

CHAPTER I

INTRODUCTION

1.1 Introduction

Cassava (*Manihot esculenta* Crantz) is a starchy root crop native to South America that has become one of the most important tropical crops worldwide, both as a food and an industrial crop. Its ability to grow in nutrient-poor soils and under drought-prone conditions has made cassava a staple food in many developing countries. In Thailand alone, cassava holds major economic significance: in 2024, the country exported over 6.3 million tons of cassava and related products, generating over 100 billion Thai Baht in revenue (Office of Agricultural Economics, 2025). Despite its importance, cassava production is threatened by several pests and viral diseases, among which cassava mosaic disease (CMD) is the most destructive.

In Southeast Asia (SEA), CMD outbreaks have been reported in Vietnam, Thailand, and China (Wang et al., 2019). The predominant causal agent in the region is the Sri Lankan cassava mosaic virus (SLCMV) (Saunders et al., 2002). The virus spreads primarily using infected cassava stem cuttings and by the whitefly vector *Bemisia tabaci* (*B. tabaci*) (Legg and Fauquet, 2004). Infected plants typically display chlorosis, mosaic, and mottled leaf patterns, stunting, and significant reductions in plant size compared to healthy plants (Chikoti, 2011). Yield losses caused by CMD are substantial, ranging from 40% to complete crop failure under severe epidemic conditions (Legg and Fauquet, 2004). Current CMD management strategies rely on insecticides and healthy planting material. However, a promising complementary approach is to reduce virus transmission by improving understanding of the host selection behavior of *B. tabaci* (Navas-Castillo et al., 2011). Plants have evolved diverse defense mechanisms against herbivores, including tolerance, antibiosis, and antixenosis (Punnuri et al., 2022). These plant defenses can directly influence the host selection and feeding behavior of insect vectors, thereby reducing pathogen transmission. Among these traits, morphological defenses such as trichome density and leaf surface characteristics play a critical role

in deterring pests (Avery et al., 2015; Heinz and Parrella, 1994; McAuslane, 1996).

Whiteflies, like other hemipteran vectors, rely on a sequence of probing and feeding behaviors to assess host plant suitability. Once a plant is identified as suitable, it initiates sustained phloem feeding, a critical step for virus acquisition and transmission (Ferreira and Moreno, 2009). Trichomes, hair-like epidermal structures, can interfere with vector behavior by acting as physical and sometimes chemical deterrents, thereby influencing insect landing, movement, and feeding (Skoczek et al., 2017). However, the relationship between trichome traits and whitefly infestation in cassava cultivars remains poorly understood, limiting the identification and recommendation of less susceptible varieties.

Virus transmission efficiency by insect vectors is also governed by three key biological phases: the acquisition access period (AAP), the latent period (LP), and the inoculation access period (IAP) (Purcell, 1982). For example, transmission of the Indian cassava mosaic virus (ICMV) by cassava-biotype *B. tabaci* requires an AAP of 48 hours (Antony et al., 2006), while the transmission of tomato yellow vein streak virus (ToYVSV) by *B. tabaci* involves an LP of 16 hours and an IAP as short as 10 minutes (Firmino et al., 2009). Such information highlights the critical role of vector feeding biology in determining the spread of viruses. Yet, the transmission characteristics of cassava mosaic virus (CMV) and the host preferences of *B. tabaci* on cassava cultivars in Thailand remain largely unstudied.

Therefore, the present study aims to investigate the transmission characteristics of *B. tabaci* as a vector of CMV and examine the influence of trichome density and size on whitefly host selection among cassava cultivars. A better understanding of these factors will not only contribute to improved whitefly and CMD management strategies but also provide insights into plant vector pathogen interactions that can inform the development of resistant cultivars, ultimately enhancing cassava productivity.

1.2 Objectives

1.2.1 To study the role of trichome density in *B. tabaci* infestations across cassava cultivars

1.2.2 To study the transmission characteristics of the *B. tabaci* vector of the SLCMV.

1.3 Scope and limitation of the research

Study transmission characteristics of cassava mosaic virus (CMV) transmission by whitefly (*B. tabaci*), including the time of AAP, LP, and IAP by using Polymerase chain reaction (PCR). The fluorescence in situ hybridization (FISH) technique is used to localize the virus within the whitefly (*B. tabaci*) body. Moreover, study host preference of the whitefly (*B. tabaci*) in 6 cassava varieties as follows: Rayong 4, Rayong 72, Kasetsart 50, Huai Bong 60, CMR 89, and Pirun 2 by the choice test experiment.

1.4 Location of thesis work

Entomology Laboratory, Suranaree University of Technology, Suranaree Subdistrict, Mueang District, Nakhon Ratchasima, Thailand

1.5 Anticipated outcomes

1.5.1 Improved understanding of the role of trichome density in *B. tabaci* infestations across cassava cultivars.

1.5.2 Characterization of the transmission characteristics of *B. tabaci* as a vector of SLCMV.

1.6 Reference

- Avery, P.B., Kumar, V., Simmonds, M.S.J. and Faull, J. (2015). Influence of leaf trichome type and density on the host plant selection by the greenhouse whitefly, *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae). *Applied Entomology and Zoology*, 50, 79–87. doi:10.1007/s13355-014-0308-5.
- Chikoti, P.C. (2011). *Development of Cassava (Manihot esculenta Crantz) Cultivars for Resistance to Cassava Mosaic Disease in Zambia*. Ph.D. Dissertation, University

- of KwaZulu-Natal, Pietermaritzburg, South Africa. Available from: https://ukzndspace.ukzn.ac.za/bitstream/handle/10413/8402/Chikoti_Patrick_Chiza_2011.pdf
- Fereres, A. and Moreno, A. (2009). Behavioural aspects influencing plant virus transmission by homopteran insects. *Virus Research*, 141, 158–168. doi:10.1016/j.virusres.2008.10.020.
- Firmino, A.A., Ramos-Sobrinho, R. and Lima, G.S.A. (2009). Transmission of tomato yellow vein streak virus by *Bemisia tabaci*. *Fitopatologia Brasileira*, 34(6), 491–497. doi: 10.1590/S0100-41582009000600001.
- Heinz, K.M. and Parrella, M.P. (1994). Poinsettia (*Euphorbia pulcherrima* Willd. ex Klotzsch) cultivar-mediated differences in performance of five natural enemies of *Bemisia argentifolii* Bellows and Perring (Homoptera: Aleyrodidae). *Biological Control*, 4, 305–318.
- Legg, J.P., & Fauquet, C.M. (2004). Cassava mosaic geminiviruses in Africa. *Plant Molecular Biology*, 56, 585–599. doi:10.1007/s11103-004-1651-7.
- McAuslane, H.J. (1996). Influence of leaf pubescence on ovipositional preference of *Bemisia argentifolii* (Homoptera: Aleyrodidae) on soybean. *Environmental Entomology*, 25(4), 834–841. doi:10.1093/ee/25.4.834.
- Navas-Castillo, J., Fiallo-Olivé, E. and Sánchez-Campos, S. (2011). Emerging virus diseases transmitted by whiteflies. *Annual Review of Phytopathology*, 49, 219–248. doi:10.1146/annurev-phyto-072910-095235.
- Office of Agricultural Economics. (2025). *Percentage and Yield Volume from Monthly Harvests at the National, Regional, and Provincial Levels*. Available from: <https://oae.go.th/uploads/files/2025/05/21/c0f0128f4dec0212.pdf>
- Punnuri, S.M., Ayele, A.G., Harris-Shultz, K.R., Knoll, J.E., Coffin, A.W., Tadesse, H.K., Armstrong, J.S., Wiggins, T.K., Li, H. and Sattler, S. (2022). Genome-wide association mapping of resistance to the sorghum aphid in *Sorghum bicolor*. *Genomics*, 114, 110408. doi:10.1016/j.ygeno.2022.110408.
- Purcell, A.H. (1982). Insect vector relationships with prokaryotic plant pathogens. *Annual Review of Phytopathology*, 20, 397–417.
- Saunders, K., Salim, N., Mali, V.R., Malathi, V.G., Briddon, R., Markham, P.G. and Stanley, J. (2002). Characterisation of Sri Lankan cassava mosaic virus and Indian cassava

mosaic virus: evidence for acquisition of a DNA B component by a monopartite begomovirus. *Virology*, 293, 63–74. doi:10.1006/viro.2001.1251.

Skoczek, A., Piesik, D., Wenda-Piesik, A., Buszewski, B., Bocianowski, J., & Wawrzyniak, M. (2017). Volatile organic compounds released by maize following herbivory or insect extract application and communication between plants. *Journal of Applied Entomology*, 141, 630–643. doi:10.1111/jen.12367.

Wang, D., Yao, X.M., Huang, G.X., Shi, T., Wang, G.F., & Ye, J. (2019). First report of Sri Lankan cassava mosaic virus infecting cassava in China. *Plant Disease*, 103, 1437. doi:10.1094/PDIS-09-18-1590-PDN.