Open Peer Review on Qeios

Thrips (Insecta: Thysanoptera: Thripidae).

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Most thrips species known as pests belong to the Thripidae family, which has around 1,500 species distributed in 250 genera. Most are phytophagous, but they can also be mycophagous or predators. They are very small insects, 1.0 to 1.3 mm long, with a narrow and elongated body, light yellow to black, and a quadrangular head. Adults have two pairs of narrow, fringed wings. The nymphs are greenish-yellow in color, lighter than the adults, have colorless legs and antennae, and are wingless. The tripod, as the name makes clear, is made up of three pillars: economic, social, and environmental, meaning that the results use the 3 pillars as an important measure (Figure 1) [1-5].

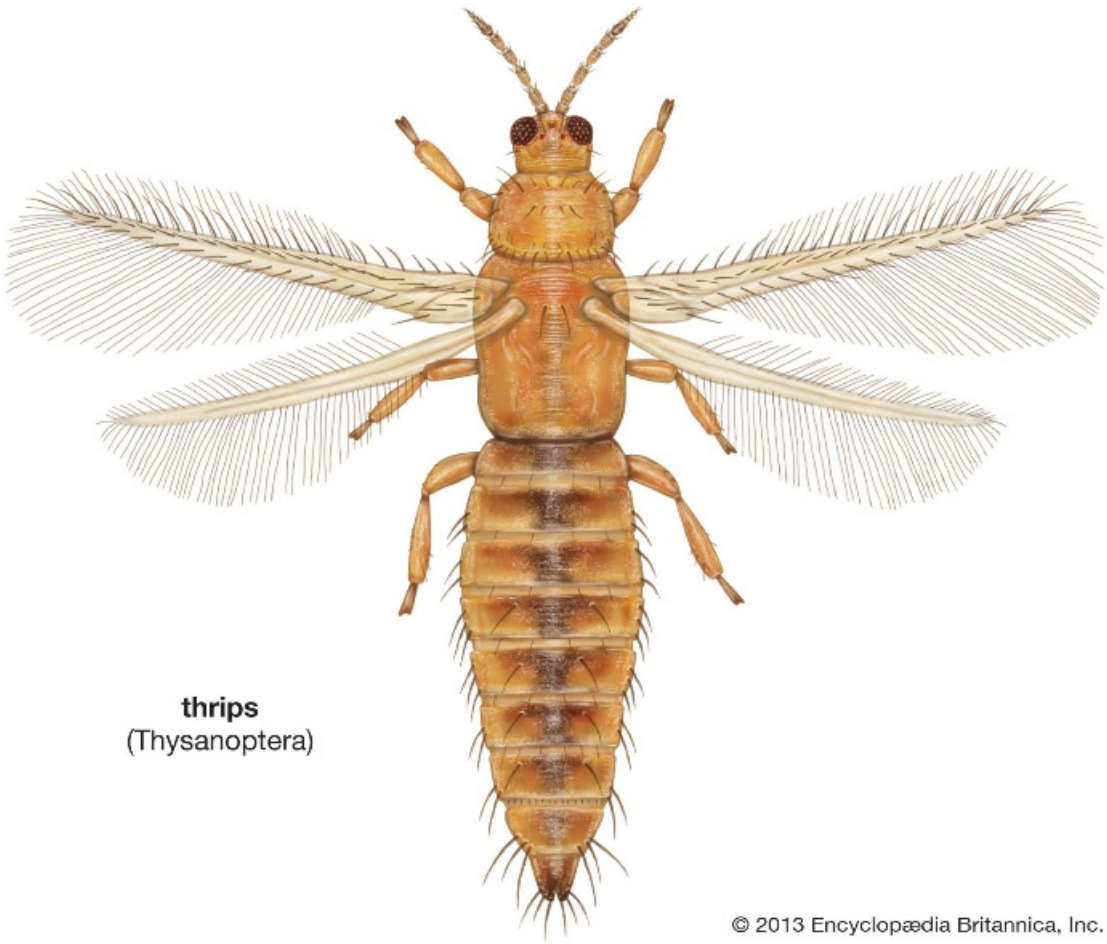

Figure 1. Thrips, (order Thysanoptera). Source: https://www.britannica.com/animal/thrips/Form-and-function.

Thrips exhibit sexual reproduction and parthenogenesis, with eggs being laid on leaves. After a few days, young forms or

nymphs appear, which are distinguished from adults because they are lighter in color and do not have wings. Metamorphosis is incomplete with two larval stages, then the pre-pupa and pupa stages, and finally the adult individual with wings. They feed on plant sap, being scraper-suckers. Your cycle is about 15 days [5-8].

When it attacks shoots and young plants, thrips cause the leaves of the needle to shrivel and thicken, which have a bright green color and silvery spots. After the attack, the plant's growth is impaired, generating 2 to 4 pairs of leaves. Both the young and adult stages of thrips attack the leaves, feeding on plant sap, causing the edges to bend upwards and cause a whitish discoloration. When the attack occurs on the inflorescences, the discoloration is reddish and can result in sterility of the spikelets. The proliferation of this pest is favored by hot and dry periods, but it can also appear in low-temperature conditions, associated with drought [10-14].

Rain reduces thrips populations by mechanical action, washing and drowning individuals, and by ensuring humidity favorable to the activity of microorganisms that cause diseases and kill these insects. There are more than two thousand species of thrips spread throughout the world, and in Brazil the three most common are *Caliothrips brasiliensis* (Morgan, 1929), *Caliothrips phaseoli* (Hood, 1912) and (Trybom, 1910). The first two frequently affect plantations in the southern region of Brazil, while the third is more common in Bahia(Figure 2) [10-14].

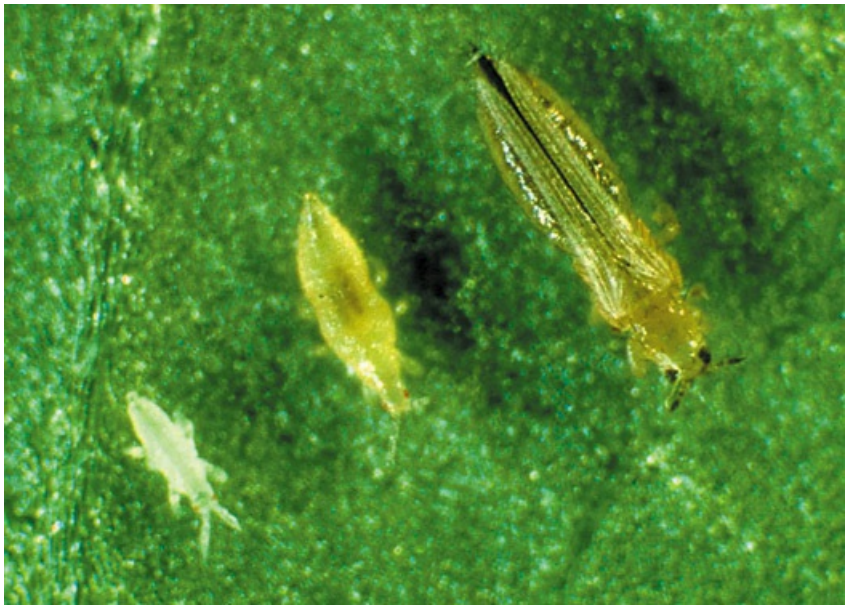

Figure 2. Tall and immature Thrips. Source: https://www.cultureindoor.com/pt-pt/content/133-thrips.

Thrips tabaci Lindeman, 1889: They vary in color from yellow to brown, measuring around 1 mm. The nymphs are greenish-yellow, lighter than the adults, with colorless legs and antennae.

Thrips palmi Karny, 1925: They are yellow as nymphs and adults, measuring more than 1 mm. Adults and nymphs live on the lower surface of leaves.

Frankliniella schultzei: They have variable coloration, from 1 to 3 mm in length at most.

Arachis hypogaea L., 1758, *Enneothrips flavens* (Moulton, 1941) is the key pest of this crop, and the entire management program is focused on controlling it (Figure 3) [16-18].

Figure 3. Thrips feeding damage to bean leave. Source: https://www.cultureindoor.com/pt-pt/content/133-thrips.

Thrip management

One of the first points to avoid large infestations of thrips in cotton is monitoring, which must be intensified at times most prone to the appearance of this pest, that is, in periods with low temperatures and dry weather. When high population levels of thrips are identified on cotton plants, the recommendation is to initiate chemical control. The recommendation of experts is to use the product on cotton when, on average, five nymphs per plant were found, during the first 30 days of the crop, precisely during the period when the pest is most attacked (Figure 4) [19-26].

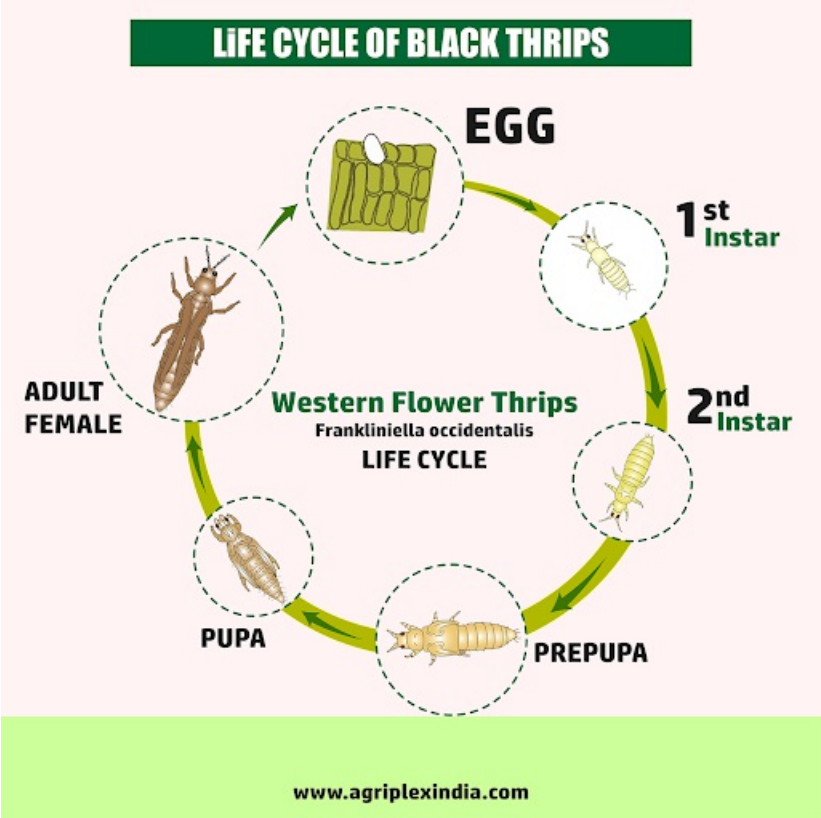

Figure 4. Life cycle -Thrips. Source: https://www.agriplexindia.com/blogs/featured/thrips-free-harvest-proven-methods-for-managing-black-thrips-in-chili-crops.

As alternative measures to chemical control, the following stand out: Manage host plants located within and/or on the edges of the crop, so that the end of the cycle does not coincide with periods of greater crop susceptibility, avoiding high infestations in critical phases; Use blue and yellow adhesive plates; Apply biological control, using predators such as Orius and/or entomopathogenic fungi. Use of fine screens to prevent thrips from entering protected crops [19-26].

Frankliniella schultzei

This thrips causes damage of economic importance to several crops: zucchini, cotton, peanuts, potatoes, eggplant, onions, tobacco, jiló, watermelon, melon, cucumber, pepper, peppers, soybeans, tomatoes, and grapes. It is an insect that can cause serious problems in tomato cultivation, as it transmits the "head turner" virus, which, depending on the rate of incidence, can wipe out a planting area. Both the young and adult stages of thrips attack the leaves, feeding on plant sap, causing the edges to bend upwards and cause a whitish discoloration. The greatest damage is caused by the transmission of the virus, which the thrips release when they suck the plant's sap [19-26].

Thrip infestation in soybeans begins in the first vegetative stages and extends to the flowering and fruiting period. At this stage, the pest can be found on leaflets, flowers, and young pods. Direct damage from thrips to soybean crops can be identified as scrapes on the leaves, which produce streaks and cause silvering on the underside of the leaf. This symptom does not compromise the development of the crop or cause defoliation. On the other hand, the indirect damage of thrips in soybeans is the transmission of the viral disease Soya Bud Blight. The soybean sprout blight virus (VQBS) is

transmitted by pollen adhered to the mouthparts of the thrips of the genus *Frankliniella* Karny, 1910 during the pest's feeding [19-26].

Thrip damage to cotton

When it attacks shoots and young plants, thrips cause the leaves of the needle to shrivel and thicken, which have a bright green color and silvery spots. After the attack, the plant's growth is impaired, generating 2 to 4 pairs of leaves. Furthermore, over-sprouting may also occur due to the death of the apical bud.

Thrip damage on tomato

The direct damage caused by thrips to tomato crops is not very different from the damage caused to crops such as soybeans or cotton. When the pest feeds on the tomato plant, silvery spots also appear on the surface of the leaves and flowers, which suffer from wrinkling. The indirect damage of thrips on tomato plants is the transmission of the tomato leaf turner virus tospovirus. The species of thrips that vector the disease are Thrips palmi and Frankliniella schultzei. When feeding on the sap of diseased plants, thrips become infected with tospovirus and transmit the disease when they feed on healthy tomato plants. The most aggressive impacts of the tomato turnip virus occur when a large population of contaminated thrips infests the crop up to 45 days after planting [19-26].

Thrips in soybean crops

One of the direct damages is the reduction of the photosynthetically active leaf area and, for this reason, they affect the weight of the grain or seed, reducing productivity. Furthermore, they can cause the miscarriage of leaves and flowers due to premature aging caused by damage to the plant. Indirectly, these insects are potential transmitters of pathogens, such as the virus that causes the “sprout blight” disease.

In soybean cultivation, the species *C. braziliensis* and *F. schultzei* prevail. The first prefers to remain on the lower part of the leaves, in the lower and middle third of the plant, while the species of the genus *Frankliniella* Karny, 1910 settles, most of the time, in the meristematic tissue. Therefore, it is essential to monitor the pest from the initial stages of the crop, to carry out early control to more easily reach the abaxial surface of the leaves, where the insect is installed [19-26].

Onion Trips

Thrips are one of the most harmful pests for onion crops not only in Brazil but throughout the world. In Brazil, the most important species is *T. tabaci* A severe infestation of this pest in onion crops has the potential to cause losses The highest incidence of this pest is favored by hot and dry periods, as it accelerates the reproduction and development of the species. Rain, however, reduces tripod populations by inhibiting the insect's dispersion in the field, in addition to causing the death of larvae.

Occur through the suction of sap in younger tissues, causing a reduction in leaf area and a reduction in the photosynthetic area. Indirect: they are agents of transmission of phytopathogenic agents, such as the Iris yellow spot virus (IYSV), known as “sapeca” in onions, and can predispose plants to the entry of diseases such as purple spot, caused by the fungus. As

a result of the attack by this pest, onion plants can experience writhing, yellowing, and drying of the leaves. Furthermore, the tipping over of the plant because of maturation is also hampered, favoring the entry of rainwater or irrigation water into the bulb, which can cause losses due to rot during storage [19-26].

Thrips in mint

Dinurothrips hookeri Hood, 1913, is a species originating from South America and distributed in Caribbean countries and recorded in Florida and Brazil and on the island of Guam. *Caliothrips phaseoli* (Hood, 1912) originated from the southwestern United States, with records in California, Texas, southern Mexico, Argentina, and Brazil.

The damage caused by the attack of these species on mint was characterized by leaves with a silvery appearance, with consequent necrosis of the leaf tissues. Without this structure, the use of the plant for preparing tea or obtaining essential oil is compromised. It was found that the infestation caused the death of the plant, due to the high population level of the insect at the time. There are no records of control methods for these insects in mint [27].

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