

CHAPTER III

EVALUATING THE IMPACT OF LEAF TRICHOME ON WHITEFLY *Bemisia tabaci* (Hemiptera: Aleyrodidae) DYNAMICS IN CASSAVA

3.1 Abstract

Cassava (*Manihot esculenta*) is an economically important crop in Thailand, but its productivity is severely limited by CMD, caused by the SLCMV and transmitted by whiteflies (*B. tabaci*). Understanding host plant resistance is therefore essential for effective disease management. Antixenosis, a resistance mechanism associated with plant morphological traits such as trichome density, may reduce whitefly colonization. This study evaluated the relationship between trichome density and whitefly infestation in six cassava cultivars: Huaybong 60, CMR 89, Kasetsart 50, Rayong 72, Rayong 4, and Pirun 2. Whitefly populations were monitored over time, and trichome density was assessed using scanning electron microscopy. Significant differences in whitefly infestation were observed among cultivars. CMR 89, Pirun 2, Rayong 4, and Kasetsart 50 showed higher infestation levels, whereas Huaybong 60 and Rayong 72 consistently exhibited lower whitefly populations. A strong negative correlation between trichome density and whitefly infestation was detected, indicating that increased trichome density effectively restricts whitefly colonization. These findings suggest that Huaybong 60 and Rayong 72 possess promising antixenosis-based resistance and may serve as valuable genetic resources for breeding cassava cultivars resistant to whiteflies and CMD.

3.2 Introduction

Cassava is a starchy, nutty root vegetable native to South America. This versatile crop serves as the foundation for a wide range of products, including food, flour, animal feed, alcohol, starches for paper and textiles, sweeteners, prepared foods, and biodegradable materials. However, a significant challenge in enhancing cassava productivity is the threat posed by diseases and pests. One of the most critical diseases

affecting cassava globally is CMD, which is particularly prevalent in Africa, India, Sri Lanka, and SEA (Legg et al., 2015; Wang et al., 2019). In SEA, CMD has been reported in countries such as Vietnam, Thailand, and China, with the SLCMV identified as the primary pathogen (Wang et al., 2019; Saunders et al., 2002). The disease is predominantly spread through infected cassava cuttings and the whitefly vector *B. tabaci* (Calatayud et al., 1994). Symptoms of CMD include distorted leaves, chlorotic mosaic patterns, mottling, and stunted plant growth (Chikoti, 2011), which can potentially reduce cassava yields by up to 40% or, in severe cases, by 100% (Legg and Fauquet, 2004).

Whitefly (*B. tabaci*, Hemiptera: Aleyrodidae) is a significant insect vector responsible for transmitting CMD (Legg et al., 2011) and over 200 other plant viruses, most of which belong to the *Begomovirus* genus family Geminiviridae (Navas-Castillo et al., 2011; Lu et al., 2019), the causative agents of CMD, the cassava brown streak disease, and SLCMV (Maruthi et al., 2005; Legg et al., 2011; Saunders et al., 2002). CMD can be effectively managed by propagating and distributing disease-free stem cuttings. However, breeding cassava resistant to the SLCMV via conventional methods remains a significant challenge due to the high heterozygosity and susceptibility to inbreeding depression in elite cultivars (Ntui et al., 2015). Furthermore, heavy reliance on chemical pesticides for whitefly management disrupts ecosystems and increases production costs, making it economically unviable for small-scale farmers (Abubakar et al., 2022). In response to insect pests like whiteflies, plants have evolved various defense mechanisms, including tolerance, antibiosis, and antixenosis (Punnuri et al., 2022). Tolerance enables plants to sustain growth and reproduction despite insect damage. Antibiosis directly impacts pest development by reducing fertility, size, and lifespan (Tefera et al., 2016). Antixenosis, in contrast, involves plant traits that deter pest attacks, often through the production of volatile organic compounds (VOCs) such as (E)- β -farnesene, (Z)-3-hexenal, and (E)-2-hexenal (Peterson et al., 2017).

As a result, developing host-plant resistance against insect vectors has emerged as a highly effective strategy for managing vector-borne viral diseases (Ferreles and Moreno, 2009). Plant defenses, such as trichome density and leaf surface characteristics, are crucial in deterring pests (Avery et al., 2015; Heinz and Parrella,

1994; Mcauslane, 1996). As hemipteran vectors of plant viruses, whiteflies rely on a sequence of behaviors to identify and select suitable host plants. Once a plant is deemed appropriate, it initiates sustained phloem-sap feeding (Fereres and Moreno, 2009). Trichomes—small hair-like structures on plant surfaces—play a critical role in defense against insect pests by providing both toxic and deterrent effects (Skoczek et al., 2017). Increased trichome density has been shown to negatively impact insect behaviors, including oviposition, feeding, and larval development (War et al., 2012). However, the relationship between trichome density and whitefly infestation in cassava cultivars remains unclear. This knowledge gap hinders the identification and recommendation of less susceptible cultivars to whitefly damage. Therefore, this study aims to investigate the influence of trichome density and size on whitefly infestation across different cassava cultivars.

3.3 Materials and methods

3.3.1 Plant Materials

Six cassava cultivars: Huaybong 60, CMR 89, Kasetsart 50, Rayong 72, Rayong 4, and Pirun 2—were sourced from Nakhon Ratchasima, Thailand. DNA was extracted from the auxiliary buds at both ends of 10 cassava plants per cultivar to determine their disease-free or infected status using PCR with specific SLCMV primers. DNA extraction was performed according to the protocols described by Kollar et al. (1990) and Nakashima et al. (1993). The quality and quantity of the extracted DNA were evaluated using a spectrophotometer (Thermo Scientific™ NanoDrop™ 2000). The presence of SLCMV was detected through PCR, employing AV1 gene-specific primers (Saokham et al., 2021): AV1 forward (5'-GTT GAA GGT ACT TAT TCC C-3') and AV1 reverse (5'-TAT TAA TAC GGT TGT AAA CGC-3'). PCR amplification was conducted in a 25- μ l reaction volume, containing 1X PCR buffer (PCR Biosystems), 0.2 μ M of each primer, and approximately 50 ng of DNA template. The thermal cycling conditions were as follows: an initial denaturation at 94 °C for 5 minutes, followed by 35 cycles of denaturation at 94 °C for 40 seconds, annealing at 55 °C for 40 seconds, and extension at 72 °C for 40 seconds, with a final elongation at 72 °C for 5 minutes. The reactions were performed using a Bio-Rad iCycler (Bio-Rad Laboratories, Hercules, CA, USA). PCR amplification results were analyzed via DNA gel electrophoresis to confirm the disease-

free or infected status of the cassava samples (Supplementary data, S1). Only disease-free cassava plants were used for propagation.

The cassava stem cuttings, each measuring 20–25 cm in length, were prepared with 20 plants allocated per cultivar. The cuttings were initially planted in pots and cultivated under greenhouse conditions without the application of chemical treatments for insect pests or disease control. After one month of growth, the cassava plants were transferred to field conditions for further study. This experimental design enabled a natural assessment of plant-pest interactions, specifically evaluating the susceptibility of different cassava cultivars to whitefly infestation.

3.3.2 Whitefly *B. tabaci* settling preference assay in the field

The choice test experiment employed a completely randomized design (CRD) to assess the preference of whitefly adults (*B. tabaci*) for six cassava cultivars: Huaybong 60, CMR 89, Kasetsart 50, Rayong 72, Rayong 4, and Pirun 2. One-month-old cassava plants were individually potted at Suranaree University of Technology, with a spacing of 30 cm between rows and pots. The experiment was designed with 10 replications per cassava cultivar. Whiteflies were allowed to infest the cassava plants naturally, and the number of adult whiteflies on all cassava leaves was counted at every five-day intervals until the plants reached four months of age. Host preference was assessed based on the mean number of *B. tabaci* observed on each cassava cultivar. The study was conducted in field settings during December 2023 to January 2024 at Suranaree University of Technology (14°58'14.38" N, 102°06'7.06" E), Nakhon Ratchasima, Thailand.

3.3.3 Whitefly *B. tabaci* settling preference assay in the laboratory

The insect choice test study was conducted using a CRD. This experiment consisted of six replications, each with 120 adult *B. tabaci*. The preference of six cassava varieties by adult *B. tabaci* was quantified using a laboratory-based choice test. The six cassava cultivars: Huaybong 60, CMR 89, Kasetsart 50, Rayong 72, Rayong 4, and Pirun 2. One-month-old cassava plants were placed at different corners of a nylon-mesh cage (dimensions: 0.6 × 1.2 × 0.6 m), with one pot per cassava variety. The experiment was conducted under controlled conditions at 28 ± 2 °C and 50–60%

relative humidity (Erdogan et al., 2024) in the entomology laboratory at Suranaree University of Technology. Adult *B. tabaci* 2–3-day-old were released into the cage using an aspirator. The net opening was unrolled and directed toward one side of the cage during release, after which the cage was immediately sealed by tying the net opening.

The number of adult whiteflies present on each cassava variety was recorded at 24 and 48 hours after the release. The test was repeated six times, with the positions of the cassava varieties rotated clockwise and counterclockwise in each replication to minimize positional bias. Host preference was evaluated by comparing the mean number of *B. tabaci* adults found on each cassava variety.

3.3.4 Trichome size and density

The morphology of the abaxial surface of three-month-old cassava leaves was analyzed to explore its correlation with whitefly feeding preferences. Each measuring 5 mm² leaf samples were soaked in 37% formaldehyde for 24 hours to preserve tissue structure. Following fixation, the specimens were dehydrated in a graded ethanol series (70%, 80%, 90%, and 100%) according to the protocol outlined by Schneeberg et al. (2017). The dehydrated specimens were then dried at the critical point and coated with gold using a Neo Coater. The leaf surface morphology of the samples was examined using a scanning electron microscope (SEM; JEOL JSM-6010LV) at the SEM Laboratory of Suranaree University of Technology, with 10 surface area replicates for each cassava cultivar. Trichome density and size were assessed by measuring 10 µm² per surface area, 10 times per replication.

3.3.5 Statistical Analysis

All statistical analyses were conducted using SAS software version 9.4 (SAS Institute, Inc., Cary, NC). Data on whitefly settling preferences, trichome size, and density were analyzed using Tukey's post hoc test at a significant level of 0.05, with all analyses performed using SAS® OnDemand for Academics.

For correlation analysis (Pearson correlation), similar studies by Ghaffer et al. (2011) were referenced to assess the relationships between the mean values of settling preference and biophysical factors. The mean number of whiteflies in six cassava cultivars, density, and size of trichomes were analyzed using the Pearson correlation. Differences were considered statistically significant at the 5% level. Principal Component Analysis (PCA) was employed to evaluate the relationships among the six

cassava cultivars. As a multivariate statistical method, PCA facilitated the identification of patterns among the cultivars based on multiple parameters, including settling preference and biophysical characteristics. PCA was performed using Origin Pro 2024 software (OriginLab Corporation, Northampton, MA, USA) to visualize and interpret relationships among the cassava cultivars (Moberly et al., 2018).

3.4 Results

3.4.1 Whitefly *B. tabaci* settling preference in the field

Analysis of variance (ANOVA) was performed to assess the infestation levels of *B. tabaci* on six cassava cultivars over a 95-day period. The results revealed significant differences in whitefly abundance among the cultivars at several observation times ($P < 0.05$), specifically at 40, 55, 60, 65, and 95 days.

At 40 days, significant differences were detected among cultivars ($P < 0.001$), with CMR 89 exhibiting a high infestation level of 4.5 ± 0.39 whiteflies per plant. Similarly, at 55 days ($P = 0.027$), Pirun 2 showed the highest infestation level, reaching 5.9 ± 1.62 whiteflies per plant, whereas Rayong 72 exhibited a comparatively low infestation of 1.6 ± 0.45 whiteflies per plant. At 60 days ($P = 0.026$) and 65 days ($P = 0.018$), higher infestation levels were consistently observed on CMR 89, Kasetsart 50, Rayong 4, and Pirun 2, while significantly lower numbers of whiteflies were recorded on Huaybong 60 and Rayong 72. At 90 days, no significant differences among cultivars were detected ($P = 0.081$). However, at 95 days, significant differences re-emerged ($P = 0.019$), with CMR 89 and Pirun 2 showing relatively high infestation levels of approximately 3.0 whiteflies per plant. In contrast, Rayong 72 maintained a low infestation level, with only 1.1 ± 0.31 whiteflies per plant (Figure 1). According to Palumbo (2021), whitefly populations should not be allowed to exceed three adults per leaf, as this action threshold in IPM programs for spring melons is associated with an increased risk of whitefly infestation and resultant crop damage.

The mean number of *B. tabaci* whiteflies recorded over the 95-day observation period differed significantly among the six cassava cultivars ($F = 5.243$; $df = 5$; $P < 0.01$). The highest mean infestation levels (mean $\pm$ SE) were observed on CMR 89 (45.6 ± 2.40), followed by Pirun 2 (42.4 ± 2.23), Rayong 4 (40.9 ± 2.14), and Kasetsart 50 (38.0 ± 2.01). In contrast, significantly lower infestation levels were recorded on

Huaybong 60 (29.8 ± 1.57) and Rayong 72 (23.0 ± 1.21). Detailed infestation levels among cultivars are presented in Figure 2.

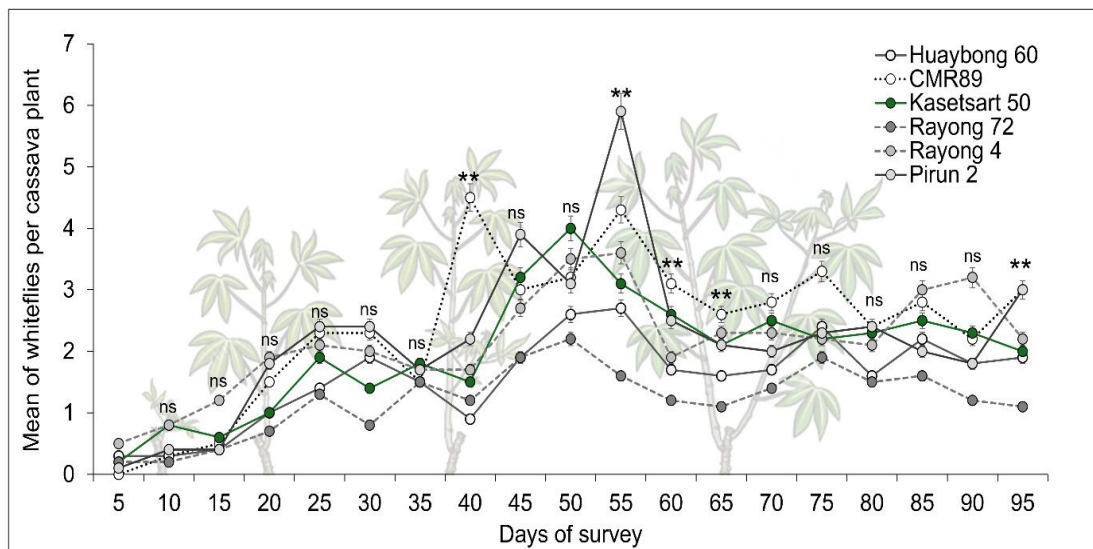


Figure 3.1 The mean number of *B. tabaci* whiteflies infesting six cassava cultivars over a 95-day survey period.

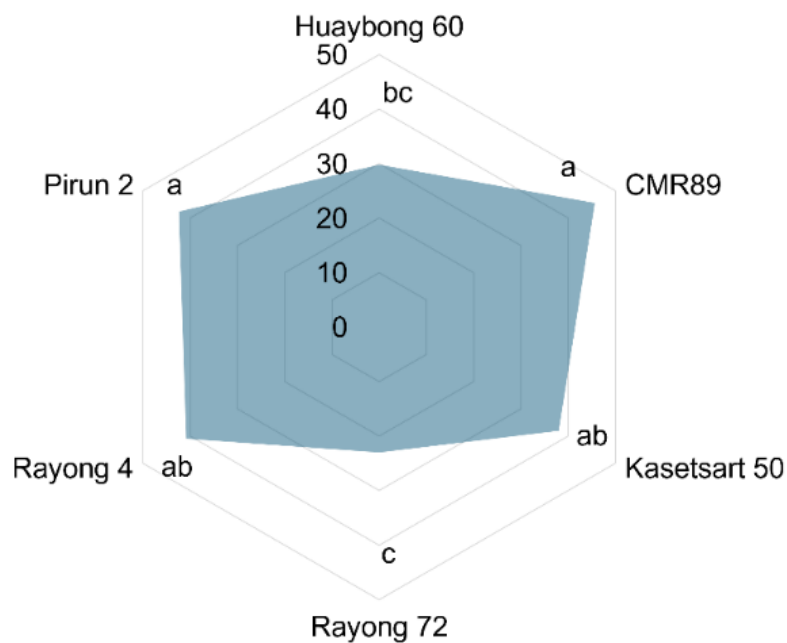


Figure 3.2 The mean number of *B. tabaci* whiteflies infesting six cassava cultivars over a 95-day period.

3.4.2 Whitefly *B. tabaci* settling preference in the laboratory

Analysis of variance (ANOVA) was conducted to evaluate the infestation levels of *B. tabaci* whiteflies on six cassava cultivars after releasing whiteflies in the cage at 24 and 48 hours. The results indicated significant differences in the number of *B. tabaci* among the cultivars at specific time points ($P < 0.05$) at 24 and 48 hours. The mean number of whiteflies per cassava plant was recorded at 24 and 48 hours after release for six cassava varieties: Huaybong 60, CMR 89, Kasetsart 50, Rayong 72, Rayong 4, and Pirun 2 (Figure 3).

At 24 hours, CMR 89 had the highest number of whiteflies (2.00 ± 0.24), followed by Pirun 2 (1.83 ± 0.28), Kasetsart 50 (1.33 ± 0.30), Rayong 4 (1.17 ± 0.28), Rayong 72 (0.17 ± 0.15), and Huaybong 60 (0.17 ± 0.15). Statistical analysis revealed that CMR89 differed significantly from Rayong 72 and Huaybong 60 ($p < 0.05$).

At 48 hours, the same trend was observed. CMR 89 again had the highest number of whiteflies (2.5 ± 0.06), followed by Kasetsart 50 (1.17 ± 0.12), Rayong 4 (1.17 ± 0.11), and Pirun 2 (1.17 ± 0.11), while Rayong 72 (0.17 ± 0.06) and Huaybong 60 (0.17 ± 0.06) remained the lowest. CMR 89 was significantly different from RY72 and HB60, as at 24 hours.

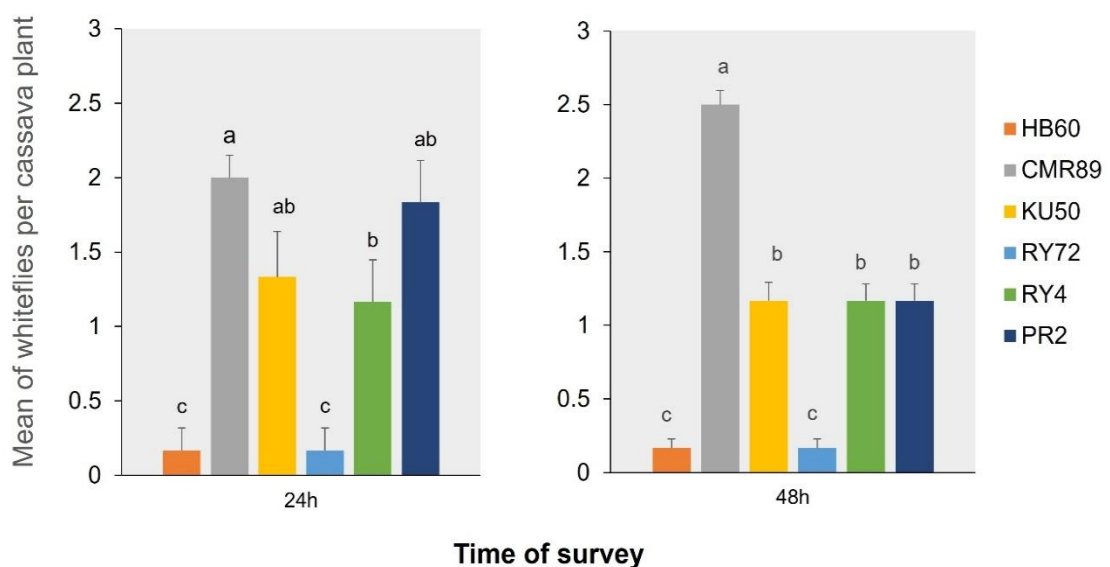


Figure 3.3 The mean number of *B. tabaci* whiteflies infesting six cassava cultivars at 24 and 48-hour surveys.

3.4.3 Trichome Density and Size

The three-month-old leaf morphology of the six cassava cultivars was examined using SEM (Figure 4), revealing the presence of non-glandular trichomes as a characteristic feature across all cultivars. The number of trichomes per 10 μm length scale varied significantly among the cassava cultivars ($F = 49.914$; $df = 5$; $P < 0.01$). The Huaybong 60 cultivar exhibited the highest trichome density (79.30 ± 2.42), followed by Rayong 72 (66.00 ± 1.90) and Pirun 2 (65.50 ± 3.56). In contrast, lower trichome densities were observed in Rayong 4 (46.40 ± 3.29) and Kasetsart 50 (44.20 ± 5.17) (Table 1).

The trichome size also varied significantly among the cassava cultivars ($F = 11.211$; $df = 5$; $P < 0.01$). The Pirun 2 cultivar had the largest trichome size (8.18 ± 0.30), followed by Kasetsart 50 (7.42 ± 0.33), Rayong 72 (7.31 ± 0.31), Huaybong 60 (7.26 ± 0.10), and CMR 89 (7.19 ± 0.34). The smallest trichome size was recorded in Rayong 4 (6.63 ± 0.34 ; Table 1).

Table 3.1 Mean trichome density and trichome size of six cassava cultivars

Cassava cultivars	Trichome density per 10 (μm^2)				Size of trichome (μm^2)			
Huaybong 60	79.30	$\pm$	2.42	a	7.26	$\pm$	0.10	b
CMR 89	60.90	$\pm$	1.90	b	7.19	$\pm$	0.34	b
Kasetsart 50	44.20	$\pm$	5.17	c	7.42	$\pm$	0.33	b
Rayong 72	66.00	$\pm$	6.03	b	7.31	$\pm$	0.31	b
Rayong 4	46.40	$\pm$	3.29	c	6.63	$\pm$	0.34	c
Pirun 2	65.50	$\pm$	3.56	b	8.18	$\pm$	0.30	a

Values in the same column followed by different letters are significantly different ($p < 0.05$) according to one-way ANOVA followed by Tukey's post hoc test.

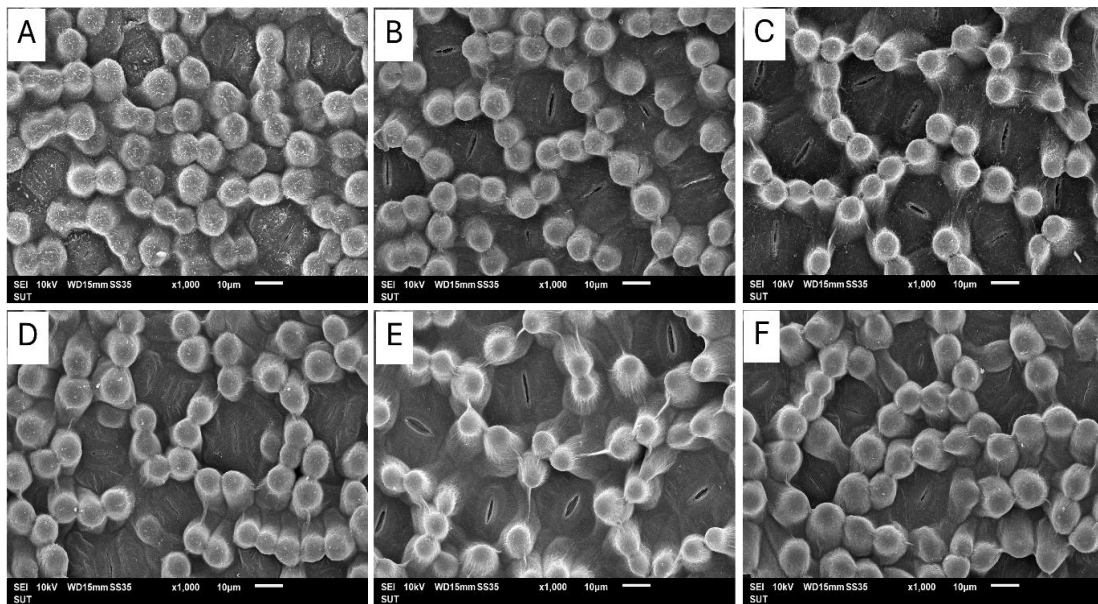


Figure 3.4 Trichomes of six cassava cultivars were observed through scanning electron microscopy (SEM) at 1000x magnification. Images show the leaf surface of (A) Huaybong 60, (B) CMR 89, (C) Kasetsart 50, (D) Rayong 72, (E) Rayong 4, and (F) Pirun 2.

3.4.4 Correlation Analysis (Pearson Correlation)

The number of whitefly infestations at various time intervals demonstrated strong negative correlations with trichome density at three months old, indicating an inverse relationship between the two variables. Specifically, at 10, 15, 40, 55, and 90 days, strong negative correlations (dark blue color) with trichome density per $10 \mu\text{m}^2$ were observed: $r = -0.86$, $r = -0.70$, $r = -0.75$, $r = -0.82$, and $r = -0.70$, respectively (Figure 5). Moreover, the trichome density negatively correlated with the number of whitefly infestations at 5, 20, 25, 60, 65, 80, and 85 days of the observed period. (blue color). The result suggests that higher trichome density on cassava leaves is associated with lower whitefly infestations.

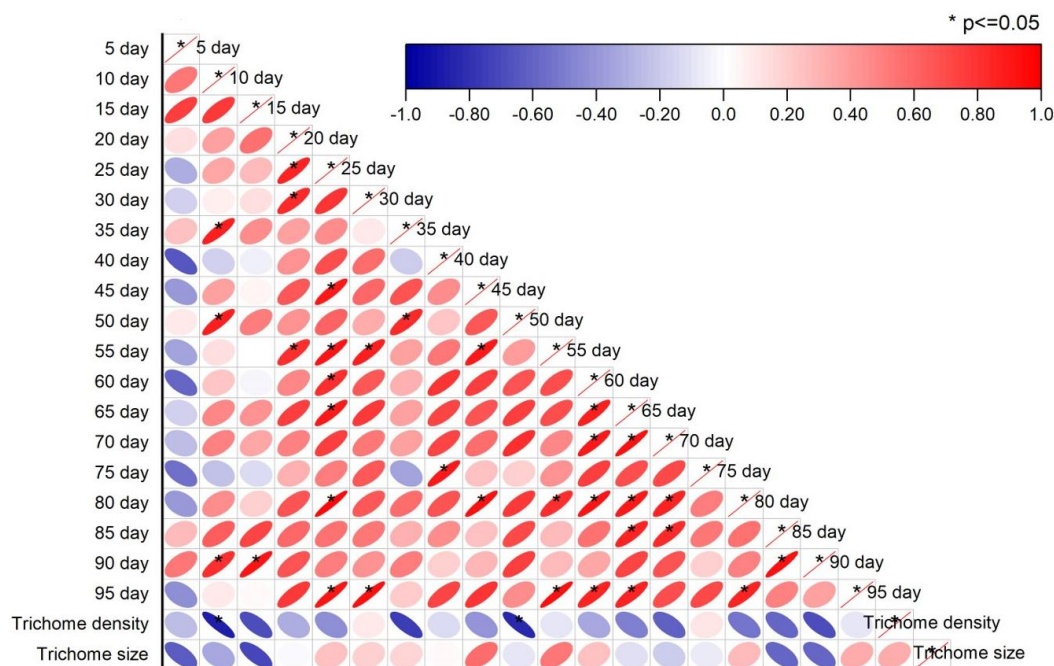


Figure 3.5 Correlation analysis of the number of whiteflies infested in a 5 to 95-day-old cassava plant with trichome density and size. (Blue means negative correlation, and red indicates positive correlation).

3.4.5 Principal Component Analysis

The first two principal components (PCs) accounted for 94.01% of the total variability in the data, with PC1 contributing 64.34% and PC2 contributing 29.67%. Through PCA, cassava cultivars were classified into two distinct groups. Group A included CMR 89, Kasetsart 50, Rayong 4, and Pirun 2. Group B comprised Huaybong 60 and Rayong 72 cultivars (Figure 6). Group A has a lower trichome density than Group B, which also experienced fewer whitefly infestations.

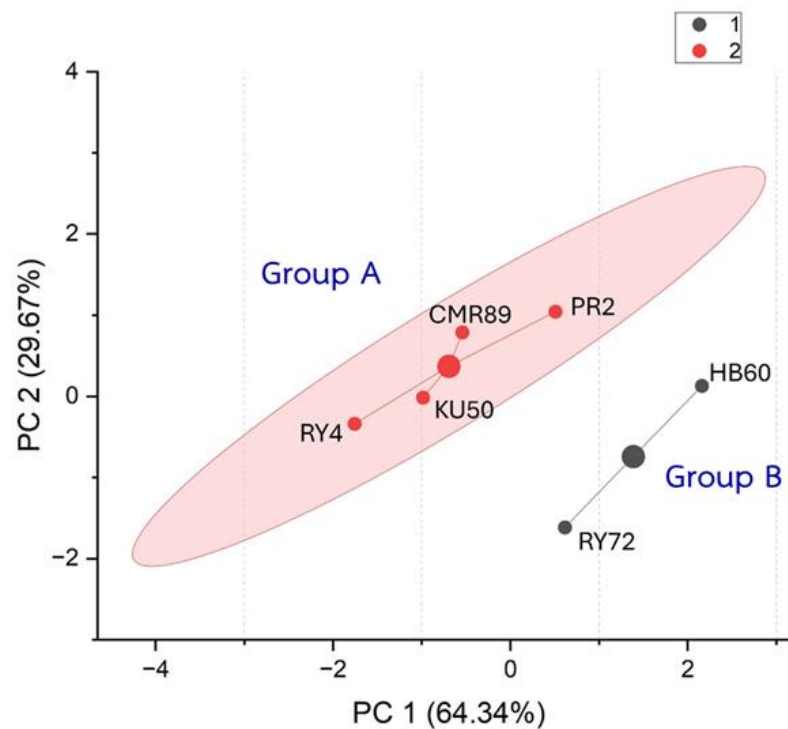


Figure 3.6 PCA (PC1 and PC2) of the number of whiteflies infested at different times with trichome density and size from six cassava cultivars.

3.5 Discussion

Whitefly infestations differed significantly among the six cassava cultivars, as demonstrated by ANOVA, and these differences were consistent with the PCA results, which categorized the cultivars into two distinct groups. Cultivars CMR 89, Kasetsart 50, Rayong 4, and Pirun 2 were associated with higher whitefly infestations, whereas Huaybong 60 and Rayong 72 exhibited comparatively lower infestation levels. Correlation analysis revealed both positive and strong negative relationships between whitefly abundance and trichome density. In cultivars showing a positive relationship, increases in trichome density were accompanied by higher whitefly infestation, whereas in cultivars exhibiting a negative relationship, higher trichome density corresponded with reduced whitefly numbers. These contrasting correlations highlight the complex role of trichomes in plant–insect interactions and underscore their importance in contributing to plant resistance mechanisms.

Trichome development is primarily under genetic control rather than being influenced by plant age. In *Arabidopsis thaliana*, trichome initiation and patterning are

regulated by key transcription factors such as GLABRA1 (GL1), which interacts with GLABRA3 (GL3) and TRANSPARENT TESTA GLABRA1 (TTG1) to form a regulatory complex that determines trichome formation (Pattanaik et al., 2014). This genetic regulation suggests that trichome density is a stable trait that can be exploited in breeding programs to enhance resistance to insect pests.

Trichomes function as physical barriers that restrict whitefly movement, feeding, and oviposition. Due to their small, delicate bodies, whiteflies have difficulty navigating leaf surfaces with dense trichome coverage, which limits their access to feeding sites and suitable oviposition areas (Lambert and Shah, 1999). In Brazilian cassava cultivars, reduced susceptibility to *Bemisia tuberculata* has been associated with morphological traits, including trichome density, as well as optical properties such as light reflectance and chroma values (Pastório et al., 2023), suggesting that resistance may result from multiple interacting plant traits.

Consistent evidence supporting the role of trichomes in whitefly resistance has been reported in tomato plants. Several studies have demonstrated that increased trichome density significantly reduces colonization and population development of *B. tabaci*. Simmons et al. (2003) reported that tomato plants with higher trichome densities exhibited lower whitefly infestations, as trichomes physically blocked whiteflies from establishing feeding sites, regardless of trichome size. Similarly, Escobar-Bravo et al. (2016) showed that increasing trichome density enhanced resistance to whiteflies and suggested that this trait could be introduced into cultivated tomato varieties through breeding programs. Furthermore, Andrade et al. (2017) demonstrated that crossing *Solanum lycopersicum* with the wild species *S. galapagense* produced progeny with high densities of type IV glandular trichomes, conferring resistance levels comparable to those of the resistant wild accession. Together, these studies indicate that trichome density is a heritable and effective trait for improving whitefly resistance in tomatoes.

Similar patterns have been observed in other plant species. In geraniums and cotton, higher trichome densities were correlated with reduced whitefly oviposition and lower pest populations (Lambert and Shah, 1999). In tobacco, a negative correlation between trichome density and whitefly resistance has also been reported (Li et al., 2014). In soybean, increased trichome density was associated with higher

mortality rates of whitefly nymphs, contributing to a reduction in overall infestation pressure (Heinz and Zalom, 1996). Moreover, high-density trichomes have been shown to impede feeding efficiency and reproductive success of whiteflies, resulting in fewer mature individuals and population decline over time (McAuslane, 1996).

While trichome density strongly influenced whitefly infestation, trichome size exhibited both positive and negative correlations with infestation levels in this study. Previous research suggests that trichome density is generally more influential than trichome size in reducing insect infestations. For instance, studies in *Arabidopsis thaliana* indicated that dense trichome coverage was more effective in impeding insect movement and feeding than trichome size alone (Mauricio and Rausher, 1997). Similar conclusions were drawn from studies on cotton, in which trichome density was more critical than trichome size in reducing infestations of cotton bollworms (Lu and Adang, 1996).

The six cassava cultivars examined in this study possessed non-glandular trichomes, which primarily function as a mechanical defense by limiting insect access and delaying damage to the epidermal layer (Kariyat et al., 2019). This physical defense mechanism contributes to cassava resistance by hindering whitefly colonization and feeding. Although PCA classified the cultivars into two main groups—Group A (CMR 89, Kasetsart 50, Rayong 4, Pirun 2, and CMR 89) and Group B (Huaybong 60 and Rayong 72)—Rayong 72 did not differ significantly from CMR 89 in trichome density or size. This suggests that factors beyond trichome traits, potentially including secondary metabolites or allelochemicals, may also play important roles in shaping plant–insect interactions (Ibanez et al., 2012; Tlak Gajger and Dar, 2021).

However, the experiment of choice, tested in both the field and the laboratory, found that temperature did not significantly affect the host preference of *B. tabaci* on cassava cultivars, as both temperature-controlled and uncontrolled choice tests showed consistent varietal preferences.

The temperature and photoperiod influenced whitefly population density in the field. During days 5–40 (December–January, Thai winter), when temperatures were lower and day length was shorter, whitefly numbers remained low. In contrast, during days 45–95 (February–March, hot season), the population increased markedly as both temperature and daylight hours rose.

Photoperiod is known to affect insect development and reproduction, with short-day conditions often suppressing population growth (Kaur et al., 2019). Additionally, previous studies have reported that the optimal temperature for *B. tabaci* reproduction lies between 28 and 33 °C (Curnutte et al., 2014; Sohani et al., 2007). The increased whitefly numbers during longer-day, warmer periods in this study support previous findings that temperature and light duration play key roles in whitefly population dynamics (Muñiz and Nombela, 2001; Ghosh et al., 2022).

3.6 Conclusion

In conclusion, trichome density is vital for cassava's defense against whitefly infestations, with higher trichome densities providing excellent protection against pest pressures. Trichome density is crucial for defending cassava cultivars against whitefly infestations. Cultivars such as Huaybong 60 and Rayong 72, which possess high-density trichomes, demonstrate enhanced resistance to whiteflies by obstructing their movement. Consequently, cassava cultivars with higher trichome densities experience significantly lower whitefly infestations. This highlights the significance of trichome density as a crucial trait for breeding insect-resistant cassava cultivars. Enhancing trichome density can improve crop resilience against whitefly pests, contributing to more sustainable and resilient cassava cultivation. Moreover, the temperature did not affect whiteflies' preference behavior; it played a key role—along with photoperiod—in influencing whitefly population growth, which is important for developing effective seasonal pest management strategies.

3.7 Reference

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