



Insect cell culture as a tool in plant virus research: a historical overview

Amalendu Ghosh  · Heena Dhall · Ralf G. Dietzgen · Rakesh Kumar Jain

Received: 9 August 2019 / Accepted: 20 February 2020 / Published online: 3 March 2020
© Springer Nature B.V. 2020

Abstract Culturing insect cells *in vitro* has witnessed remarkable growth in the past decades. Over 600 cell lines of dipteran, hemipteran, and lepidopteran insects have been reported so far. Besides its wide adoption for the production of recombinant proteins, viral pesticides, and vaccines, insect cell culture is increasingly being used as a tool for basic research in genetics, molecular biology, biochemistry, and virology. Since its first application in plant virus studies in 1956, insect cell culture has become an indispensable tool to study the complex and intimate interactions of plant viruses and their insect vectors. The *in vitro* cell cultures of several insect vectors of plant viruses including leafhoppers, planthoppers, aphids, thrips, and whiteflies have been successfully employed to understand the functions of viral proteins and receptor-mediated endocytosis into vector cells. This review summarizes the development of novel media and insect cell culture systems and their applications in plant virus research.

Keywords Insect cell lines · Virus-vector relationships · Leafhoppers · Planthoppers · Aphids · Thrips · Whiteflies · Reoviruses · Rhabdoviruses

A. Ghosh (✉) · H. Dhall · R. K. Jain
Insect Vector Laboratory, Advanced Centre for Plant Virology,
Indian Agricultural Research Institute, New Delhi 1100012, India
e-mail: amal4ento@gmail.com

R. G. Dietzgen
Queensland Alliance for Agriculture and Food Innovation, The
University of Queensland, Brisbane, QLD 4072, Australia

Introduction

Insect vectors are responsible for the horizontal spread of many important pathogens to humans, domestic animals, wildlife and agricultural crops. Virus-vector interactions that facilitate this spread continue to be an important research area aimed at developing better control measures. The success in the field of vertebrate cell culture has attracted the attention of many arthropod researchers to develop similar cultures for insects. The spread of arboviruses in humans and animals has further necessitated the development of cell cultures of insects. Mosquito and tick cell lines were utilized to understand virus-vector interactions at the cellular level (Bell-Sakyi et al. 2007). In the agricultural sciences, the importance of insect cell lines was emphasized initially for the production of baculoviruses targeting lepidopteran insects, which were otherwise difficult to control. Later, the baculovirus expression vector system became popular for the expression of many heterologous proteins. The baculovirus expression vector system is often preferred over other systems, due to its unique characteristic of enabling post-translational modifications.

A remarkable expansion in the field of insect cell culture has been witnessed during the past decade for the production of recombinant proteins, viral pesticides, and vaccines as reviewed by Smaghe et al. (2009) and Palomares et al. (2018). Lately, the exploitation of insect cell lines in arbovirus and baculovirus research raised renewed interest and led to technical opportunities in developing cell cultures of insect vectors that transmit economically important plant viruses. A few studies