Short note [Nota corta]

FIRST REPORT OF COMMON BEAN FLOWER THRIPS *Megalurothrips usitatus* Bagnall IN COSTA RICA †

[PRIMER REPORTE DEL TRIPS DE LA FLOR DEL FRIJOL *Megalurothrips usitatus* Bagnall EN COSTA RICA]

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SUMMARY

Background: The species *Megalurothrips usitatus* is a thrips insect that has been recorded in Asia, Oceania, Australia and recently in America, attacking legume crops. **Objective:** to report *Megalurothrips usitatus* as species associated with flowers of common bean plants in Costa Rica. **Methodology:** the thrips from three growing bean locations were sampled and characterized through light microscopy in Costa Rica. Furthermore, a phylogenetic analysis of the COI gene compared with the databases of the National Center for Biotechnology Information (NCBI) was performed. **Results:** The species was recorded in three bean growing areas (Sardinal of Guanacaste, Estación Experimental Agrícola Fabio Baudrit Moreno in Alajuela and La Managua in Quepos). **Implications:** the new report of the insect in flowers of *Phaseolus vulgaris* implies future monitoring actions and respective integrated management; ignoring thrips populations could cause losses in the bean's regional production. **Conclusion:** the bean flower thrips is reported for the first time in Costa Rica.
Keywords: *Phaseolus vulgaris* L.; phytopathology of beans; flower insects; exotic species.

RESUMEN

Antecedentes: La especie *Megalurothrips usitatus* es un insecto tisanóptero que ha sido registrado en Asia, Oceanía, Australia y recientemente en América, atacando cultivos de leguminosas. **Objetivo:** reportar *Megalurothrips usitatus* como especie asociada a flores de plantas de frijol en Costa Rica. **Metodología:** fue realizado un muestreo en plantas de frijol en tres localidades en Costa Rica, los trips fueron caracterizados por medio de microscopía de luz convencional y un análisis filogenético del gen COI en el que se comparó con las bases de datos del Centro Nacional de Información Biotecnológica de los Estados Unidos de América. **Resultados:** en las tres zonas de cultivo de frijol (Sardinal de Guanacaste, Estación Experimental Agrícola Fabio Baudrit Moreno en Alajuela y La Managua en Quepos) fue registrada la especie. **Implicaciones:** el nuevo reporte del insecto en flores de *Phaseolus vulgaris* conlleva a iniciar acciones de monitoreo, además del respectivo manejo integrado con el fin de que las poblaciones de trips no generen posibles pérdidas en la producción regional de frijol. **Conclusión:** se reporta por primera vez el trips de la flor de frijol en Costa Rica.
Palabras clave: *Phaseolus vulgaris* L.; fitopatología de frijol; insectos de flor; especie exótica.

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INTRODUCTION

Insects of the order Thysanoptera (thrips) have been recorded as causing two main types of damage in crops worldwide: damage from direct feeding, and as vectors of viral or fungal pathogens (Lewis, 1997). In the American tropics, rapid distribution of foreign thrips species has been well documented. Two brief examples are what happened in Cuba with *Thrips tabaci* Lindeman (Thripidae) (Jiménez *et al*., 1999) and Costa Rica with species in horticultural areas, mainly from the genus *Frankliniella* Karny (Soto-Rodríguez *et al*., 2009). This last country has the highest biodiversity of thrips in Central America (Retana-Salazar *et al*., 2017), but few species reported in Costa Rican by Soto-Rodriguez (2011) can be associated with severe attacks on crops production, mainly on the legumes group.

Ninety-seven percent of the Costa Rica population consumes beans (*Phaseolus vulgaris* L.), making it a staple food (Rodríguez-González and Fernández-Rojas, 2015). Updated data by National Council of Production (Government of Costa Rica) recorded 19.865 ha sowed between years 2022-2023 and 13.724 Ton harvested between years 2021-2022 (Consejo Nacional de Producción, 2023). Most of the bean yield is harvest by low-income farmers, with cultivars less than 5 ha each, mostly located in the north (La Cruz, Upala, Los Chiles), central (Pérez Zeledón) and south areas (Buenos Aires) of this country (Hernández-Fonseca, 2009). Nowadays, there is access to greater bean varieties with resistance to biotic and abiotic phytopathological issues, high productivity and better adapted to low scale production (Hernández *et al*., 2018). Currently, the red-bean Cabécar and the black-bean Nambí are the most widely grown cultivars.

The bean flower thrips *Megalurothrips usitatus* (Bagnall) (Thripidae) was originally described from Allahabad, India but is widely distributed in southern Asia and Oceania, specifically in Bangladesh, Cambodia, Philippines, Pakistan, China, Vietnam, Thailand, Sri Lanka, Sumatra, Malaysia, and Papua New Guinea (Reyes, 1994). It is considered an agricultural pest in Australia (Healey, 2016; Department of Agriculture, Australian Government, 2019). This thrips is associated with different bean varieties (*Phaseolu*s spp., *Psophocarpus* spp. and *Vigna* spp.) and other legumes such as peas (*Pisum sativum* L.), pigeon pea (*Cajanus cajan* H.) and soybean (*Glycine max* L.) but has also been recorded from such unrelated plants as peanuts (*Arachis hypogaea* L.), mango (*Mangifera indica* L.), eggplant (*Solanum melongena* L.) and sweet bell pepper (*Capsicum annuum* L.).

In continental America, *M. usitatus* was reported in March 2020 from Florida, USA (Soto-Adames, 2020). In Belize, the species was also reported by the Ministry of Agriculture, Food Security and Trade in March 2021 attacking black-eyed beans (*Vigna unguiculata*) (Roberson and Feucht, 2021). Honduras recorded it in March 2022, with samples collected in 2021 from Danlí (El Paraíso), El Zamorano, Francisco Morazán and Olancho (Orozco, 2022). The most recent report was from Santiago Ixcuintla, Nayarit, with material collected in 2021 (Cambero-Campos *et al*., 2022). In the Caribbean, *M. usitatus* has been registered only from Cuba in May 2021, in plant material collected late 2019 in provinces of Artemisa and Mayabeque, as well as early 2020 in San José de las Lajas (Elizondo-Silva *et al*., 2021). In that country, the species was also reported from the province of Cienfuegos (Urdaniva-Gutiérrez, 2021). This is the first record of the species in *Phaseolus vulgaris* var. Cabécar and Nambí in Costa Rica.

MATERIAL AND METHODS

The bean crop samples were collected from Sardinal de Carrillo (10°31'40.68"N; -85°38'40.60"W, March 11th and May 10th, 2022), Guanacaste. La Managua, Quepos, Puntarenas (09°27'11.00"N; -84°07'14.00"W, May 4th, 2022). Estación Experimental Agrícola Fabio Baudrit Moreno (University of Costa Rica) Alajuela (10°00'26.00"N; -84°15'57.00"W, April 6th, 2022).

The thrips specimens were identified through conventional light microscopy using a Zeiss® Axiolab, with objectives 5X-63X. The insects were mounted in Canada balsam on glass slides (Palmer and Mound, 1990) at the Center for Research in Microscopic Structures, University of Costa Rica (CIEMic-UCR). Keys for identification Palmer *et al.* (1989) and Mound *et al*. (1993) were used. All identified specimens were donated to the Thysanoptera Collection, CIEMic-UCR.

DNA genomic material was extracted with the DNeasy Blood & Tissue Kit by QIAGEN®, following the manufacturer's instructions. A partial region of the mitochondrial cytochrome oxidase I gene (COI) was amplified with the primers LCO1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3') (Folmer *et al*., 1994). The reactions were done in 25 µl volume with 3-50 ng DNA (1-2 ul), 0.2 ul Taq DNA polymerase (DreamTaq, Thermo Scientific, 5 U/ul), 2.5 ul of DreamTaq Buffer (10X), 0.625 ul of each dNTP mix 10 mM, 1.25 ul of each primer at 10 uM. The amplification protocol consisted of 1 min of initial denaturation at 94 °C followed by 35 cycles of 30 sec at 94 °C, annealing at 58 °C for 30 sec, extension at 72 °C for 1 min and a final extension at 72 °C for 1 min. The resulting PCR products were purified and sequenced by Macrogen Inc. (Seoul, Korea), using the

same forward and reverse PCR primers. Both complementary chains were assembled and edited using the software BioEdit v7.2.5. A ClustalW aligned was performed in MEGA11 with 628pb strings, then a phylogenetic neighbor-joining method and the bootstrap consensus tree was obtained (Kadirvel *et al*., 2013). Sequences from Costa Rica have been deposited in GenBank under accession numbers OP268199, OP268200 and OP268201.

RESULTS AND DISCUSSION

A total of forty individuals of thrips (males and females) were captured in each sampled location, then the analysis concluded it was the species *Megalurothrips usitatus* Bagnall (Thripidae: Thripinae). This species is reported to be polyphagous (Stuart *et al*., 2011), but so far, it has only been observed in bean plants flowers, in Costa Rica. In this country, *M. usitatus* deformed young shoots, bronzing stems and leaf petioles occurred (Figure 1A) until they became necrotic. The foliage suffered deformation until the leaflets had curled (Figure 1B) and the last internodes were shortened with severe absence of vines. In buds and flowers, necrosis was present where there were high numbers of *M. usitatus* (Figure 1C). Young vines also showed deformation and necrosis, while a thick, brownish-striated surface layer (Figure 1D). When damages to flowers were significant, a premature flower drop resulted (Talekar, 1998). The observations in Costa Rica agreed with those reported by Elizondo-Silva *et al*. (2021) in Cuba and Cambero-Campos *et al*. (2022) in Mexico. In both countries, *M. usitatus* is known as an alien species on fabaceous plants. In Asia, this species has been recorded as transmitting of bean bacterial diseases (Palmer *et al*., 1989).

Figure 1. Bean plants attacked by *M. usitatus*. A) deformed young shoots. B) deformation and the leaflets curled. C) adults of *M. usitatus* on buds and flowers. D) Brownish-striated surface layer in vines.

The flowers of bean plants had *M. usitatus* with high number of immature stages, larvae I and II, where eggs may be laid by females on petals and sepals, like what was recorded by Talekar (1998) in Asia. Females are dark brown to black and larger than males (Figure 2A), antennae segments III are lighter than the rest of the segments, with wings with dark shades medially and at the apex (Figure 2B). With all morphological characteristics of the subfamily Thripinae, in addition, with three pairs of ocellar setae and eight post-ocellar (Figure 2C). Median posteromarginal setae at the anterior margin of sternite VII (Figure 2D) and notorious enlarged sense cone at segment VI of antennae (Figure 2E). The COI partial regions of *M. usitatus* from Costa Rica showed homology with accessions from China (MF686690.1), India (KF015513.1) and Bangladesh (KX233543.1), (Figure 3).

When climate control chambers were used in China (26 °C, 75% RH and 16: 8 h L:D), development required an average of 9.5-11.5 days from egg to adult (Liang-De *et al*., 2015). At laboratory, with range of 15-35 °C, Haiyan *et al*. (2014) observed a shortened longevity at higher temperatures, taking 60 days at 15 °C but only 11 days at 35 °C, with a maximum peak of oviposition at 232 eggs per female at 30 °C. Then, while some thrips species increasing their population when ambient temperature arose, *M. usitatus* may suffer a decline with a shorted-life cycle after 30 °C.

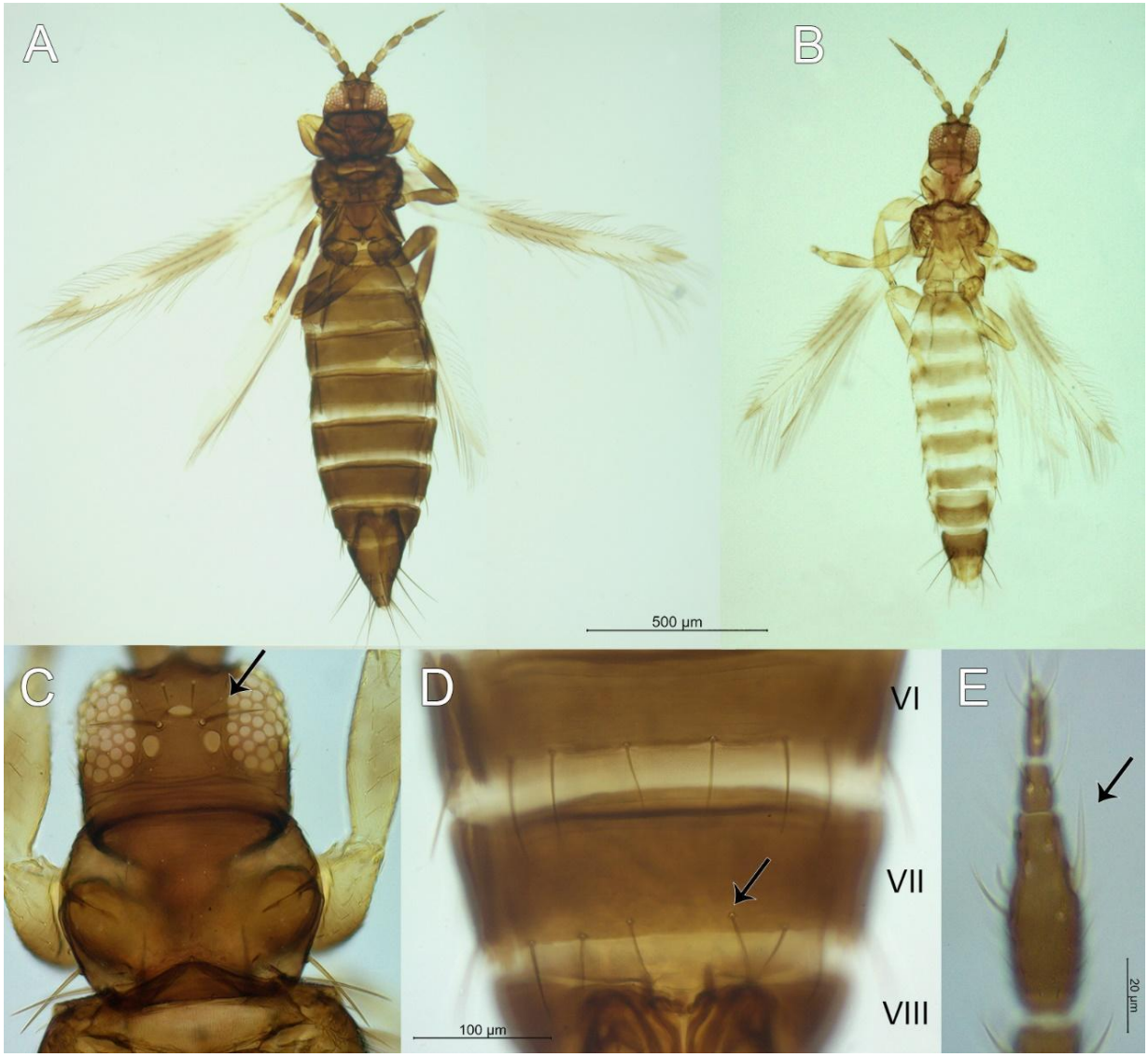

Figure 2. Adults of *M. usitatus* from Costa Rica. A) Female at 5X. B) Male at 5X. C) Female head and prothorax, arrow shows ocellar setae with same scale as Figure 2D at 20X. D) Sternite VII, arrow reveals median posteromarginal setae at the anterior margin at 20X. E). Segment VI of antennae with a clearly enlarged sense cone when viewed at 63X.

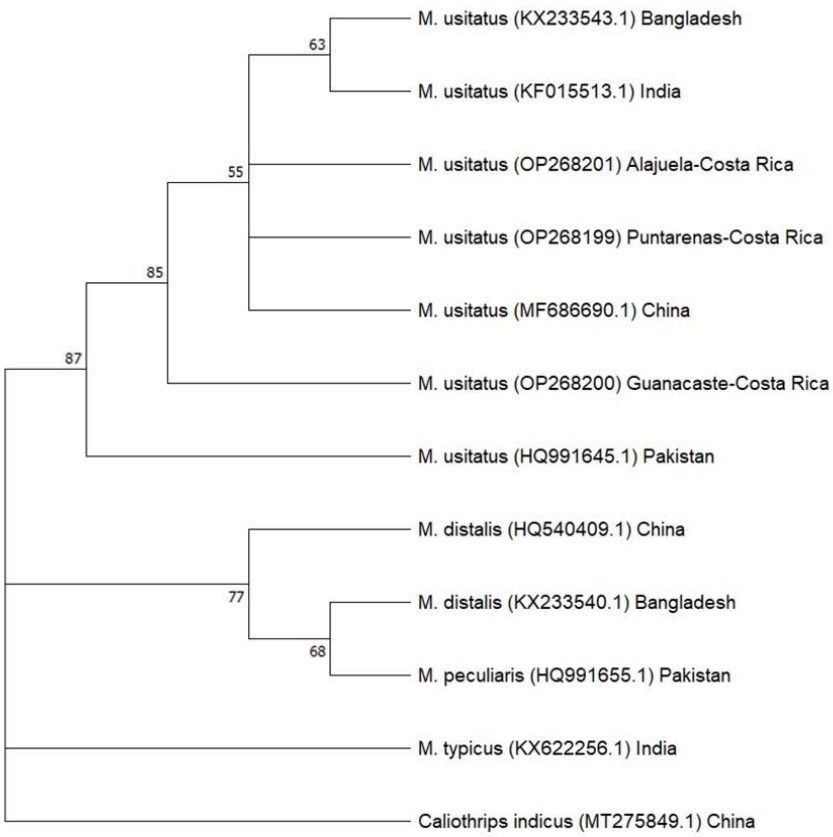

Figure 3. Neighbor-joining tree (bootstrap consensus from 500 replicates) of *M. usitatus* species from Costa Rica using the partial COI gene. Accession MT275849.1 labeled as *Caliothrips indicus* from China was used as outgroup.

CONCLUSION

Morphological and COI gene data determined the first record of the bean flower thrips in Costa Rica. An alert and further risk management should be activated by competent phytosanitary authorities at the Central America region.

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Compliance with ethical standards. The authors confirm that this investigation was conducted under the current ethical procedures. No humans or animals were used in the studies of this article.

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