EPPO Datasheet: *Ceratothripoides claratris*

Last updated: 2020-11-23

IDENTITY

Preferred name: *Ceratothripoides claratris*
Authority: (Shumsher)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Thysanoptera: Thripidae
Other scientific names: *Ceratothrips reticulatus* Reyes, *Mycterothrips moultoni* Seshadri & Ananthakrishnan, *Taeniothrips claratris* Shumsher
Common names: Oriental tomato thrips
[view more common names online...]
EPPO Categorization: A1 list
[view more categorizations online...]
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: CRTZCL

Notes on taxonomy and nomenclature

The genus *Ceratothripoides* was proposed by Bagnall in 1918 for one African species (*Ceratothripoides brunneus* Bagnall, 1918). The genus now includes five species, all originating from Eurasia or Africa, for which a detailed diagnosis and an identification key is provided by Mound and Nickle (2009).

As described in the section on identification, *Ceratothripoides claratris* is very similar to *Ceratothripoides cameroni*, whether these are two distinct species, or whether the slight differences in colour are intraspecific variation, as suggested by Zur Strassen (1975), remains unclear.

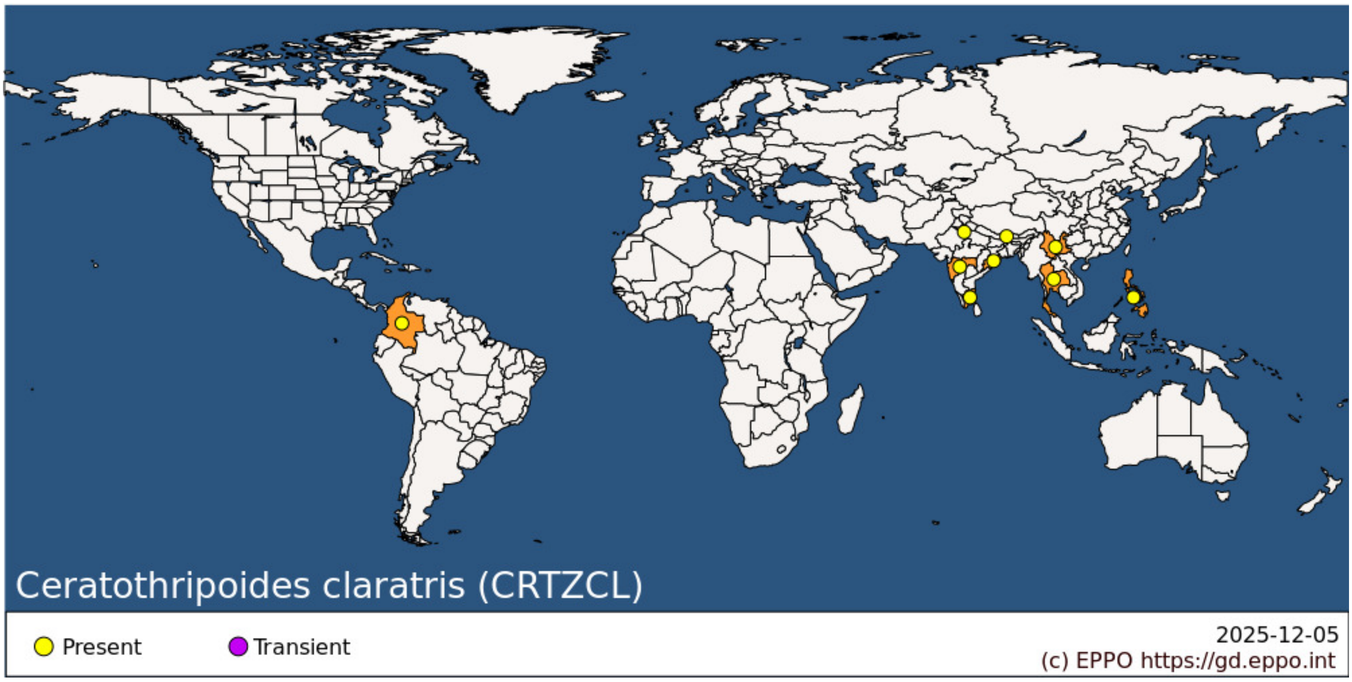
HOSTS

C. claratris is oligophagous, feeding on plants in only a few families. It has been observed on Solanaceae, Cucurbitaceae, Fabaceae and Asteraceae crop plants. Tomato is considered as the main host but this species is also known to feed on solanaceous crops such as sweet pepper (*Capsicum annuum*), eggplant (*Solanum melongena)* and tobacco (*Nicotiana tabacum)*. The host list is based on Premachandra and Borgemeister (2006), Steenken and Halaweh (2011) and Reyes (1994).

Host list: *Capsicum annuum*, *Citrullus lanatus*, *Cucumis melo*, *Cucumis sativus*, *Cucurbita moschata*, *Datura sp.*, *Lactuca sativa*, *Momordica charantia*, *Nicotiana tabacum*, *Phaseolus vulgaris*, *Pisum sativum*, *Solanum lycopersicum*, *Solanum melongena*, *Solanum virginianum*, *Vigna unguiculata subsp. unguiculata*, *Vigna unguiculata*

GEOGRAPHICAL DISTRIBUTION

C. claratris probably originated in Asia and adapted to the hot humid tropical climate of South East Asia. However, the exact origin is not obvious as the thrips population in Thailand is highly homogenous with about 85% of all specimens assayed belonging to a single multilocus haplotype (Thakaew *et al*., 2011). According to these authors, *C. claratris* was introduced to Thailand from abroad and may have dispersed forming new populations maintaining a high genetic similarity compared to the parental population.



Asia: China (Yunnan), India (Delhi, Maharashtra, Odisha, Sikkim, Tamil Nadu), Philippines, Thailand
South America: Colombia

BIOLOGY

As in other thrips species, *C. claratris* has six development stages: the egg, which is embedded in the plant tissue, two active larval stages, two inactive pupal stages, i.e. propupa and pupa, and the adult. Adults and the two larval stages feed on the foliage. The late second stage larvae drop off the plants and pupate in the soil or on leaf litter (Rodmui (2002) cited in Premachandra *et al*. (2004)).The data on development, reproduction and longevity of *C. claratris* indicate that this species is better adapted to high temperatures (i.e. 30–35°C) than other important tropical thrips species such as *T. palmi* and *S. dorsalis* as shown by Premachandra *et al*. (2004) on tomatoes in a climate chamber. The optimal conditions for *C. claratris* are reported to be 30°C. Estimation of the maximum temperature for development is 38°C and egg development is inhibited at 40°C. The lower thermal threshold for egg-to-adult development is estimated between 16 and 18°C. *C. claratris* reproduces by arrhenotokous parthenogenesis. The sex ratios of inseminated females is strongly female-biased, except at 25°C. Female longevity and fecundity are temperature-dependent with the highest longevity recorded at 25°C (18.5 days) and the highest fecundity recorded at 30°C with an average of 116 eggs laid per female (average daily fecundity of 10.3 eggs).

DETECTION AND IDENTIFICATION

Symptoms

C. claratris may cause both direct and indirect damage to host plants.

On tomatoes, it feeds on the foliage, stems and fruits resulting in direct damage such as scarring, malformation (Ghosh *et al*., 2017) and desiccation in case of heavy infestations. On other host plants, symptoms are not precisely documented in the literature, but are expected to be similar to those observed on tomatoes.

Indirect damage by *C. claratris* is also associated with virus transmission in tomatoes. The Oriental tomato thrips is an effective vector of *Capsicum chlorosis virus* (CaCV) and TNRV (Tomato necrotic ringspot virus) (genus Tospovirus, family Bunyaviridae) as demonstrated in laboratory settings by Premachandra *et al*. (2005a) and Seepiban *et al.* (2018). This resulted in typical symptoms of tospovirus infection such as chlorotic spots, chlorotic ringspots, necrotic spots, necrotic ringspots, mosaics and leaf necrosis (Jones, 2005).

Morphology

Eggs

The eggs are reniform, pale and opaque (average 0.13mm long). When mature they become yellowish-orange.

Larva

The small white L1 larvae resemble adults but lack wing pads, and have a lesser number of segments in the antennae (average size of L1 is approximately 0.40mm). The second larval stage L2 is similar to the previous stage but bigger in size (average size 0.80mm). Larvae cannot be identified by morphological observation.

Pupa

No precise description of the propupae and the pupae are given in the literature. The propupae and pupae resemble the adults and larvae in terms of body shape, and they possess wing pads. The wing pads of the pupae are longer than that of the propupae.

Adult

The adults are brown with legs extensively shaded brown. The main morphological characteristics are as follows: Antennae 8-segmented, pronotum with two pairs of posteroangular setae, metanotum reticulate, forewings uniformly pale with no dark shading, the first vein usually having 7 setae basally and 2 setae distally and compound eyes with some weakly pigmented facets. The adult females have an average width of about 0.2 mm and a length of 1 mm. The males are slightly smaller than females.

The genus *Ceratothripoides* can be identified according to Mound and Kibby (1998) and the species by following the key provided by Mound and Nickle (2009) together with a full description of *C. claratris*.

Confusion with similar species

Many of the morphological characters of *Ceratothripoides* are also shared with the species of *Pezothrips* and with the legume-flower associated species *Megalurothrips*, *Odontothrips* and *Odontothripiella*. Furthermore, the sternites of the males of *Pezothrips* and *Ceratothripoides* species have numerous small pore plates. But *Pezothrips* species have setae S2 on sternite VII arising at the margin, in contrast with setae S2 well in front of posterior margin in the species of *Ceratothripoides*. *Ceratothripoides claratris* is very similar to *Ceratothripoides cameroni* and differs only by colour: *C. claratris* has antennal segment V and legs extensively brown, whereas *C. cameroni* has antennal segment V yellow or shaded and legs yellow. But several specimens have remarkable variable coloration. As mentioned above whether these slight differences in colour represent two distinct species, or whether this is intraspecific variation, as suggested by Zur Strassen (1975), remains unclear. No biotype differentiation has been reported in *C. claratris* and the population in Thailand is highly homogenous with limited genetic polymorphisms among specimens collected from different locations (Thakaew *et al*., 2011).

Detection and inspection methods

Because of their small size and their behavioural responses (thigmotaxis), thrips are easily overlooked if the import inspection is carried visually. Only heavily infested plants are likely to be detected by visual examination. However, this is rarely the case in the context of import control. So the detection of thrips is more effective with the use of a Berlese funnel (thrips move down into the funnel to escape desiccation and are captured in a jar) allowing fast extraction of arthropods within 48h in port and airport facilities. Adults and larvae are trapped in this way, but only adults can be identified morphologically. The use of coloured sticky traps is not recommended because thrips are difficult to extract and are often no longer recognizable. Molecular-based method for identification of thrips species can be useful. For example, species commonly found in Thailand (*C. claratris*, *Frankliniella intonsa*, *Scirtothrips dorsalis* and *Thrips palmi*) were successfully distinguished based on the ITS2 region of each thrips species (Seepiban *et al*., 2015).

PATHWAYS FOR MOVEMENT

As for other thrips species, the Oriental tomato thrips has only poor natural dispersal potential at both larvae and adult stages. But it is liable to be carried on fruits, cut plant parts and plants for planting of host species from countries where it occurs. It had not been reported from interceptions in the EUROPHYT database however a single interception on *Solanum melongena* is reported in England from India by Collins (2010). Considering the broad distribution of *C. claratris* in Eastern and Southern Asia, special vigilance should be exercised on hosts imported from this area, either as whole plants or fruits.

PEST SIGNIFICANCE

Economic impact

Ceratothripoides claratris is one of the most destructive insect pests of tomato in Thailand causing considerable yield losses in both field and glasshouse conditions, although the yield losses have not been precisely estimated so far. It is known to feed on the foliage, stems, and fruits. Oviposition by females on fruits leads to scarring and malformation of tomatoes (Premachandra *et al*. 2005a). *C. claratris* attacks also other economically important vegetables such as cucumber, *Cucumis sativus* (Cucurbitaceae), eggplant, *Solanum melongena* and *Solanum virginianum (=S. xanthocarpus*) (Solanaceae), pumpkin, *Cucurbita moschata* (Cucurbitaceae), cowpea, *Vigna sinensis* (Fabaceae), sweet pepper, *Capsicum annuum* (Solanaceae), and yard long bean, *Vigna unguiculata* (Fabaceae) (Premachandra, 2004).

Capsicum chlorosis virus (CaCV) was found first in sweet pepper and tomato plants in Australia in 1999 and since 2002, CaCV has emerged as an important disease on tomatoes, causing high losses in central and north-eastern regions of Thailand. Premachandra *et al*. (2005) showed the successful transmission of this virus in tomato by *C. claratris* (which is not the only vector). The same authors reported that up to 87% of adult *C. claratris* transmitted CaCV to tomato leaf disks. However, subsequent studies, with a selected population of *C. claratris* from the same location, with the same virus strain and under similar experimental conditions indicated that the percentage of viruliferous adults rarely exceeded 30% and so was much lower than reported earlier (Halaweh and Poehling, 2009). The authors suggest that the competence of *C. claratris* as a vector for this virus is probably a heritable trait controlled by a recessive allele, also highlighting the complicated interrelationships between thrips, tospoviruses and plants to explain the variable efficiency with which field populations transmit CaCV. Several authors emphasized that the success of thrips transmission depends on many factors, such as stages of the acquired thrips, virus replication and translocation, and the amount of virus that reaches the salivary glands. Moreover, viruliferous *C. claratris* carrying a mixed infection of TNRV and CaCV were identified in tomato production fields (Seepiban *et al*., 2015). TNRV and CaCV are now the two major tospoviruses detected in tomato crops in Thailand according to Seepiban *et al*. (2018).

Control

Premachandra (2004) reported that the predominant plant protection strategy in vegetable crops in Asia is chemical control. But the high use of pesticides has resulted in problems such as pest resistance, negative effects on natural enemies, contamination of water sources, and direct health hazards to both farmers and consumers.

Alternatives to chemical control are currently being studied for *C. claratris* but none of them are routinely applied at the moment:

- Eulophid parasitoids (*Ceranisus menes* and *Goethena shakespearei*) have been identified from parasitized *C. claratris* larva (Murai *et al*., 2000). However, their efficacy in controlling this species and their specificity need to be assessed. So far, no attempts for mass releases in greenhouses and/or fields have been made (Premachandra, 2004).

- Extracts from the Neem tree (*Azadirachta indica*) are becoming increasingly important in pest management due to their insecticidal properties and environmental compatibility. Thoeming and Poehling (2006) used different neem products in soil applications and showed strong systemic effects against *C. claratris* on young tomato plants when high azadirachtin concentrations (400 mg /L) were repeatedly applied under protected cultivation. The authors concluded that long-term protection in protected cultivation in the tropics and subtropics with soil treatments seems to be difficult and needs additional measures of integrated pest management.

- Premachandra *et al.* (2005b) showed highly effective insecticidal activity of spinosad (mainly caused through contact effects) against all tested life stages of *C. claratris* (i.e., L1, L2 and adults) both through direct and residual contact toxicity and regardless of the dose rates used. High efficacy and much faster effects of spinosad against larvae and adults of *C. claratris*, coupled with its longer persistence (both compared to neem) can help to suppress the rapid population build-up of *C. claratris*, particularly under greenhouse conditions. The author concluded that spinosad is more effective against *C. claratris* than neem.

- UV manipulation of ambient light can strongly affect flight activity, orientation, and host location of *C. claratris*. Blocking the transmission of UV into and around tropical greenhouses can greatly limit the entry of thrips into the greenhouse (Kumar et Poehling, 2006; Nguyen *et al*., 2009).

- Several entomopathogenic fungi provide good control against thrips as long as high enough humidity can be maintained to enable infection, which is the case in warm, humid environments but a less effective solution in temperate climates. The highest mortality rates of *C. claratris* were obtained with *Isaria fumosorosea* (= *Paecilomyces fumosoroseus*) (BCC7058 and FWA5 isolates) and with *I. fumosorosea* (FWA3 isolate) causing 93.3% and 90% mortality, respectively. However, these rates were not significantly different from isolates BCC1659 and FWA4 of *I. fumosorosea* and isolates BCC1658 and KKU1 of *Beauveria bassiana* (Panyasiri *et al*., 2007).

Phytosanitary risk

This species is adapted to the hot humid tropical climate of South East Asia (Ghosh *et al*., 2017). The data provided by Premachandra (2004) on development, reproduction and longevity indicate that *C. claratris* does not tolerate as well cooler temperatures and better adapted to higher temperatures (i.e. 30-35ºC) in comparison to other important thrips pests in the tropics and subtropics (such as *T. palmi* and *S. dorsalis)*. Moreover, the relatively short life cycle of *C. claratris*, coupled with its high reproductive potential, female biased sex ratio and long lifespan can lead to a rapid population build up, both in the field and under greenhouse conditions in the tropics. It has therefore the potential to threaten tomato elsewhere in the tropics (Permachandra, 2004). A phytosanitary risk assessment for the EPPO region was performed by an Expert Working Group (EPPO, 2017), which concluded that it is unlikely, with a moderate uncertainty, that *C. claratris* can establish outside in the EPPO region, but considered that transient populations may occur. However, *C. claratris* has a high potential to directly and indirectly (through vectoring CaCV), damage tomatoes under protected cultivation through the EPPO region.

PHYTOSANITARY MEASURES

Given the known distribution of *C. claratris* (South East Asia), special care should be taken when importing tomatoes (and also other host plants) from areas at risk (China, India or Thailand). However, the absence of any interception of this species till now in Europe could indicate that (i) there is currently no commercial pathway at risk between the EPPO region and areas at risk or (ii) *C. claratris* is not present at the moment on commercial pathways from areas at risk or (iii) *C. claratris* is not detected during import inspections but then does not find adequate conditions to establish in Europe.

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ACKNOWLEDGEMENTS

This datasheet was prepared in 2020 by Philippe Reynaud (ANSES). His valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2025) *Ceratothripoides claratris*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Co-funded by the European Union