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SHORT COMMUNICATION

Western flower thrips *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae): A newly recorded invasive species in Indonesia

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ABSTRACT

The most economically important invasive thrips species, known for causing serious damage to various crops through feeding and virus transmission, was recorded in the cut flower production center of West Java Province, Indonesia. Thrips specimens were collected from chrysanthemum plastic houses using sweep nets, beating trays, yellow pan traps, and hand vacuums. Based on morphological characteristics, the specimens were identified as *Frankliniella occidentalis* Pergande 1895 (Thysanoptera: Thripidae). Infestation levels in chrysanthemum ranged from 9 to 15 individuals per plastic house. This is the first confirmed report of *F. occidentalis* infesting chrysanthemums in Indonesia, as the species has not been previously recorded in the country. It can be distinguished from other thrips species by its unique morphological traits, including comb-like setae on the eighth abdominal tergite and distinctive chaetotaxy patterns on the head and pronotum.

Key words: First report, floriculture, *Frankliniella occidentalis*, invasive species

INTRODUCTION

The globalization of agricultural commodity trade, coupled with global climate change, has significantly increased the prevalence of invasive species worldwide (He et al., 2020; Hulagappa et al., 2022; Ollier & Bertelsmeier, 2022). Among these, thrips are considered major invasive pests due to their small size, rapid reproductive rate, cryptic behavior, and tendency to lay eggs within plant tissues (He et al., 2020; Reitz et al., 2020; Hulagappa et al., 2022). The order *Thysanoptera* comprises approximately 6500 recognized species, though only about 1% are classified as significant pests of commercial crops (He et al., 2020; Hussain et al., 2022). Within this order, the genus *Frankliniella* includes over 238 species (Wang et al., 2023), some of which pose serious threats to agriculture by damaging crops and transmitting plant viruses (Reitz et al., 2020; Matsuda & Ichihara, 2022). Furthermore, *Frankliniella* species have become a growing concern for agriculture in many countries due to their high reproductive potential, strong invasive capabilities, and remarkable adaptability to new environments (He et al., 2020; Hussain et al., 2022).

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Frankliniella occidentalis is a major economic pest in Asia, Africa, the Americas, and Europe, where it infests ornamental plants, vegetables, and fruit crops (Matsuda & Ichihara, 2022; Ollier & Bertelsmeier, 2022). Native to western North America, it is commonly known as the western flower thrips (EPPO, 2022; CABI, 2023; Wang et al., 2023). Since the 1970s, this pest has spread globally through the trade of infested plant materials, including seed cuttings, potted plants, cut flowers, fruits, and vegetables (Hussain et al., 2022; Wang et al., 2023). As *F. occidentalis* has expanded into new regions, its host range has grown to include over 600 plant species across 65 families (Hu et al., 2021; CABI, 2023). While its primary hosts include chrysanthemums, gerberas, roses, cucumbers, and chilies, it also infests a wide range of crops such as beans, carrots, bananas, oranges, strawberries, mangoes, melons, grapes, cocoa, corn, eggplant, cotton, tobacco, and tomatoes (Hussain et al., 2022; EPPO, 2022; CABI, 2023).

The presence of *F. occidentalis* on chrysanthemums is often overlooked due to its small size and preference for concealed plant parts, such as young leaves, buds, and petals (Rogge & Meyhöfer, 2021; Rodríguez & Coy-Barrera, 2023). Infestations significantly reduce both the quantity and quality of chrysanthemum flowers, preventing them from meeting the standards for higher market value. As a result, *F. occidentalis* is considered one of the most severe challenges in cut chrysanthemum production, with damage levels exceeding 50% in some cases

(den Belder et al., 1999; Duan et al., 2013; Matsuda & Ichihara, 2022). In the Netherlands, annual economic losses caused by *F. occidentalis* are estimated at approximately US$30 million, excluding additional losses associated with viral infections such as impatiens necrotic spot virus and tomato spotted wilt virus (He et al., 2020; CABI, 2023).

Frankliniella occidentalis is a highly successful invasive species due to its adaptability and broad host range. The western flower thrips primarily spreads internationally through the transport of horticultural materials, including cuttings, seedlings, and potted plants. In Europe, the infestation expanded from its initial outbreak in the Netherlands at an estimated rate of 200–249 km per year (Kirk & Terry, 2003). In China, it was first documented in Beijing in 2003. Since then, its population has expanded rapidly, making it one of the most widespread thrips species affecting various crops in the country (Duan et al., 2013; He et al., 2020; Wang et al., 2023).

In Indonesia, *F. occidentalis* had not been previously reported as a pest on any crops, including chrysanthemum cut flowers. This study presents the first confirmed record of *F. occidentalis* infestation in Indonesia, specifically on chrysanthemum crops in West Java Province. Since this species has not been documented in the country before, information on the symptoms and extent of the damage it causes remains unavailable. The presence of *F. occidentalis* in Indonesia is a significant concern for quarantine authorities due to its economic impact as a major pest and virus vector. Systematic monitoring of its spread in other regions is essential for effective pest management and control strategies.

This study aims to document the first occurrence of *F. occidentalis* in Indonesia and provide baseline information on its presence in chrysanthemum crops. The findings will serve as a reference for future research on thrips infestations, particularly in the Indonesian floriculture industry, with a focus on chrysanthemum production.

MATERIALS AND METHODS

Research Site. The survey was conducted in four districts that serve as primary centers for chrysanthemum cut flower production in West Java Province, Indonesia: Cianjur, West Bandung, Sukabumi, and Bogor. In response to numerous farmer complaints about thrips infestations on chrysanthemum cut flowers, a total of 48 plastic houses owned by local farmers were surveyed (Figure 1).

Thrips Sampling. Twelve plastic houses were selected in each district using purposive sampling, with a minimum distance of 1 km between locations. Within each plastic house, a 1 m × 1 m plot was designated as the sampling point, positioned at least 10 m from other plots. Thrips were collected using four sampling methods: sweep netting, beating trays, yellow pan traps, and hand vacuums. A 40 cm diameter sweep net was swung in four double swings, totaling 100 sweeps per plastic house. A beating tray (30 × 20 × 3 cm) was used to dislodge thrips from chrysanthemum crowns with 30 beats per plot. Thrips were also collected using a hand vacuum, systematically moved across the upper and lower canopy of chrysanthemums for two minutes per plot. A yellow pan trap (11 cm diameter, 3.5 cm depth), filled with approximately 100 mL of water mixed with unscented detergent, was installed for 10 hours. Beating tray sampling was conducted at 7:00 a.m., while yellow pan traps were deployed from 7:00 a.m. to 5:00 p.m. Sweep netting and vacuum sampling were performed from 8:00–11:00 a.m. and 3:00–5:00 p.m. All collected thrips specimens were preserved in 10 mL vial bottles containing 70% ethanol and labeled with the collection date and location. The samples were then transported to the Laboratory of Insect Biosystematics, Plant Protection Department, IPB University, for further analysis.

Samples Treatment. Immature stages were separated from adults. Thrips morphotypes were categorized and identified, and the number of adult individuals was counted. Thrips specimens were treated with 10% KOH, rinsed with distilled water, and then dehydrated in 70% ethanol.

Taxonomic Identification. Thrips specimens collected from 48 plastic houses were preserved in 70% ethanol. The samples were placed in a watch glass containing 5% KOH and heated at 45 °C for approximately one hour to facilitate tissue maceration. Internal body contents were removed using a fine-tipped needle inserted at the base of the hind legs. After maceration, the specimens were cleaned by passing them through a graded ethanol series before being transferred to Hoyer's medium for slide preparation. The prepared slides were dried in a drying box at 45 ºC for one week. Thrips species were identified using taxonomic keys from Mound & Kibby (1998), Sartiami & Mound (2013), Cluever & Smith (2017), and Wang et al. (2019). The morphological characteristics of both male and female specimens were examined under an Olympus CX21 stereomicroscope. These characteristics included body

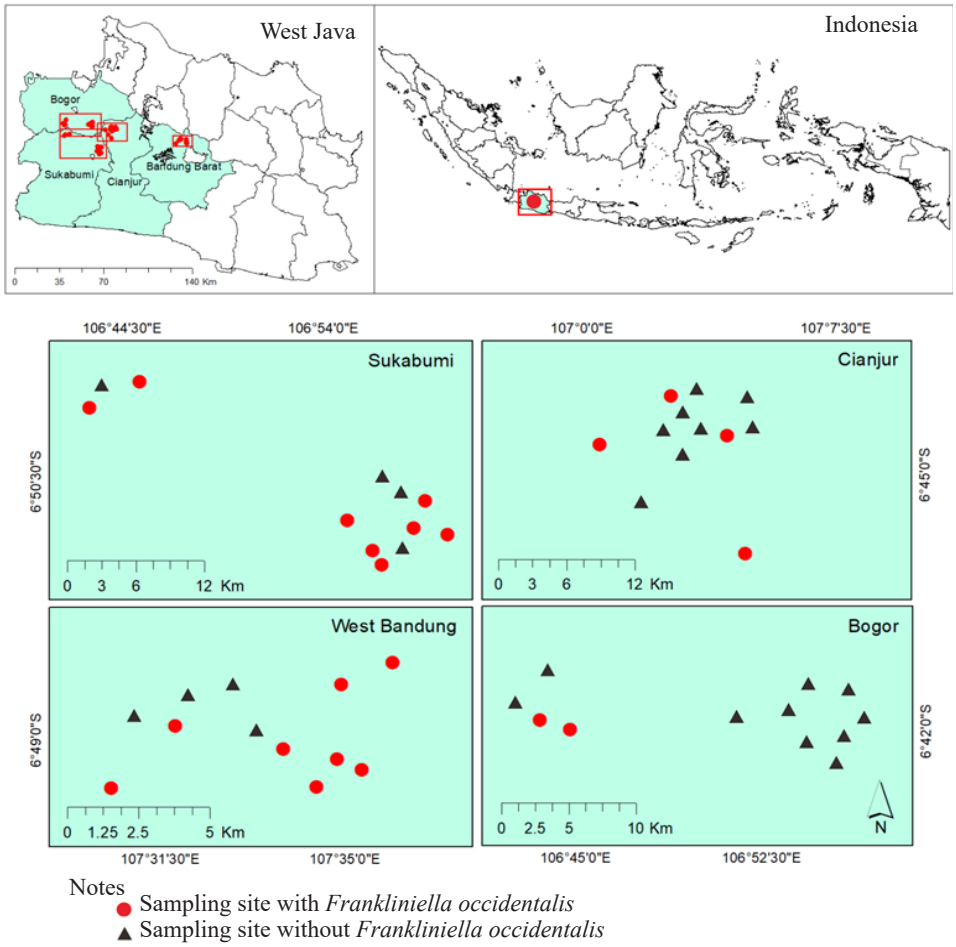

Figure 1. The distribution of *Frankliniella occidentalis* at 22 sampling sites (red circles) across four regencies of chrysanthemum production in West Java Province, Indonesia.

length, body color, the length of postocular setae, the presence of metanotal campaniform sensilla, and the irregular comb on tergite VIII. High-resolution images were captured using a Leica M205C stereomicroscope equipped with a Leica DFC450 digital camera and processed with LAS V.4.4.0 at the iLaB of BRIN (National Research and Innovation Agency), Cibinong Science Center, Bogor, West Java, and the Laboratory of Insect Biosystematics, Plant Protection Department, IPB University. Voucher specimens were stored at the Laboratory of Insect Biosystematics, Plant Protection Department, IPB University.

RESULTS AND DISCUSSION

Diagnosis. Female (macroptera): Adult thrips with fully developed wings were the predominant life stage collected, while larval stages were present in smaller numbers. The identified female *Frankliniella occidentalis* measured approximately 500 µm in length, with a yellow body and a distinct brown stripe running across the middle of the abdomen. The legs were yellowish-brown, and the forewings were pale yellow with two unbroken rows of dark-colored setae (Figure 2A). The head was broader than long and featured three pairs of ocellar setae, each exceeding the width of the hind ocelli (Figure 3B). The antennae consisted of eight segments (Figure 2B), with segment VIII longer than segment VII (Figure 2C). The base of antennal segment III had a smooth pedicel (Figure 2D). Antennal segments II, VI, VII, and VIII were brownish, while segments III, IV, and V were yellow with brown apices. The sensory cones on segments III and IV were branched. The pronotum contained four small setae between the main anteromarginal setae (Figure 3B). It had five primary pairs of setae, with one pair of minor setae positioned medially between the postero-marginal submedian setae. The anteromarginal setae were slightly shorter than the antero-angular setae (Figure 3C). The metanotum had two pairs of setae and campaniform sensilla along its anterior margin (Figure 3E). On abdominal tergite VIII, the posteromarginal comb was well-developed, featuring short to moderately long, slender microtrichia (Figure 3D). Additionally, ctenidia were present on the anterior region of tergite VIII (Figure 3F).

Key to identifying the species of the Frankliniella genus found in Indonesia:

1	Abdominal tergite VIII lacks a posteromarginal comb of microtrichia; ocellar seta III arises within the ocellar triangle between the hind ocelli ..... ***F. schultzei***
	Ocellar III setae do not arise between posterior ocelli (Figure 3B); abdominal tergite VIII has a comb of microtrichia in its posterior edge **2**
2	The metanotum has two pairs of setae at the anterior margin but lacks campaniform sensilla; forewing offers two complete rows of veinal setae; abdominal tergites V–VIII have paired of ctenidia **3**
	Metanotum includes two pairs of setae at the anterior edge and typically a campaniform sensilla present (Figure 3C); fore wing has two full rows of veinal setae; abdominal tergites V–VIII with a paired ctenidia .**4**
3	Pair I of postocular setae is present, and pair IV is short, considerably shorter than the distance between hind ocelli; pronotum anterior edge normally having one pair of minor setae between the larger anteromarginal pair ..... ***F. intonsa***
	Five pairs of main setae are found on the pronotum between the major anteromarginal pair; postocular setae pair I is present, and pair IV is longer than the spacing across the hind ocelli (Figure 3B) 4
4	Abdominal tergites typically have a brown patch medially (Figure 2a); tergite VIII posteromarginal comb with discontinuous microtrichia originating on triangular bases (Figure 3d)…..*****F. occidentalis***

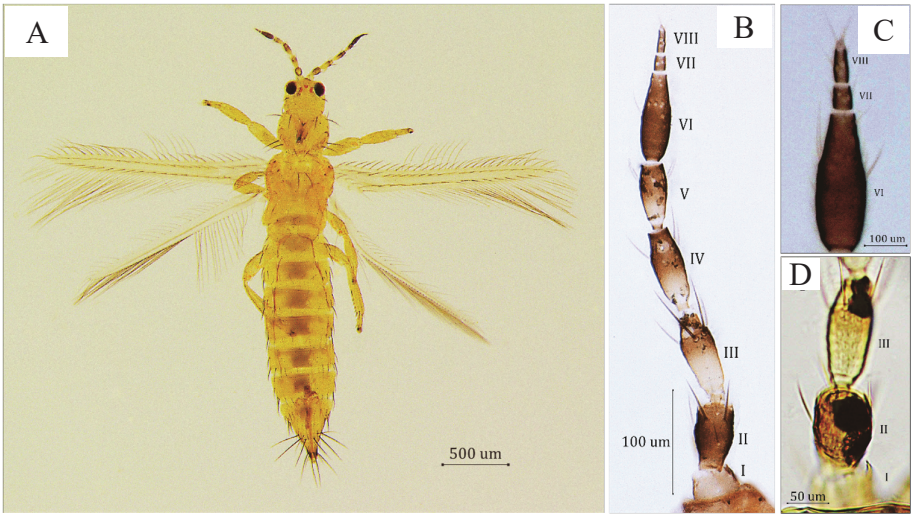

Figure 2. *Frankliniella occidentalis* adult. A. Yellow body color with fully extended wings, and each tergite showing a brown patch and a dark yellow median stripe; B. Antennae are 8-segmented, with segments III and IV bearing forked sense cones; C. The eighth segment is longer than the seventh; D. The base of antennal segment III has a smooth pedicel.

Distribution. According to CABI (2023), *Frankliniella occidentalis* has a widespread global distribution. In Africa, it has been reported in Algeria, Nigeria, Egypt, Morocco, Eswatini, Kenya, South Africa, Uganda, and Tunisia. In Asia, it has been documented in Azerbaijan, Malaysia, Lebanon, Taiwan, Japan, Sri Lanka, Iran, Myanmar, Israel, India, Kuwait, China, the Philippines, Qatar, South Korea, Turkey, Uzbekistan, and Thailand. The species is also prevalent across Europe, Oceania (Australia and New Zealand), and the Americas.

Thrips Abundance. The present study identified *Frankliniella occidentalis* as a newly invasive pest in West Java Province, Indonesia. It was found in 31 out of 48 plastic houses growing chrysanthemums, highlighting an alarming threat to local agricultural production (Figure 1). Among the trapping methods used, the beating tray captured the highest average number of *F. occidentalis*, while the yellow pan trap recorded the lowest count (Figure 4). The thrips sampling methods employed in this study were complementary, but direct sampling techniques, particularly the beating tray and hand vacuum, proved to be more effective for collecting *F. occidentalis* than other methods. Marullo et al. (2021) noted that the effectiveness of thrips sampling methods depends on the target species and environmental conditions.

F. occidentalis populations varied by region,

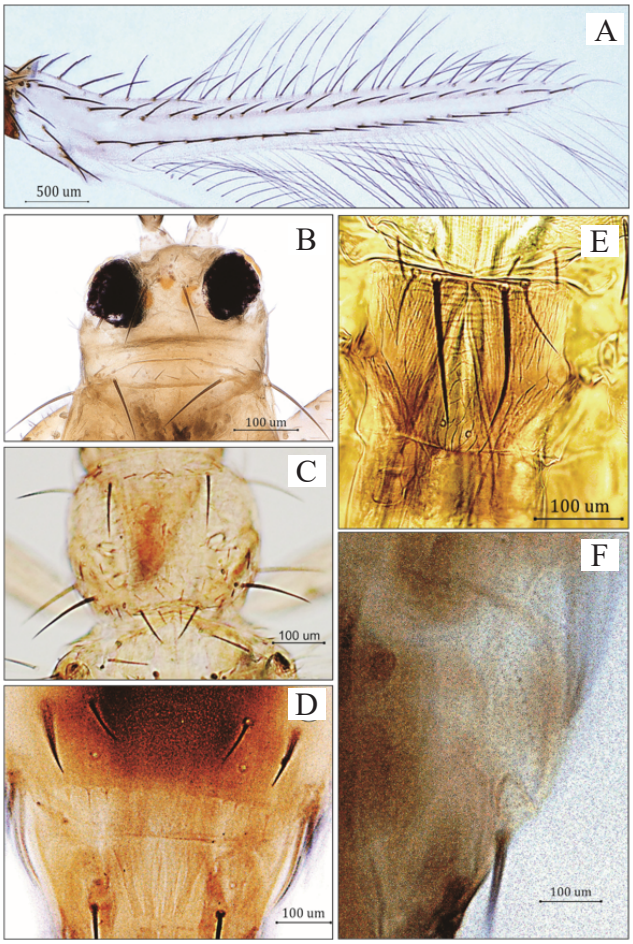

Figure 3. Main morphological traits of *Frankliniella occidentalis*. A. Two complete rows of unbroken dark setae on the forewings; B. ocellar setae do not originate between the posterior ocelli; C. Pronotum with four major setae and four minor setae on the anterior margin; D. posteromarginal comb on tergite VIII with short to fairly long microtrichia, not interrupted in the center; E. metanotum with campaniform sensilla present; F. ctenidium present on the anterior margin of tergite VIII.

with the highest density found in Sukabumi Regency (15 thrips per plastic house) and the lowest in Bogor Regency (9 thrips per plastic house). This pest was initially found on several varieties, including Fiji (white, yellow, and purple), Reagen (white), Jaguar (pink), Dwina Kencana (yellowish-red), Puspita Nusantara (yellow), Jimba and Jayani (white standard), and Aiko Agrihorti (red standard). It was observed in both the vegetative and generative phases across all sampling areas, including Cianjur, West Bandung, Sukabumi, and Bogor.

West Java is the leading producer of chrysanthemum cut flowers in Indonesia, accounting for 38.5% of the national supply. The industry consists of large, medium, and small-scale enterprises catering to various market segments (Hutapea et al., 2021; Statistics-Indonesia, 2022). According to the Indonesian Ministry of Agriculture (2020), *F. occidentalis* was previously classified as an A1 quarantine pest, indicating it was not known to be present in Indonesia. This study provides the first confirmed report of *F. occidentalis* infesting chrysanthemum crops in West Java Province.

Frankliniella occidentalis, commonly known as the western flower thrips, primarily targets flowers but can also infest the leaves and buds of various plant species (Hu et al., 2021; Ollier & Bertelsmeier, 2022). According to Chen et al. (2020), this pest poses a significant threat to chrysanthemums, as its presence can greatly reduce their market through value both direct and indirect damage. *F. occidentalis* causes two main types of injury. The first, known as growth damage, occurs when thrips feed on leaves, buds, and flowers, leading to deformation. The second, referred to as silvery damage, results from thrips feeding on leaves, creating empty clusters of plant cells filled with air that give the affected areas a silvery appearance (Figure 5). Female thrips prefer to lay their eggs in

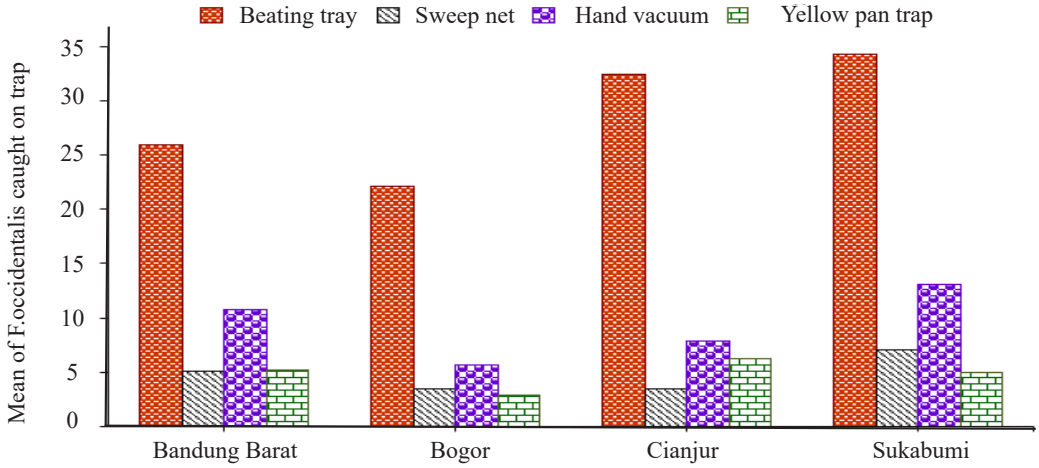

Figure 4. Mean number of *Frankliniella occidentalis* adults captured using a beating tray, sweep net, hand vacuum, and yellow pan trap across from four regencies in the chrysanthemum production centers of West Java Province.

Figure 5. Thrips damage symptoms on chrysanthemum cut flowers, showing puncture marks and light to dark spots of various sizes. A–C. Damage of flower buds; D–F. Damage on blooming flowers; G-I. Malformation and chlorotic areas on the upper side of chrysanthemum leaves.

young leaves, increasing reproduction rates in new growth (Rogge & Meyhöfer, 2021). Their tiny eggs are embedded within plant tissues, facilitating the spread of the species through the trade of fresh plant material.

A key indicator of *F. occidentalis* infestation is the presence of black fecal spots on affected plants. Severe infestations can lead to chlorophyll loss, weakening the plants and causing leaf shriveling. Attacks on flower buds can result in deformities or prevent blooming altogether. In addition to causing physical damage, *F. occidentalis* acts as a vector for plant viruses, such as impatiens necrotic spot virus and tomato spotted wilt virus, both of which negatively impact plant growth and development. Effective thrips management is essential to protect commercial crop yields (He et al., 2020; CABI, 2023).

Based on its morphology, *F. occidentalis* is characterized by its yellow body with a distinct brown abdominal stripe, pale forewings, prominent antennae, branched sensory cones, patterned setae, metanotal sensilla, and a well-developed posteromarginal comb with ctenidia on tergite VIII. This study confirms its presence in chrysanthemum cut flower production centers in West Java, Indonesia, where it had previously gone undetected due to the dominance of *Thrips parvispinus* in vegetable and food crop cultivation. The rapid spread of *F. occidentalis* poses a significant threat because of its high reproductive capacity and the year-round planting of host crops. Given that West Java is Indonesia's second-largest horticultural hub, strict quarantine regulations are crucial to prevent its invasive spread. Further research is needed to map its distribution, identify host plants, and locate natural enemies to develop an effective integrated pest management (IPM) strategy.

CONCLUSION

The present study provides the first report of *Frankliniella occidentalis* infesting chrysanthemum cut flowers in West Java, Indonesia. The rapid spread of this pest poses a significant threat to flower production, highlighting the need for strict quarantine measures and effective pest management strategies. Further research is essential to monitor its distribution, biological traits, genetic variability, and host plants over time, as well as to develop an integrated pest management approach to mitigate its impact on Indonesia's horticultural industry.

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AUTHORS' CONTRIBUTIONS

DH and PH conceived the original idea for this research. DS and D assisted in designing the experimental protocol. DH carried the survey and thrips collecting. DS, D, and PH supervision the experiment. DH and DS performed the identification, data analysis, and interpretation. DH, D, and PH drafted the manuscript. All the authors reviewed and approved the final manuscript

COMPETING INTEREST

The authors declare no competing of interest.

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