production system. Proper integration and adoption of these strategies by farmers are imperative.

Keywords: Cardamom hill reserves, intensification, integration, pesticide consumption, strategies.

Devan hills) towards its north, the Idukki Reserve Forest in the west, and the Cumbum and Kothakudy valleys to the eastern side[4–6].

India is the second largest exporter and one of the major consumers of cardamom, with an average annual export of 1850 tonnes in 2019–20 (ref. 7). The increased cardamom production during the past decades was associated with a many-fold increase in the consumption of synthetic fertilizers and pesticides[8]. The share of Indian cardamom exports in total world exports decreased from 28% in 1988 to 9% in 2020 in quantity and 42.5% to 9% in value and the export is limited to the Middle East. India's share in the imports to Saudi Arabia decreased in 2019, mainly due to the rejection of the consignments consequent to the detection of higher levels of toxic pesticide residues[7].

Higher susceptibility to insect pests and diseases is considered a major threat to long-term sustainable cardamom production in India. Out of more than 56 species of insect pests[9,10] causing damage to various plant parts of cardamom, shoot and capsule borers (*Conogethes punctiferalis* Guenée), cardamom thrips (*Sciothrips cardamomi* Ramakrishna), root grubs (*Basilepta fulvicornis* Jacoby) and whiteflies (*Singhiella cardamomi* David & Subrahmaniam) demand more quantity of insecticides[11]. Pesticide demand