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Thrips parvispinus (Karney): An Emerging Invasive Pest to Horticultural Crops

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Abstract**:** *Thrips parvispinus* (Karney) is an invasive pest first reported from India in 2015 and again in 2018, but no significant damage on major commercial crops was noted until detection on chilli in Andhra Pradesh in 2021. Since then, rapidly spread across different regions of India, infesting a wide range of crops, with a severe outbreak during the 2021–22 season. Morphologically, *T. parvispinus* is distinguished by uniformly dark forewings with a pale base and continuous rows of setae on the first and second veins of forewing. The species exhibits a wide host range, occurring on almost all flowering plants, including weeds. Adults predominantly feed on pollen, with peak populations in chilli coinciding with full bloom. Females insert eggs beneath the leaf epidermis, visible as minute eruptions, and the life cycle comprises egg, two larval instars, prepupa, pupa and adult. Although its damage resembles that of other thrips, *T. parvispinus* shows a stronger preference for flowers and fruits, leading to flower drop and brownish fruit discoloration that reduces market value.

Keywords**:** Chilli, *Thrips parvispinus*, Life stages, Integrated pest management, Taxonomic characters

Indian chilies are renowned worldwide for their vibrant colour, diverse pungency and rich flavor, which add special taste and appeal to global cuisines. Hence, Indian chilies are most demanded spice in the international spice trade. Moreover, India's diverse climate is well suited for cultivating a wide range of chilli varieties, both in terms of pungency and colour. Major chilli producing countries are India, China, Indonesia, Mexico and Thailand followed by Pakistan, Bangladesh, Ethiopia, Vietnam and United States. In India chilli is cultivated in an area of 0.92 million hectares with the production of 2.69 million metric tonnes. In India major chilli producing states are Andhra Pradesh, Telangana, Madhya Pradesh, Karnataka and West Bengal. In Andhra Pradesh chilli is cultivated in an area of 0.18 million hectares with the production of 10.32 lakh metric tonnes (2024-25) (www.indianspices.com). During 2024-25, India had exported 0.75 million tonnes of chilli with the export value of Rs. 11,404.90 crore (Approximately US $ 1.34 billion). Chilli has great export potential besides huge domestic requirement on other side number of limiting factors contribute for low productivity. Among the sucking pests thrips are causing major loss by infesting the crop continuously from seedling stage to harvesting stage. Thrips is one of the largest genera of the insect's order Thysanoptera in the family Thripidae and consists of numbers of species. Invasive thrips, *Thrips parvispinus* (Karny 1922) (Thysanoptera: Terebrantia: Thripidae)is a member of “Thrips orientalis group” (Mound 2005). It is also called as western thrips/ taiwanese thrips/tobacco thrips. During 2021, *Thrips parvispinus*, invasive thrips species was noticed in all major chilli growing areas of Andhra Pradesh (Sireesha et al., 2021). In the subsequent years the species was dominated over *Scirtothrips dorsalis* which was dominant thrips species earlier to 2021. Severe outbreak of the pest *Thrips parvispinus* was observed during 2021-22 cropping season, resulting in huge economic loss ranging from 50-70%. The systematic studies were conducted on various aspects of pests viz., Taxonomic characters, pest spread, Pest behavior, Alternate hosts, nature of damage, alternate hosts and its management using cultural, mechanical, biological and chemical methods at Horticultural Research Station, Lam, Guntur with a view to provide practical solution to the farmers.

First observation of pest on chilli: *Thrips parvispinus* was first noticed in Chilakaluripeta and Pratipadu mandals of Guntur district (16.09 N 80.16E & 16.16 N 80.22E) during January, 2021 and subsequently its spread was noticed in all chilli growing areas of Andhra Pradesh. Preliminary identification showed that it is complex of *Thrips florum*, *Thrips hawaiiensis*, *Thrips palmi* and *Frankliniella schulzei*. Later it was identified as *Thrips parvispinus* and it was confirmed that the 90-95% of the thrips species collected on chilli were of *Thrips parvispinus*. This was the first record from India on the occurrence of this species in chilli ecosystem (Sireesha et al., 2021). This species is native to Asian tropics and has been reported from Indonesia, India, Thailand, Malaysia, Singapore, Taiwan, China, Philippines, Australia and the Solomon Islands (Mound and Collins 2000, Mound and Masumoto 2005). Though it was reported from India by Tyagi et al. (2015) and Rachana et al. (2018) on other crops it was not reported from chilli ecosystem anywhere in India. It was reported that it is most damaging to papaya in Hawaii and Indonesia, peppers and Solanaceous crops in Indonesia and ornamentals in Europe and Indonesia.

Identification of pest using taxonomic characters: Adult thrips from the chilli flowers were collected in plastic vials containing 70 % alcohol and the taxonomic studies were carried by observing the characters after preparing temporary and permanent slides. The identification of *T. parvispinus* was done by using the key developed by Mound (2005). Samples collected from the chilli fields in Guntur district of Andhra Pradesh consists thrips species *Thrips parvispinus* Karny only. The Characteristic features which differentiate *T. parvispinus* from other known species of the genus Thrips, which falls within *T. orientalis* group are: Adult female body was brown, head and thorax paler than abdomen, legs yellow, Male body was yellow (Fig. 1A). Antennae seven segmented, segments III and IV each with forked sense cone and segment III and bases of IV and V segments are pale (Fig. 1B). Head broader than long, ocellar setae pair III arising at the anterior margin of ocellar triangle, postocular setae III shorter than postocular setae I and IV (Fig. 1C) Pronotum with two pairs of posteroangulars setae and two pairs of poster marginal setae (Fig. 1E). Metanotum with median reticulations, median setae placed well behind the anterior margin, campaniform sensilla absent (Fig. 1D). Forewings uniformly dark or shaded with pale base (Fig. 1I). First and second veins of fore wing with continuous setal row (Fig. IH). Hind wings are present (Fig. 1K). Posterior margin of abdominal tergite VIII without comb a few microtrichia present laterally (Fig. 1G) and abdominal sternites III–VI with discal setae, but absent on II and VII (Fig. 1J).

Pest spread: This species is native to the Asian tropics and has been reported from Indonesia, India, Thailand, Malaysia, Singapore, Taiwan, China, Philippines, Australia and the Solomon Islands (Mound and Collins 2000). However, during the last 20 years the species has been expanding its range and is now found in Greece, France, Spain, The Netherlands, Tanzania, Mauritius, Reunion and Hawaii (The Netherlands Plant Protection Organization Quick scan 2019, Mound et al., 2016).

In India *T. parvispinus*, was first reported on *Carica papaya* L. by Tyagi et al. (2015) from Bengaluru, later it was reported on Dahlia rosea Cav. (Asteraceae) (Rachana et al., 2018) and *Brugmansia sp*. (Solanaceae) (Roselin et al., 2021). In chilli, it was first reported from Andhra Pradesh (Sireesha et al., 2021) followed by Telangana, Karnataka, Chhattisgarh, Gujarat and eastern parts of India. *T. parvispinus* is polyphagous with the preferred hosts varying across its geographic distribution. In regions where the species has been long established, the crops most affected are papaya, peppers, potatoes, eggplants, beans, shallots and strawberries. In Indonesia, field pepper yield losses due to *T. parvispinus* reach 23 percent (Johari et al., 2014).

Host range: During 2021-22, the survey conducted in Guntur district of A.P. to record the incidence and intensity levels of *T. parvispinus* on fruit crops, vegetables, spice crops, flower crops, field crops and weeds were recorded. Incidence of *T. parvispinus* was found on 34 host plants belonging to 15 families which were categorized into Vegetable crops (8 species), Spice Plants (2 species), Fruit crops (2 species), Flower plants (1 species), Field crops (5 species) and Weeds (16 species) (Table 1). Among the different crop families observed, the highest incidence of *Thrips parvispinus* was recorded on crop families viz., Solanaceae, Fabaceae, Cucurbitaceae, Asteraceae,

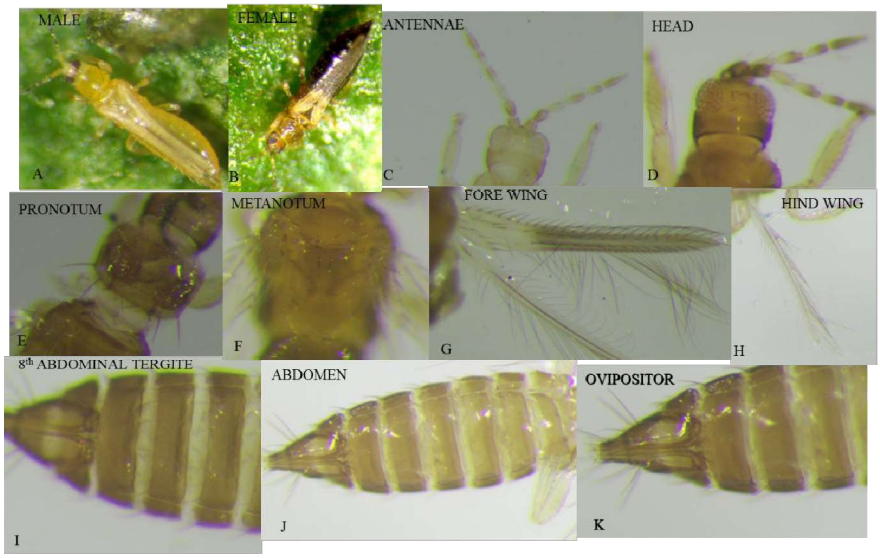

Fig. 1. Identification characters for *Thrips privispinus* Karny

Table 1. Incidence of *Thrips parvispinus* Karny on different host plants

Common name	Scientific name	Order	Family	Incidence and Intensity (Population/ flower)
Vegetable crops				
Beans	*Phaseolous vulgaris*	Fabales	Fabaceae	9.4
Bittergourd	*Momordica charantia*	Cucurbitales	Cucurbitaceae	9.2
Brinjal	*Solanum melongena*	Solanales	Solanaceae	3.6
Coccinia	*Coccinia grandis*	Cucurbitales	Cucurbitaceae	5.4
Cucumber	*Cucumis sativus*	Cucurbitales	Cucurbitaceae	4.2
Gerkhins	*Cucumis anguria*	Cucurbitales	Cucurbitaceae	6.9
Moringa	*Moringa oleifera*	Brassicales	Moringaceae	7.4
Tomato	*Solanum lycopersicum*	Solanales	Solanaceae	7.1
Sorrel/Roselle	*Hibiscus sabdariffa*	Molvales	Malvaceae	5.0
Spice crops				
Ajwain	*Trachyspermum ammi*	Apiales	Apiaceae	5.3
Coriander	*Coriandrum sativum*	Apiales	Apiaceae	5.1
Flower crops				
Marigold	*Tagetes erecta*	Asterales	Asteraceae	8.7
Fruit crops				
Citrus	*Citrussp.*	Sapindales	Rutaceae	3.5
Mango	*Mangifera indica*	Sapindales	Anacardiaceae	8.3
Field crops				
Black gram	*Vigna mungo*	Fabales	Fabaceae	8.2
Green gram	*Vigna radiate*	Fabales	Fabaceae	4.5
Red gram	*Cajanus cajan*	Fabales	Fabaceae	4.7
Sunflower	*Helianthus annus.*	Asterales	Asteraceae	2.8
Tobacco	*Nicotiana tabacum*	Solanales	Solanaceae	5.6
Cotton	*Gossypium hirsutum*	Malvales	Malvaceae	5.2
Weeds				
Goat weed	*Ageratum conyzoides*	Asterales	Asteraceae	2.1
Jews mallow	*Corchorus olitorius*	Malvales	Malvaceae	1.9
Slender amaranth	*Amaranthus viridis*	Caryophyllales	Amaranthaceae	1.8
Hog weed	*Boerhavia diffusa*	Caryophyllales	Nyctaginaceae	2.0
Asian spider flower	*Cleome viscose*	Brassicales	Cleomaceae	2.7
Tooth leaved croton	*Croton bonplandianum*	Malpighiales	Euphorbiaceae	2.4
Native gooseberry	*Physalis minima*	Solanales	Solanaceae	3.7
Black pig weed	*Trianthema sp.*	Caryophyllales	Aizoaceae	1.1
Carrot grass	*Parthenium hysterophorus*	Asterales	Asteraceae	2.6
Tridax	*Tridax procumbens*	Asterales	Asteraceae	4.8
Shrub verbena	*Lantana camera*	Lamiales	Verbenaceae	8.3
Chaff flower	*Achyranthes aspera*	Caryophyllales	Amaranthaceae	3.2
Touch- me- not	*Mimosa pudica*	Fabales	Fabaceae	3.6
Black night shade	*Solanum nigrum*	Solanales	Solanaceae	5.1
Brazilian spinach	*Alternanthra sessilis*	Caryophyllales	Amaranthaceae	2.5
Indian acalypha	*Acalypha indica*	Malpighiales	Euphorbiaceae	2.9

Apiaceae, Euphorbiaceae, Amaranthaceae followed by Malvaceae, Anacardiaceae, Moringaceae, Rutaceae, Aizoaceae, Verbanaceae, Cleomaceae, and Nyctaginaceae. Among the vegetable crops, highest population per flower was recorded in beans (9.4), bittergourd (9.2), moringa (7.4), tomato (7.1) followed by cucurbits and lowest in brinjal (3.6). In spice crops population per umble was recorded in ajowain (5.3) and coriander (5.1). In fruits crops *T. parvispinus* was recorded from mango (8.3) and citrus (3.5). In flower crops it was observed in marigold (8.7). In field crops *T. parvispinus* incidence was recorded from redgram (4.7), green gram (4.5), black gram (8.2), sunflower (2.8) and tobacco (5.6). On weeds, higher number of *T. parvispinus* was recorded on *Lantana camera* (8.3) followed by *Solanum nigrum* (5.1), *Tridax procumbens* (4.8), *Physalis minima* (3.7), *Mimosa pudica* (3.6), *Acalypha indica* (2.9), *Cleome viscose* (2.7), *Parthenium hysterophorus* (2.6), *Alternanthra sessilis* (2.5), *Croton bonplandianum* (2.4), *Ageratum conyzoides* (2.1), *Boerhavia diffusa* (2.0), *Corchorus* (1.9), *Amaranthus viridis* (1.8) and lowest in *Trianthema sp* (1.1). *Thrips parvispinus* was also reported to feed on papaya, peppers, potatoes, eggplants, beans, shallots and strawberries. The damage is inflicted by direct feeding of larvae and adults on leaves and growing buds. In papaya, *Cladosporium* a saprophytic fungus is known to cause a secondary infection on tissue damaged by the thrips (Lim 1989).

Thrips parvispinus has been reported as a serious pest across several Asian countries. In Thailand, it was recorded as a pest of vegetable crops (Bansiddhi and Poonchaisri 1991). Sastrosiswojo (1991) identified it as a major pest on vegetable plants in Indonesia, while Talekar (1991) highlighted its destructive nature on chilli in the same region. Vos (1994) also reported *T. parvispinus* as a significant pest of chilli cultivation in Java. In India, the species was first documented on papaya plantations (Tyagi et al., 2015), followed by reports on ornamental plants such as *Dahlia rosea* Cav. (Rachana et al., 2018) and *Brugmansia* spp. (Roselin et al., 2021), as well as in chilli fields (Sireesha et al., 2021). Present observations across various crops further indicate that *T. parvispinus* is widely distributed and occurs on all flowering plants, including weeds (Table 1).

Pest behavior and life cycle: Adults are mainly pollen feeders and are found in shaded areas of the plant, mainly the underside of leaves and inside flowers. During the initial years of pest infestation, in chilli ecosystem, when the pest was in establishment stage, multiplication of the pest was rampant, and female to male sex ratio was very high (1:20). This indicates pest was multiplied through Thylytoky. Gradually, this difference decreased, and about four years later, the population stabilized with a sex ratio of approximately 1:1, Since then, the pest has become a regular problem in chilli crop. Population of the pest was not observed during summer months.

Male and female insects differ in size and colour. Females are 1 mm long with brown head and prothorax, yellowish brown meso and metathorax and black abdomen, forewings are dark, with light coloured base. Males are 0.6 mm long and evenly yellow. Larvae are bigger in size having different instars and uniform yellow in colour.

Observations on different life stages revealed that the female adult lays eggs beneath the leaf epidermis. The egg-laying sites can be seen as minute eruptions on underside of leaf and are irregular. Total lifecycle has four stages viz., egg, first instar larva, second instar larva, pre pupa and pupa with duration of three to four weeks. Egg period ranges from 5.00 to 6.00 days (5.26±0.60). The eggs are oval, shiny white, with a pair of visible red eyes. First instar larva is shiny white with red eyes and is actively moving and feed on leaf by scraping near midrib and this stage lasts for 2-3 days (2.63±0.52). Early second instar larva is pale yellow gradually turn into dark yellow with increased size and actively moving and feeding on chlorophyll and making the leaf papery. This stage lasts for 3-4 days (3.08±0.51). pupal stage lasts for 4-6 days. Pupa is uniformly yellow, before pupation it searches for the remote place to undergo pupation. It has pre-pupa and pupa, wing buds appear in pre-pupal stage itself. Adults live up to 7-8 days. Total life cycle completed in 21-27 days under normal laboratory conditions.

Nature of damage: On leaves, the infestation begins with deep punctures and scratches on the underside caused by the insects sucking sap (Fig. 2A). Scraping of chlorophyll on the lower surface and continued sap extraction lead to corresponding yellowish patches on the upper surface of the leaf (Fig. 2B). As damage progresses, the underside of the leaf turns reddish brown (Fig. 2C). Distortion of the leaf lamina, along with necrotic areas and yellow streaking, is commonly observed (Fig. 2D). Under severe infestation, especially on newly emerging leaves, the foliage becomes dried or blighted (Fig. 2E), with areas adjacent to veins being particularly preferred.

On flowers, scraping of petal tissues using their mouthparts results in brownish streaks on the petals (Fig. 2F). Thrips also feed on pollen, which can adversely affect pollination. Affected flowers often dry up and wither (Fig. 2G), ultimately reducing fruit set. On fruits, the pest causes brownish streaks on the fruit surface (Fig. 2H), and the fruits become hard and discoloured (Fig. 2I). The pedicel may turn brown, and the overall fruit size is noticeably reduced.

Economic impact: Andhra Pradesh being the largest producer of Chilli contributes 38 per cent to the total

Fig. 2. Nature of damage and symptoms of damage due to *T. parvispinus* on Chilli

production in India. In Andhra Pradesh Guntur alone contributes 15 per cent to total production in Inada. During 2021-22 cropping season, the area under chilli increased from 70,000 ha to 1,06,656 ha due to constant market price for dry chilli and conversion of cotton area to chilli due to incidence of pink boll worm. With rapid spreading ability, thrips species affected chilli crop in approximately 9 lakh acres in Telangana and Andhra Pradesh. As per the survey conducted by Dr. Y.S.R. Horticultural University, Andhra Pradesh, yield loss in Guntur district during 2021-22 (total area surveyed: 106656 ha) is estimated up to 85 to 100% in severely affected areas (60% of the total cropped area), 75 to 85% in moderately affected (18% of the total cropped area), below 50% in less affected (10% of the total cropped area) and 12% of total cropped area is uprooted because of the severe incidence of thrips.

Management: During the initial years of *T. parvispinus* infestation in chilli, farmers misidentified the pest as red spider mite and relied heavily on miticides such as wettable sulphur and abamectin. Excessive use of sulphur during flowering led to severe flower drop. With the intervention of the Horticulture University and the Department of Horticulture, Andhra Pradesh, farmers were trained to correctly identify the pest and to use only recommended pesticides safely. Subsequently, the efficacy of 16 insecticides, along with one biostimulant, water, and kaolin clay, was evaluated against *T. parvispinus*. Among these, Fipronil 80% WG @ 0.2 g/L proved highly effective and performed on par with Fipronil 4% + Acetamiprid 4% SC, Spirotetramat 11.01% + Imidacloprid 11.01% SC, Acetamiprid 20% SP, Diafenthiuron 47% + Bifenthrin 9.4%, Emamectin benzoate 5% SG, and Fipronil 5% SC + Diafenthiuron 50% WP. With the introduction of Isoxazoline-group insecticides viz Broflanilide, Fluxametamide, and Isocycloserum, further trials conducted at the Horticultural Research Station, Lam, confirmed their effectiveness against the pest. Additionally, various botanicals and entomopathogens were evaluated for their bioefficacy. Based on the pest's biology and the performance of chemical and biological options, an Integrated Pest Management (IPM) module was subsequently developed for sustainable management of *T. parvispinus*.

Cultural Methods

- As Gemini virus is the major problem in chilli growing areas use of Resistant varieties against Gemini virus will provide good scope for better management of Thrips parvispinus.
- Application of recommended and balanced use of fertilizers. Recommended fertilizer dose is 120:24:48 NPK/acre. Nitrogen and potash fertilizers need to be applied in five splits during crop growth. Application of Organic fertilizers like FYM@10 tones/ acre, Neemcake @200kg/acre Vermicompost @ 2tonnes/acre Azospirillum and phosphate solubilizing bacteria each @2kg/acre, in order to maintain proper nutrition to the plants.
- Application of neem cake @ 200 kg /acre even on the standing crop helps to break down the life cycle of the pest as it undergoes pupation in soil.
- Application of Vermicompost or well decomposed farmyard manure enriched with the *Metarhizium anisopliae* will have effect on pupae in soil.

- Avoid close spacing (Follow recommended spacing of 75x30 cm).
- Use of 25-30-micron silver mulch helps to disturb the pupation and adults are also get deterred due to reflective light.
- Use of mixed crops, Intercrops, trap crops will help in decreasing the pest load on chilli and encourage the natural enemy population.

Mechanical Methods

- Installation of Blue or white sticky traps near to plant height @ 30 per acre on community basis to reduce the adult population and also for monitoring

Biological Methods

- Encourage development and multiplication of parasitoids and predators through planting boarder crop with maize or Jowar
- Inundative release of predators like lace wing bugs and lady bird beetles as they feed on aphid larvae and adults
- Application of azadirachtin 10,000ppm @1ml/L before flowering either as single application or in combination with recommended chemicals after thorough mixing in order manage the resistance development.

Chemical Control

- Need based application of effective insecticides belong to different categories viz., isoxazolines, phenylpyrazoles, tetramic acid derivatives and spinosyns analog with biologicals/botanicals.
- Effective management of the pest is possible through alternation of the effective molecules with different groups and it is evident with the various experiments conducted at Horticultural Research Station, Iam, Guntur.

CONCLUSIONS

Thrips parvispinus (Karny), an invasive species, was first detected in the chilli ecosystem of Andhra Pradesh in 2021 and rapidly spread across regions and cropping systems. A severe outbreak during the 2021–22 season caused extensive damage, significant yield losses, export rejections, and heavy economic distress among farmers. Its wide host range, adaptability, and aggressive reproductive capacity have enabled it to thrive on multiple crops and even displace the previously dominant *Scirtothrips dorsalis* in chilli. The findings underscore the need for a comprehensive Integrated Pest Management (IPM) strategy for sustainable long-term management of this emerging pest.

AUTHOR'S CONTRIBUTION

K. Sireesha designed the experiments, conducted surveys, recorded pest observations, carried out experiments, collected and analyzed data, and contributed to writing and editing the manuscript. Y. Lalitha Priya performed the taxonomic identification, documented photographs, assisted in conducting experiments, and contributed to data collection.

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