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Insidensi Penyakit Virus dan Populasi Serangga Vektor pada Tanaman Cabai Merah (*Capsicum annuum* l.) di Sukarami, Kecamatan Gunung Talang

Virus Disease Incidence and Vector Insect Populations in Red Chili Pepper Plants (*Capsicum annuum* L.) in Sukarami, Gunung Talang District

Harits Mawdudy Irfan, Yenny Liswarni*, Jumsu Trisno

[1]Faculty of Agriculture, Universitas Andalas, Padang, West Sumatra, Indonesia
*Email : yennyliswarni@agr.unand.ac.id

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ABSTRACT

Background: Red chili pepper (*Capsicum annuum* L.) is a leading horticultural commodity in Indonesia, but its productivity is often limited by insect-transmitted viral diseases. **Objective**: This study aimed to determine the incidence of viral disease, the population dynamics, and the species of insect vectors on red chili pepper in Sukarami, Gunung Talang District, Solok Regency. **Methods**: Direct field observation was conducted on a 0.0273 ha plot (800 plants) in Jorong Sukarami, Nagari Koto Gaek Guguk, from November 2024 to April 2025. One hundred sample plants across five diagonally-arranged subplots were observed. Disease incidence (IP = n/N × 100%) was recorded weekly from 21 to 98 days after planting (DAP), while vector populations were counted visually at four critical phases: vegetative, flowering, fruiting, and post-harvest. **Results**: The incidence of virus-like symptoms increased progressively from 6% at 3 weeks after planting (WAP) to 73% at 14 WAP, with the sharpest increase (16 percentage points) occurring between the 8th and 9th week during flowering. *Bemisia tabaci* was the dominant vector, rising from 8 individuals at the vegetative phase to 57 after harvest, while *Myzus persicae* appeared only after the first harvest (16 individuals). **Conclusion**: Disease incidence increased concurrently with *B. tabaci* population, suggesting a temporal association between disease development and vector abundance. Early monitoring and management of *B. tabaci* during the vegetative phase is therefore recommended to reduce virus transmission risk.

Keywords: *Bemisia tabaci; Begomovirus; chili; Incidence; Myzus persicae*

ABSTRAK

Latar belakang: Cabai merah (*Capsicum annuum* L.) merupakan komoditas hortikultura unggulan di Indonesia, namun produktivitasnya sering terbatas akibat penyakit virus yang ditularkan oleh serangga vektor. **Tujuan**: Penelitian ini bertujuan untuk mengetahui insidensi penyakit virus, dinamika populasi, serta jenis serangga vektor pada tanaman cabai merah di Sukarami, Kecamatan Gunung Talang, Kabupaten Solok. **Metode**: Pengamatan lapangan secara langsung dilakukan pada lahan seluas 0,0273 ha (800 tanaman) di Jorong Sukarami, Nagari Koto Gaek Guguk, dari November 2024 hingga April 2025. Sebanyak seratus tanaman sampel pada lima subplot dengan pola diagonal diamati dalam penelitian ini. Insidensi penyakit (IP = n/N × 100%) dicatat setiap minggu dari 21 hingga 98 hari setelah tanam (HST), sedangkan populasi vektor dihitung secara visual pada empat fase kritis: vegetatif, pembungaan, pembentukan buah, dan pascapanen. **Hasil**: Insidensi gejala mirip virus meningkat progresif dari 6% pada 3 minggu setelah tanam (MST) menjadi 73% pada 14 MST, dengan peningkatan tertajam (16 poin persentase) terjadi antara minggu ke-8 dan ke-9 pada fase pembungaan. *Bemisia tabaci* merupakan vektor dominan, meningkat dari 8 individu pada fase vegetatif menjadi 57 individu setelah panen, sedangkan *Myzus persicae* baru terdeteksi setelah panen pertama (16 individu). **Kesimpulan**: Insidensi penyakit meningkat bersamaan dengan populasi *B. tabaci*, yang mengindikasikan adanya keterkaitan temporal antara perkembangan penyakit dan kelimpahan vektor. Pemantauan dan pengendalian *B. tabaci* sejak fase vegetatif direkomendasikan untuk mengurangi risiko penularan virus.

Kata kunci: *Begomovirus; Bemisia tabaci; cabai merah; insidensi penyakit; Myzus persic*

BACKGROUND

Red chili pepper (*Capsicum annuum* L.) is one of the important horticultural commodities in Indonesia, although its productivity still remains below its yield potential. Red chili pepper productivity in Indonesia during 2022–2024 reached 10.64, 11.51, and 11.49 tons ha^{-1}, respectively, while in West Sumatra it reached 10.05, 11.33, and 12.21 tons ha^{-1}, respectively (Badan Pusat Statistik Indonesia, 2025). This productivity is still lower than the potential chili yield, which can reach approximately 20 tons ha^{-1}. Solok Regency is one of the centers of red chili pepper production in West Sumatra, but chili productivity in this region still faces various constraints, particularly from plant pest organisms (OPT) (BPS Provinsi Sumatera Barat, 2025).

Diseases caused by viruses are an important constraint in red chili pepper cultivation because they can cause substantial yield losses. Losses due to viral diseases in various chili production centers in Indonesia have been reported to range from 20–100% (Duriat et al., 2007). Several viruses associated with chili pepper plants include Cucumber Mosaic Virus (CMV), Chilli Veinal Mottle Virus (ChiVMV), and Pepper Yellow Leaf Curl Virus (PYLCV), which can cause symptoms such as mosaic patterns, chlorosis, leaf yellowing, leaf curling, and stunted plant growth (Duriat et al., 2007; Chandra et al., 2016; Trisno et al., 2021).

Infections occurring from the early growth phase have the potential to cause suboptimal plant development and subsequently reduce yield. The spread of viruses in chili pepper plantations is closely related to the presence of insect vectors. Phytophagous insects associated with chili pepper plants, including *Bemisia tabaci*, *Myzus persicae*, Aphis gossypii, and Thrips spp., can play a role in transmitting various plant viruses (Sudiono et al., 2005; Meilin, 2014; Tricahyatif et al., 2021). Among these groups, *B. tabaci* is one of the important vectors because it transmits Begomovirus, which causes yellowing and leaf curl disease in chili pepper (Rahayuwati et al., 2016).

The population and dynamics of insect vectors can influence the likelihood of virus transmission, making it important to monitor vector population development alongside observations of disease progression. A number of studies have reported high incidences of viral disease in chili pepper plants across various regions. Vivaldy et al. (2016) reported a viral disease incidence of 28% in chili pepper plants in Tomohon, North Sulawesi, with Bemisia sp., Myzus sp., and Thrips sp. found as insects associated with the crop. Ulinnuha and Syarifah (2021) also reported a yellow leaf curl disease incidence of 66.67% in the Segana chili pepper variety in Banyumas Regency. In West Sumatra, Begomovirus causing yellow leaf curl disease in chili pepper plants has also been reported by Trisno et al. (2010).

Hidayat et al. (2018) further demonstrated an increase in Pepper Yellow Leaf Curl Virus incidence associated with an increase in the *B. tabaci* population. Although viral diseases and insect vectors in chili pepper plants have been widely reported in various regions, information on the development of viral disease incidence and the dynamics of vector insect populations in red chili pepper plantations in Sukarami, Gunung Talang District, Solok Regency, remains limited. Such information is needed to understand disease development from the early growth phase as well as changes in vector populations at each plant growth phase. This data can serve as a basis for determining the timing of more precise vector and disease management. Based on these issues, this study aimed to determine the viral disease incidence, population dynamics, and species of insect vectors found on red chili pepper plants in Sukarami, Gunung Talang District, Solok Regency, West Sumatra.

METHODS

Location and Time

his study was conducted from November 2024 to April 2025 on a red chili pepper plantation in Jorong Sukarami, Nagari Koto Gaek Guguk, Gunung Talang District, Solok Regency, at an elevation of 1,060 meters above sea level (masl) with sandy loam soil. Morphological identification of the insect vectors was carried out at the Insect Bioecology Laboratory, Department of Plant Protection, Faculty of Agriculture, Universitas Andalas, Padang.

Materials and Tools

The materials used included local variety red chili pepper seedlings (5 weeks after sowing), silver plastic mulch, chicken manure, Yara NPK fertilizer, MAP, MKP, KCl, SP-36, and Urea, insecticides (abamectin, fipronil, methomyl, profenofos), mancozeb fungicide, 70% alcohol, and 10% KOH. The tools used included a hoe, measuring tape, bamboo stakes, a camera, a hand counter, an aspirator tube, a binocular stereo microscope, and iron plates for marking subplots.

Research Method

This study used a direct field observation method with a purposive sampling approach. A 0.0273 ha plot (21 m × 13 m) was prepared into raised beds measuring 1.20 m wide and 12–13 m long, with a 30 cm spacing between beds. A total of 800 chili pepper plants were planted at a spacing of 60 cm × 40 cm, and maintained through scheduled fertilization, watering, weeding, staking, and pesticide application on a two-week rotation. Five sample subplots were established diagonally across the plot, each consisting of 20 plants across two adjacent beds, giving a total sample size of 100 plants, marked using iron plates.

Observation

Field agroecosystem conditions were observed through interviews with farmers and direct observation, covering the land's history, variety, seedling source, cropping pattern, water source, soil type, dominant weeds, surrounding crops, and previously occurring pests and diseases. Viral disease symptoms on leaves, flowers, and fruit were observed and documented three times, namely during the vegetative, flowering, and fruiting phases. Disease diagnosis was based on visual symptoms commonly associated with viral infection, particularly yellowing, chlorosis, leaf curling, crinkling, and plant stunting. Based on symptom characteristics and the presence of *B. tabaci,* the symptoms were considered potentially associated with *Begomovirus* infection. However, the causal virus was not molecularly or serologically confirmed in this study.

Viral disease incidence was observed weekly starting from 21 days after planting (DAP), or 3 weeks after planting (WAP), until 98 DAP (14 WAP), divided into three phases: vegetative (3–6 WAP), flowering (7–10 WAP), and fruiting (11–14 WAP). Disease incidence was calculated using the formula:

$$IP = (n / N) \times 100\% \quad \ldots\ldots 1$$

where IP is disease incidence (%), n is the number of plants showing viral disease symptoms, and N is the number of plants observed (100 plants).

Vector insect populations were observed at four critical phases: vegetative (28 DAP), flowering (49 DAP), fruiting (77 DAP), and after the first harvest (105 DAP). Observations were conducted in the morning between 06:00–09:00 WIB using the visual count method, counting all adult vector insects (*Bemisia tabaci*, *Myzus persicae*, *Thrips* sp., and *Aphis gossypii*) on the sample plants with a hand counter. Insects found were captured using an aspirator tube for morphological observation in the laboratory.

Captured insects were preserved in 70% alcohol; specifically for *B. tabaci*, specimens were soaked in 10% KOH for two days to clear the body tissue, then observed under a binocular stereo microscope at 40×10 magnification, following Triplehorn & Johnson (2005) and Hodges & Evans (2005).

Data Analysis

Data on disease incidence and vector populations were tabulated using Microsoft Excel, with mean values calculated per week or per phase and presented in tables and trend graphs. Disease incidence and vector population data were analyzed descriptively by calculating mean values per observation week or growth phase and presenting the results in tables and trend graphs. The temporal patterns of disease incidence and vector population were compared descriptively to identify concurrent changes during crop development..

RESULTS AND DISCUSSION

Field Agroecosystem Conditions

In the previous season, the study plot was used for shallot cultivation, which had experienced a fairly severe infestation of onion aphids (*Neotoxoptera formosana*) (Table 1). The chili pepper plants used were of a local variety, grown as a monoculture with water sourced from technical irrigation, on sandy loam soil at an elevation of 1,060 masl. The dominant weeds found were goatweed (*Ageratum conyzoides*) and wild amaranth (*Amaranthus* sp.), while surrounding crops included sweet potato (5 m away) and other red chili pepper plantings (25 m away).

Table 1. Agroecosystem conditions of the chili pepper plantation in Sukarami

No.	Parameter	Description
1	Land history	Former shallot field; previously infested by onion aphids (*N. formosana*)
2	Chili variety	Local (uncertified)
3	Seedling source	Vegetable seedling producer, Jawi-Jawi
4	Cropping pattern	Monoculture
5	Water source	Technical irrigation
6	Soil type	Sandy loam
7	Dominant weeds	Goatweed (A. conyzoides), wild amaranth (Amaranthus sp.)
8	Surrounding crops	Sweet potato (5 m), chili pepper (25 m), shallot (50 m)
9	Other pests & diseases	Armyworm, fruit fly, stink bug, Cercospora leaf spot
10	Elevation	1,060 masl

The land's history of onion aphid infestation indicates the presence of an established vector insect population in the surrounding environment. Goatweed has been reported as an alternative host for *B. tabaci* and several Begomoviruses (Liu et al., 2010), while proximity to sweet potato plants further supported vector migration into the chili pepper plot. The monoculture cropping pattern with close plant spacing created a humid microclimate conducive to the development of *B. tabaci* colonies, so that the overall agroecosystem conditions in Sukarami supported vector development and the spread of viral disease.

Viral Disease Symptoms in Chili Pepper Plants

The initial symptoms of viral infection appeared at 3 WAP in the form of pale young leaves, which then developed by 5–7 WAP into chlorosis, leaf yellowing, upward leaf curling, and crinkling. Severely infected plants experienced stunted growth and became dwarfed (Figure 1).

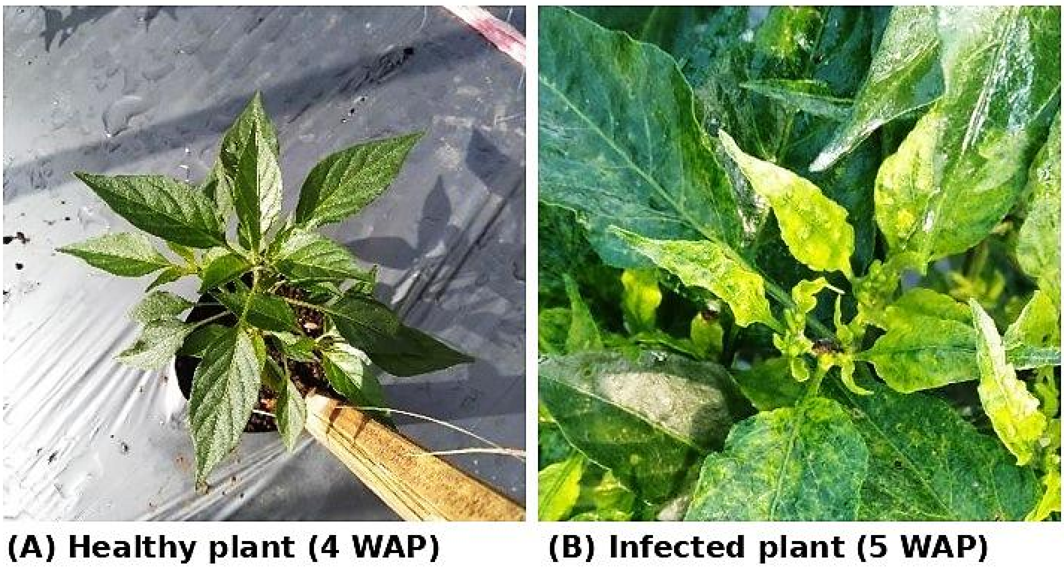

Figure 1. Comparison of healthy chili pepper plants (A, 4 WAP) and virus-infected plants (B, 5 WAP)

These symptoms are consistent with those commonly associated with Begomovirus infection, which is frequently transmitted by B. tabaci (Brown et al., 2015), and are in line with Trisno et al. (2010), who described yellowing and shrinking of young leaves, leaf curling, the emergence of axillary shoots, and plant dwarfing as characteristic symptoms of Geminivirus infection.. The appearance of symptoms from the vegetative phase onward indicates that virus transmission had already occurred at the seedling stage or early planting, while the growth inhibition reflects disruptions to metabolism and photosynthesis in infected plants (Hull, 2014). Therefore, the observed symptoms were considered suggestive of *Begomovirus* infection; however, this association remains presumptive because no molecular or serological confirmation was conducted.

Viral Disease Incidence

Viral disease incidence increased progressively as the plants aged. During the vegetative phase (3–6 WAP), incidence remained relatively low, ranging from 6–17%. An increase became apparent during the flowering phase (7–10 WAP), reaching 22–48%, and peaked during the fruiting phase (11–14 WAP) with an incidence of 73% (Table 2, Figure 2).

Table 2. Viral disease incidence (%) at various chili pepper growth phases

Phase	WAP	W1	W2	W3	W4
Vegetative	3-6	6%	8%	12%	17%
Flowering	7-10	22%	28%	44%	48%
Fruiting	11-14	51%	59%	68%	73%

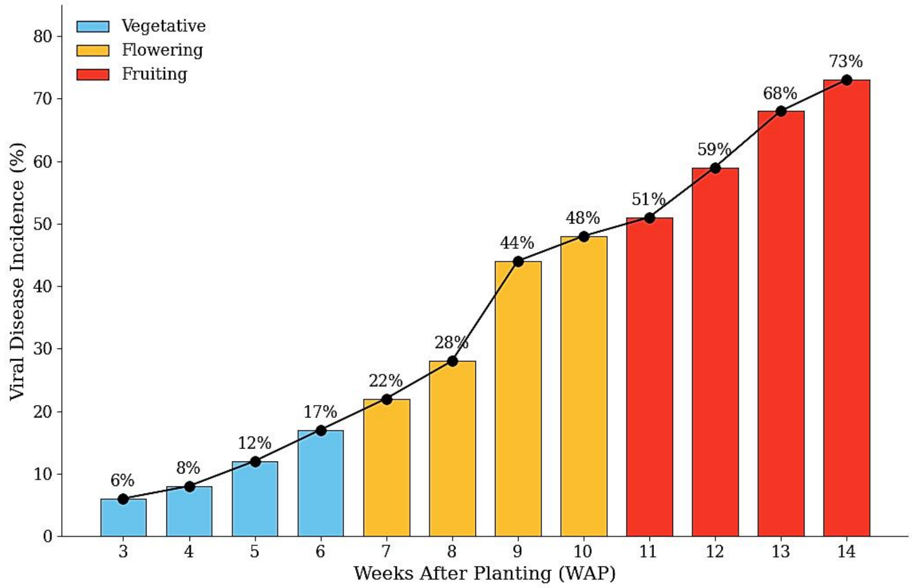

Figure 2. Graph of viral disease incidence in chili pepper plants from 3–14 weeks after planting

The greatest increase occurred between week 8 (28%) and week 9 (44%), representing a 16-percentage-point increase within one week during the flowering phase. This increase coincided with the continued development of the *B. tabaci* population and the progression of plants toward fruit formation.. The slow rate of increase during the early vegetative phase (6–17%) suggests a still-limited initial inoculum source, likely originating from asymptomatically infected seedlings or from vectors migrating in from outside the plot. During the generative phase, the increase in disease incidence coincided with a rising *B. tabaci* population. The availability of young plant tissues may also influence vector colonization; however, these factors were not directly measured in the present study. (Ariyanti, 2011).

This result is consistent with Hidayat et al. (2018), who found a sharp increase in Pepper Yellow Leaf Curl Virus incidence in chili pepper alongside an increasing *B. tabaci* population during the flowering phase, as well as Singarimbun et al. (2017), who reported that increases in viral disease incidence were accompanied by increases in vector insect population. The high incidence during the fruiting phase (73%) indicates that most plants had already become infected before the main harvest period, which could potentially reduce both the quality and quantity of yield significantly.

Vector Insect Population

Two species of vector insects were found in the study plot: *Bemisia tabaci* (whitefly) and *Myzus persicae* (green peach aphid). The *B. tabaci* population was already present during the vegetative phase (8 individuals), increasing to 12 individuals during the flowering phase, 26 individuals during the fruiting phase, and surging to 57 individuals after the first harvest. In contrast, *M. persicae* was not detected at all until the fruiting phase, only appearing after harvest with a population of 16 individuals (Table 3, Figure 3).

Table 3. Vector insect populations found on chili pepper plants

Vector	Vegetative (4 WAP)	Flowering (7 WAP)	Fruiting (11 WAP)	Harvest (15 WAP)
B. tabaci	8	12	26	57
M. persicae	0	0	0	16

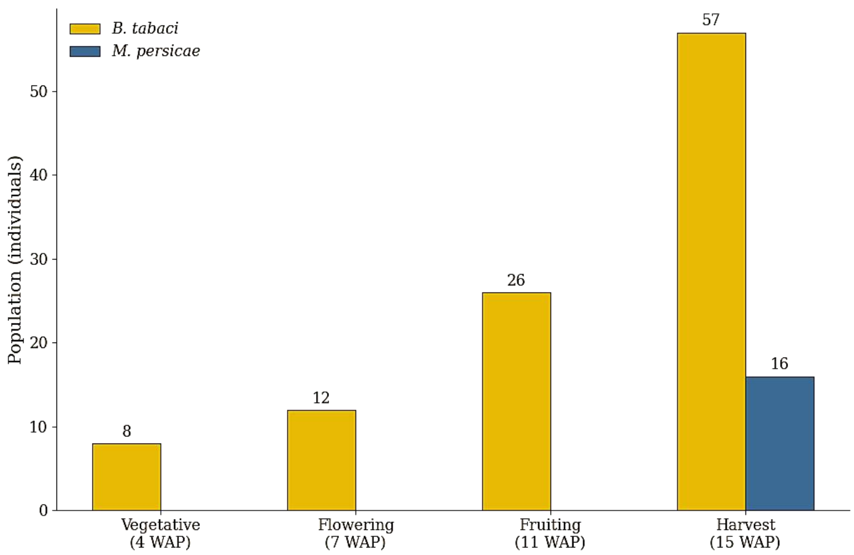

Figure 3. Graph of vector insect population from the vegetative phase to after harvest

The dominance of *B. tabaci* throughout the cropping cycle indicates that this species was the most abundant potential insect vector at the study site and may have contributed to the spread of the suspected viral disease. Several factors may have contributed to the increase in *B. tabaci* population, including the presence of alternative host plants around the plot and environmental conditions during crop development. Daytime temperatures of approximately 24–28°C may also support B. tabaci development (Hirano et al., 1993; Ariyanti, 2011). However, the relative contribution of these factors was not experimentally evaluated in this study.

Conversely, the low population of *M. persicae*, which only appeared after harvest, is thought to be due to the use of silver plastic mulch, which reflects ultraviolet light and disrupts aphid orientation and landing (Utama et al., 2015), the use of systemic insecticides that are more toxic to *M. persicae*, and the relatively low nighttime temperatures (15–18°C) in the highlands of Gunung Talang, which are less optimal for *M. persicae* development.

Morphology of Vector Insects

Adult *B. tabaci* are pale yellow, very

small in size (1–1.5 mm), with wings covered by a layer of white wax giving them a powdery appearance, reddish compound eyes, seven-segmented antennae, and a stylet-type mouthpart (Figure 4). These characteristics are consistent with Marwoto & Inayati (2011), who reported a forewing length of approximately 0.673 mm and a hindwing length of 0.572 mm for *B. tabaci*. The viruses transmitted by *B. tabaci* are generally members of the Begomovirus group that cause yellow leaf curl disease in chili pepper (Singarimbun et al., 2017).

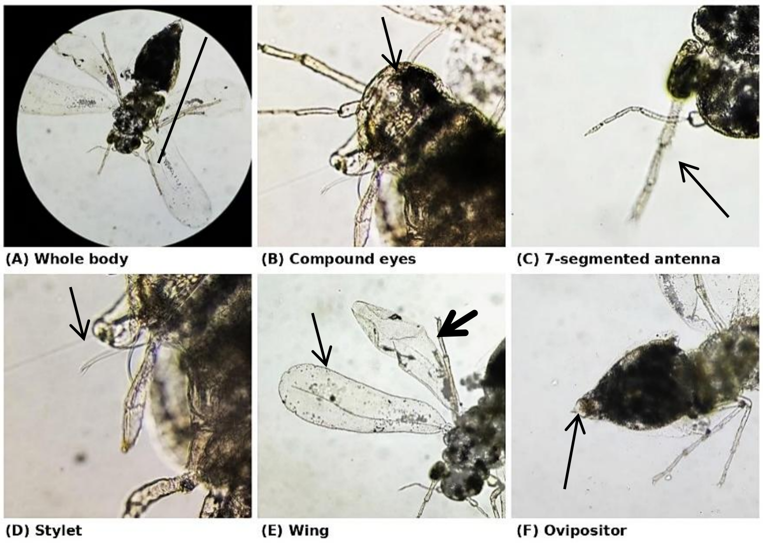

Figure 4. Morphology of *B. tabaci* under a binocular microscope at 40×10 magnification (a) whole body (b) compound eyes (c) antenna (d) Stylet (e) wing (f) ovipositor

Adult *M. persicae* are oval-shaped, 2–3 mm long, blackish-brown in color, with six-segmented antennae and cylindrical cornicles on the 5th or 6th abdominal segment as an important diagnostic feature (Figure 5). This characteristic is consistent with the description by Emden & Harrington (2007). Despite its low population, *M. persicae* still warrants attention because it is a vector for more than 100 species of plant viruses, including Potyvirus and Cucumber Mosaic Virus.

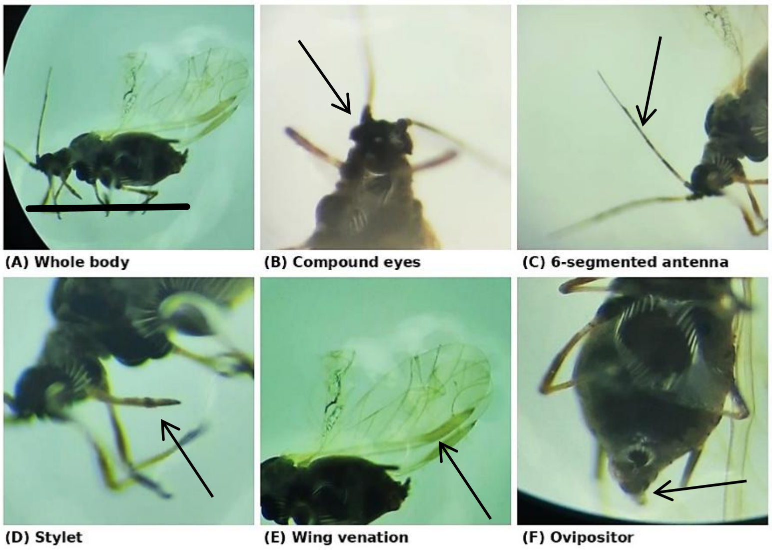

Figure 5. Morphology of *M. persicae* under a binocular microscope (a) whole body (b) compound eyes (c) antenna (d) stylet (e) wing (f) ovipositor

CONCLUSION

The incidence of virus-like symptoms on red chili pepper plants in Sukarami increased progressively from 6% at 3 WAP to 73% at 14 WAP, with the largest increase of 16 percentage points occurring between weeks 8 and 9. *Bemisia tabaci* was the dominant potential insect vector, with its population increasing from 8 individuals at 4 WAP to 57 individuals after the first harvest, while *Myzus persicae* was detected only after harvest. The concurrent increase in virus-like symptom incidence and *B. tabaci* population suggests a temporal association between disease development and vector abundance. Early monitoring and integrated management of *B. tabaci*, including sanitation of alternative host plants, should therefore be considered from the vegetative phase to reduce the risk of virus transmission. The observed symptoms were considered suggestive of Begomovirus infection based on symptom characteristics and the presence of *B. tabaci*, but the causal virus was not confirmed through molecular or serological assays.

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