

# Identification, distribution and temporal occurrence of aphids infesting large cardamom and their efficiency in transmitting large cardamom viruses in northeastern sub-Himalayan region

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**Abstract** Sikkim and Darjeeling hills of India are the largest producer and exporter of large cardamom. The two aphid-transmitted viruses, cardamom bushy dwarf virus (CBDV, genus *Babuvirus*) and large cardamom chirke virus (LCCV, genus *Machuravirus*), seriously affect the production of large cardamom. In the present study, three aphid species, *Micromyzus kalimpongensis* Basu, *Pentalonia nigronervosa* Coquerel and *Aulacorthum solani* Kalt. were identified and documented to colonize large cardamom in the different plantations based on survey, morphometrics and COI gene sequence-based phylogeny. *A. solani* was recorded in large cardamom for the first time in this study. The temporal

occurrence and distribution of these three aphid species have been documented. *M. kalimpongensis*, a root feeding aphid was consistently present in large cardamom plantations throughout the year; predominantly on high altitude (>900 m) plantations. *P. nigronervosa* was predominant in plantations <1000 m altitude, and the population was higher during the summer season only. The incidence of *A. solani* was observed during the winter season only. All the aphid species infesting large cardamom were tested for their ability to transmit the two viruses, CBDV, and LCCV. Only, *M. kalimpongensis* but not the other two species of aphid could transmit CBDV to large cardamom. *P. nigronervosa* transmitted only LCCV, however, the rate of transmission was low. *A. solani* could not transmit any one of these viruses.

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Large cardamom or black cardamom (*Amomum subulatum* Roxb, family Zingiberaceae) is a perennial plantation crop grown extensively in the sub-Himalayan state of Sikkim and Darjeeling district of West Bengal, India. The unique agro-climatic conditions of Sikkim and Darjeeling hills favour this area to be the major producer of large cardamom in the world. Sikkim alone contributes over 85 % of the total production in India. Large cardamom plays a vital role in the livelihood of the farming communities of Sikkim and Darjeeling hills. Two aphid-transmitted viruses viz. cardamom bushy dwarf virus (CBDV, genus *Babuvirus*) and large cardamom chirke virus (LCCV, genus *Machuravirus*) are known to pose serious constraints to large cardamom production. CBDV infected clumps of large cardamom show severe stunning and proliferation of tillers that results in the sterility of plants. Thus, the plants infected with CBDV

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