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Thrips parvispinus (Karny): Pest of concern to Indian farmers in Chilli – A Review

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ABSTRACT: Thrips are the most prevalent species of sucking pests that attack a range of horticulture crops and spread dangerous plant viruses. As a result of changing crop production patterns, increased pesticide use, and climate change, there are reports of a thrips outbreak in a number of locations. The global range of *Thrips parvispinus* (Karny) (Thysanoptera: Thripidae) has dramatically expanded over the past two decades. In addition to India, it is now known to occur in France, Greece, Hawaii, Mauritius, Reunion, Spain, Tanzania, and the Netherlands. Initial record of *T. parvispinus* was reported on papaya in Bengaluru in 2015. After that many southern states (Andhra Pradesh, Karnataka, and Telangana) have been reported an infestation of *T. parvispinus* particularly on chilli crops, inflicting 50–80% damage. Being a polyphagous species, infestations of beans, eggplant, papaya, chillies, peppers, potatoes, shallots, *Ficus*, *Anthurium*, *Chrysanthemum*, *Dahlia*, *Dipladenia*, and *Gardenia* and strawberries have been documented. *T. parvispinus* undergoes five phases of development and completes their life cycle in 13–15 days. Larvae suck sap from the underside of leaves, whilst adults primarily colonise on flowers and the underside of leaves. The production of fruits is decreased by infestation, which results in high flower drop. Several IPM approaches like timely planting, mulching, balanced use of nitrogenous fertilizers, installation of blue sticky traps, spraying of biopesticides and microbial pesticides and some insecticides like Spirotetramat @ 160g/acre, tolfenpyrad 15 EC @ 1 ml/L of water, spinetoram 11.7 SC @1 ml/L and many more recommended by CIB&RC. The review presents the status of *T. parvispinus* at national and global level, including its identification, taxonomic status, distribution and host range, biology and lifecycle, nature of damage, feeding behaviour and various management strategies, in the context of the seriousness of the damage caused by the invasive pest in India in the recent past. This review also discusses the importance of exploring various IPM techniques for the control of this invasive thrips.

Keywords: Thrips, *T. parvispinus*, chilli, polyphagous, pest status, life cycle, integrated pest management.

INTRODUCTION

Chilli is known as a significant commercial spice and vegetable crop, as well as a widely used global spice known as "wonder spice." It is grown almost everywhere in the country, during the *Kharif* and *Rabi* seasons. Chilli cultivation is hindered by many constraints like abiotic and biotic stresses. Chilli crop yield potential and total production are poor due to low producing varieties and a high occurrence of insect-pests and disease, particularly thrips. Previously, just one significant species of thrips, *Scirtothrips dorsalis* (Hood), was detected infesting chilli and inflicting economic loss, but this year another invasive thrips, *Thrips parvispinus* (Karny), was observed causing serious harm to chilli flowers and fruits. Thrips are tiny insects that range in size from 1 to 4 mm. Thrips are among the most important agricultural pests in the world due to the damage they do through oviposition, feeding, and the potential to transfer plant viruses. Thrips are members of the order Thysanoptera, which currently has about 5500 recognised species. Tubulifera and Terebrantia are the two suborders of the order. Approximately 60% of the species belong to the Tubulifera suborder, which is confined to a single family, the Phlaeothripidae. 44 species of thrips have been reported from India (Rachana and Varatharajan 2017). Several species in this genus are significant pests, causing damage directly by feeding and egg laying or indirectly through vectoring several pathogenic tospoviruses on economically important crops. They use their well-developed left mandible to pierce and suck sap from various parts of the plant. The eggs are oviposited into plant tissues by gravid females using a saw-like ovipositor (Ananthakrishnan, 1984). *Thrips parvispinus* (Karny), a pest species of South East Asia, is a significant pest on a variety of agricultural and horticulture crops of major plant natural orders (Rachana and Varatharajan 2017). *T. parvispinus*, a member of the "*Thrips orientalis* group" (Mound, 2005), is a common pest with quarantine implications that has been identified from Thailand to Australia and Europe (Mound and Collins 2000). It is also known as western thrips or tobacco thrips. It is a globally distributed invasive pest species that requires quarantine. The insect pests are challenging to manage due to their small size and difficult to identify behaviour. As a result, an attempt is made to evaluate information about the invasive thrips *T. parvispinus* at the national and global levels, including its host range and distribution, identification, life cycle, extent of damage, and management techniques.

DISTRIBUTION AND HOST RANGE

T. parvispinus' s geographic range has expanded dramatically over the last two decades, and it is now known to occur in Greece (Mound and Collins 2000), Mauritius (Mound, 2010), Tanzania and Uganda (Moritz *et al.*, 2013), Spain (Lacasa *et al.*, 2019) and the Netherlands (Anonymous, 2019), in addition to India. Tyagi *et al*., (2015) were the first to report the presence of this species in India on papaya *(Carica papaya*) from Bangalore and Karnataka (Rachana *et al.*, 2018). Several other host plants are *Brugmansia* sp., *Tagetes* sp., *Citrullus lanatus* (Thunb.) *Momordica charantia* L. *Chrysanthemum* sp., *Gossypium* sp., *Mangifera indica* L., *Tamarindus indica* L., *Dahlia rosea*, and *Capsicum annum* (Rachana *et al.*, 2022). This pest was initially discovered infesting the key chilli-growing regions of Gujarat (mainly Anand, Vadodra, Kheda, Chhotaudepur, Panchmahal, and Mahisagar districts) (Patel *et al.*, 2022).

It is a polyphagous species that has been recorded to infest beans, eggplant, papaya, pepper, potato, shallot and strawberry. In Indonesia, *T. parvispinus* infestations were most prevalent on chilli, melon, cucumber, brinjal, and squash (Johari *et al.*, 2014). Furthermore, it was discovered on ornamentals in greenhouses in Europe, including umbrella trees, gerberas, gardenias, and citrus (Lacasa *et al.*, 2019). According to a joint survey report by the Directorate of Plant Protection, Quarantine, and Storage, as well as the State Agriculture Universities and Agriculture Departments of Telangana and Andhra Pradesh, more than 0.4 million ha of chilli crop were infested with this invasive threat, with yield losses ranging from 10 per cent to 30 per cent. A greater incidence of infestation (10 to 20 thrips/flower) was seen in the Andhra Pradesh districts of Warangal, Khammam, and Guntur (Janyala, 2021 and DPPQS, 2021).

IDENTIFICATION OF THRIPS PARVISPINUS

The adults of female *T. parvispinus* have dark brown body, head and thorax are lighter than abdomen. In comparison to female thrips, male adults are light brown in colour and smaller in size. Through, scanning electron microscopy, it was discovered that thrips have been seven segmented antennae and forked sensory organs on their III and IV segments. Three pairs of ocellar setae are present on the head, the third pair is relatively small and outside the ocellar triangle. On the pronotum, there are three pairs of posterior border setae and two pairs of lengthy posteroangular setae. The metanotum is reticulate and devoid of campaniform sensilla; lengthy median setae are found behind the anterior edge (Hulagappa *et al.,* 2022). In contrast, tergite VIII has a microtrichia comb. Ctenidia are present in the V–VIII tergite at the lateral portion, and in the tergite VIII, they are situated behind the spiracles. The length of the wing exceeds the length of the abdomen. At the first and second wing's vein fronts, there was a full line of setae. It is black or darkened with a pale base (Johari *et al.,* 2014).

BIOLOGY AND LIFE CYCLE

Under greenhouse conditions, *Thrips parvispinus* completes its life cycle on chilli pepper in 13–14 days. Temperature has an impact on the life cycle from egg to adult. The entire cycle lasts roughly 15 days (Lewis, 1973). Males and females of *T. parvispinus* underwent an average preadult phase developmental time of 12.97 and 12.57 days, respectively. The metamorphic transition between paurometabola and holometabola in *T. parvispinus* has also been noted (Borror *et al.,* 2005). *T. parvispinus* has five immature stages. Egg stage, two-instar nymph, prepupal and pupal all had durations of 4.79, 1.36, 3.54, 1.08 and 1.96 days, respectively. Pre-oviposition lasts for 1.11 days, and the life cycle finishes in 13.68 days. Male longevity was six days, female longevity was 8.55 days, and each female produced 33 eggs on average. The population growth of *T. parvispinus* followed a type III survivorship curve with an intrinsic rate of increase of 0.15 individuals per day per female (Hutasoit *et al.,* 2017).

The eggs of female thrips are laid on the leaves, and the larvae emerge after four to five days. The larvae go through two moults in four to five days while feeding leaves and flowers. Larvae then develop into pupae, and after two to three days the adult appears. We currently don't know what proportion of the population pupates in the soil, but we believe that some of the population does. The prominent little dark spherical dots on the blooms are the result of egg deposition in the bract leaves. On the light-coloured variety, these are more noticeable. This part of their biology is still being studied. Sexual reproduction has been noted for this thrips. A female lives for nine days and lays roughly 15 eggs. Male adults have an average lifespan of six days (Ahmed *et al.,* 2023).

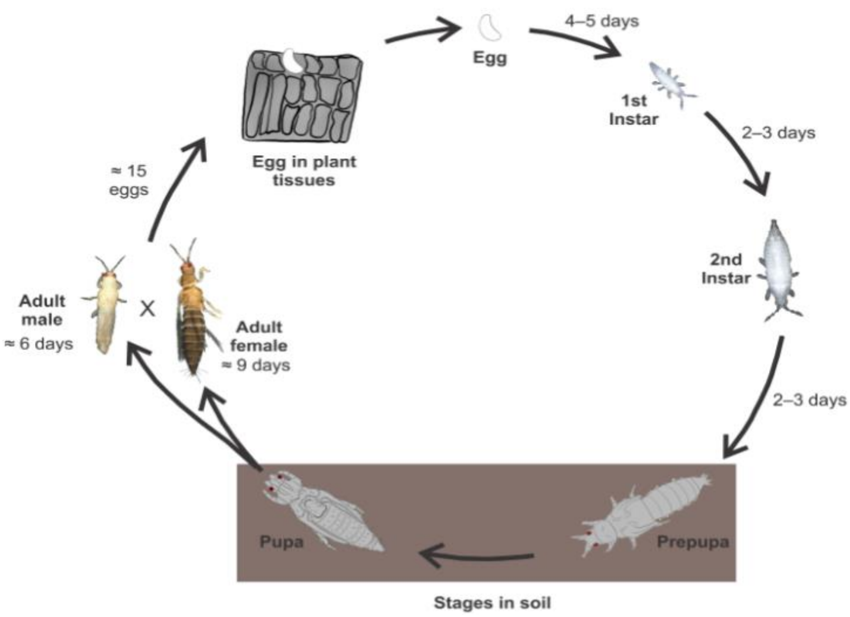

Fig 1. Life cycle of *Thrips parvispinus* (Ahmed *et al.*, 2023).

FEEDING BEHAVIOUR AND NATURE OF DAMAGE

Thrips parvispinus larvae are confined to the underside of leaves, whereas adults prefer to colonise flowers and the undersides of leaves. By rasping and sucking the plant sap, both adults and larvae harm plants. Heavy infestation lowers fruit set and development, stunts plant growth, causes flower drop, and eventually reduces production. Due to the North East Monsoon's significant rainfall in 2021, *T. parvispinus* infestations in chilli crops were much worse than those caused by other thrips species in the country's southern regions. Evidently, observable plant damage in the form of feeding scars on petals, leaves, or fruit provides information on the diet of thrips. In contrast to what is indicated by visible damage, thrips species may have wider and more varied diets. Many species have been shown to consume pollen (Kirk, 1984), and some species that are thought to be phytophagous are actually facultatively predatory (Kirk, 1997). The inclusion of pollen in the diet can stimulate oviposition, reduce larval development time, and increase female fecundity (Zhi *et al.*, 2005; Riley *et al.*, 2007).

Deep scratches and punctures on the underside of the leaves are signs of thrips damage. The underside of the leaf that has been infected turns reddish brown, whereas the upper side of such a leaf appears yellowish. Common signs include distorted leaf lamina with necrotic regions and yellow streaks. Furthermore, distorted leaf lamina with necrotic patches and yellow streaks was observed. Newly developing leaves that are severely infested become dried out or blighted (Sridhar *et al.*, 2021). These thrips mainly infest the flowers which are white in colour and fragrant (Mound and Collins, 2000). Due to thrips scraping on petals, petals on floral sections develop brownish streaks. Damage causes flowers to dry out and wilt, which reduces fruit production. The plant's growth is hampered by a severe infestation because thrips feed on its growing parts, and fields with a severe infestation also show bloom drop. In the nectariferous region of chilli flowers, a number of adults, including both males and females, were observed hiding and feeding. According to Hutasoit *et al.* (2017), the *T. parvispinus* is the most prevalent species discovered on the flowers (71%) and leaves (56%) of chilli pepper and cayenne pepper plants. This pest's infection of fruit caused inappropriate and deformed fruit setting, fruits growing on button-shaped shapes (as in the case of bell peppers), and fruit surfaces to seem rough and scratchy. According to Maharijaya *et al.* (2011), the fruits developed an aberrant form.

THE OUTBREAK AND ECONOMIC IMPORTANCE

The Andhra Pradesh, Telangana, and Karnataka states saw an outbreak of this species in 2021, which left extremely infested areas with 70–100 per cent damage. Thrips on chilli blooms were first observed in January 2021 in the Chilakaluripeta and Pratipadu mandals of the Guntur district of the Andhra Pradesh state; thereafter, its spread was observed in all chilli growing areas in the state (Sireesha *et al.*, 2021). Its severe infestation was also reported from eastern parts (Varanasi and Mirzapur districts) of Uttar Pradesh (Sethy *et al.*, 2022).

The widespread spread of *T. parvispinus* reached lag phase and led to its population rising alarmingly in a span of four years. This has affected the specie's capacity to adapt to a variety of plant hosts as well as their propensity to widen their geographic range within the nation (Rachana *et al.*, 2022). There is a significant production loss in India as a result of the widespread flower shedding, deformity, and falling of chilli fruits. The chilli farmers in Andhra Pradesh predicted a loss of Rs. 1 lakh per acre (Anonymous, 2021b). According to Johari *et al.*, (2014), *T. parvispinus* causes a 23–60 per cent reduction in chilli yield in field settings in Indonesia. According to Varatharajan *et al.* (2016), *T. parvispinus* is a crucial pollinator for a variety of tropical and subtropical crops.

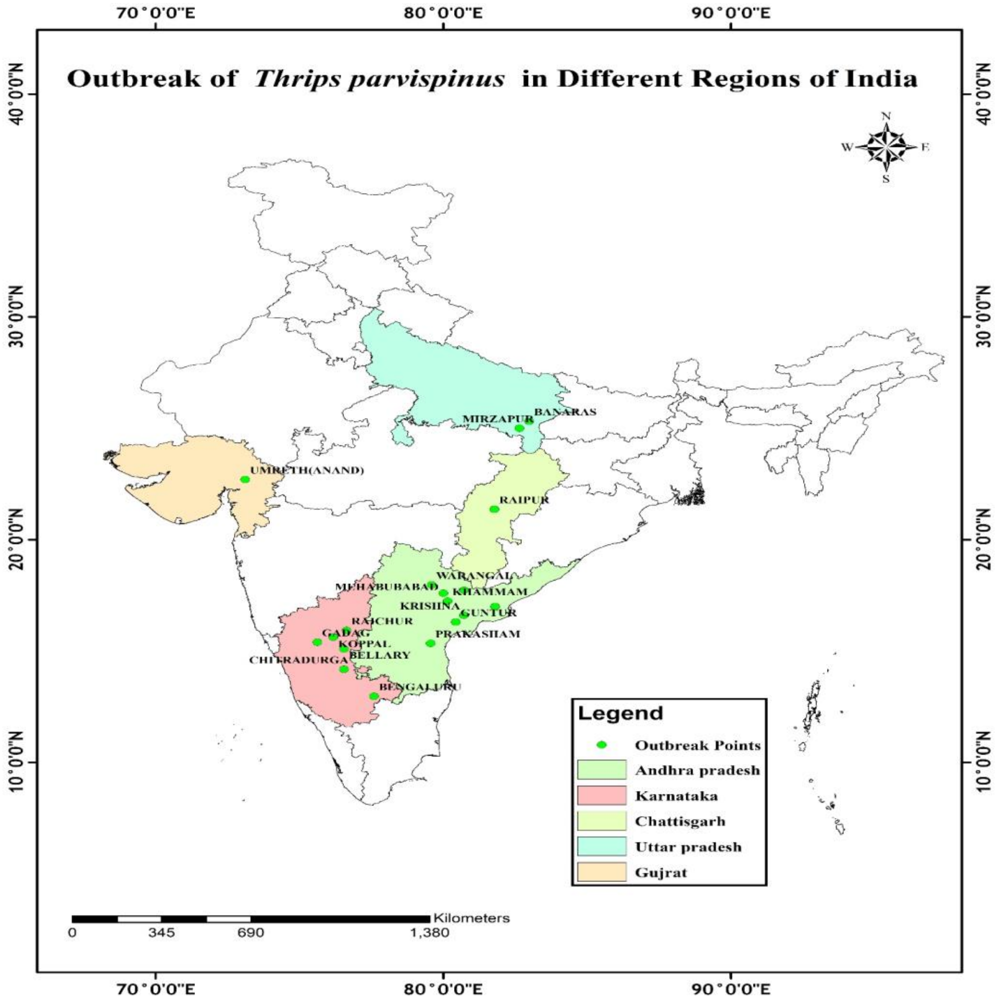

Fig. 2. Map showing the outbreak record of *Thrips parvispinus* in India. Green colour dots indicate the particular location reported.

MANAGEMENT

There is very little information known about *T. parvispinus* management globally. This article presents the information that is currently available based on field studies that have been done and some of the impromptu recommendations given where the incidence is in severe proportions.

Cultural practices:

- Under three different screening methods- green house, leaf disc, and detached leaf tests- the *Capsicum annuum* AC 1979, *C. annuum* bisbas, *C. annuum* CM 331, *C. baccatum* no. 1553, *C. annuum* keystone resistant giant, and *C. baccatum* aji blanco christal were discovered to be resistant against *T. parvispinus* (Maharijaya *et al.,* 2011).
- The mayang ratih genotype of chrysanthemum was discovered to have a parent that was resistant to *T. parvispinus*, and it can be utilised in future resistance breeding programmes (Musalamah *et al.,* 2021).
- It is important to follow recommended fertiliser usage guidelines and avoid using nitrogenous fertilisers excessively (Sireesha *et al.,* 2021).

Physical practices:

- *Frankliniella occidentalis* (Pergande), *Frankliniella intonsa* (Trybom), *Thrips tabaci* Lindeman, *Thrips palmi* Karny, and *Thrips parvispinus* Karny all experience 100 per cent mortality when exposed to 60 per cent CO_2 atmospheres at 30°C (Seki and Murai 2012).

Mechanical practices:

- According to Murai *et al.* (2009), *T. parvispinus* was more attracted to white colour traps than blue or yellow ones. While, Sireesha *et al.* (2021) observed that the blue and yellow sticky traps are luring more *T. parvispinus* adults.
- For mass trapping right after transplanting, there should be placement of blue sticky traps 25-35 per acre (Anonymous, 2021a).

Biological control:

- This pest could be controlled by spraying *Bacillus albus*-NBAIRBATP or *Pseudomonas fluorescens*-NBAIRPFDWD @ 20 g/L on the flowers and fruits of chillies (Anonymous, 2021a).
- In 2003 and 2005, research on thrip's natural enemies and a control threshold to enable

integrated pest management (IPM) of thrips on sweet pepper in protected cultivation in tropical settings in Indonesia was carried out. Potential natural enemies included the ladybird beetle species *Menochilus sexmaculatus* and *Coccinella transversalis*, as well as the entomophagous fungus *Lecanicillium lecanii*. Among them *Menochilus sexmaculatus* and fungus *Lecanicillium lecanii* were found effective for the management of *T. parvispinus* (Prabaningrum *et al.*, 2008).

- *Azadirachtin* 10000 ppm, 0.003%, 3 ml/L and *Pseudomonas fluorescens* 1% WP, 2 108 cfu/g, 4 g/L were shown to be effective in controlling the new invasive thrips, *T. parvispinus*, which infested chilli (Anonymous, 2022).

Botanical control:

- The Indonesian mahogany, *Toona sureni*, 3.0% and fish poison bean, *Tephrosia vogelii*, 2.5 and 3.0%, and eucalyptus oil, 2.0% all recorded more than 30.0% efficacy during the vegetative stage and the lowest attack of *T. parvispinus* until 75 DAP, and they all provided the highest marketable flower yields of chrysanthemum (Rahardjo *et al.*, 2021).
- Neem cake should be applied at a rate of 200 kg per acre to standing crops as well. Use of soap solution, neem oil, or pongamia oil in strongly infested areas (Sridhar *et al.*, 2021).

Legal control:

- It has been noted that mature leaves and fruits contain less thrips. Therefore, it is unlikely that thrips will be found on completely ripe green chilli fruits. However, during routine phytosanitary inspections of the export cargoes, the petiole region of the chilli must be carefully scrutinised. Fully mature and partially withered pods are picked for red chilli export. Sun drying reduces the moisture content of harvested pods to 10 per cent. If there are any associated insect pests, they are entirely eliminated throughout the harvesting and sun drying processes. As a result, neither *T. parvispinus* nor any other species of thrips are a barrier to red chilli export. Pesticide residues should be monitored by observing the waiting period. (DPPQ&S, 2022).

Chemical management:

- To reduce pest resistance, Sugano *et al.*, (2013) recommended spraying papaya with a variety of pesticides with various modes of action. *T. parvispinus* lives and feeds on the papaya plant's flowers and growing shoots, hence these areas should be sprayed. Young papaya leaves and fruit typically have waxy surfaces and can be challenging to wet, thus a surfactant like Latron B-1956 should be used to enhance spreading and wetting of the leaves and thereby provide greater control.
- *T. parvispinus* was fully destroyed after being exposed to a liquid form of phosphine at a concentration of 200 ppm for 1 hour (Setyawan *et al.*, 2015).
- Fipronil 80WG @ 40g/acre, Fipronil 40% + imidacloprid @ 40g/acre, Cyantraniliprole @ 240ml/acre, Acetamiprid @ 40g/acre, and Spirotetramat @ 160g/acre are among the insecticides that are being rotated as ad hoc recommendations for the management of *T. parvispinus* outbreaks (Sireesha *et al.*, 2021).
- Plants sprayed with tolfenpyrad 15 EC @ 1 ml/L water, and spinetoram 11.7 SC @ 1 ml/L water both recorded lower thrip counts in chillies (2.39 and 2.67 thrips/flower, respectively) (Anonymous, 2022a).

Integrated pest management (IPM) approaches for thrips in chilli crop (Anonymous, 2022(b)):

- Clean cultivation means keeping crop field's borders and bunds weed-free because many weeds serve as thrip's alternate hosts. Summer ploughing is necessary for resting stage (pupae).
- Apply well-decomposed farm yard manure (FYM) or compost at a rate of 1 t/acre, ameliorated with *Metarhizium anisopliae* or *Pseudomonas fluorescens* at a rate of 2 kg/t, in addition to the recommended rates of farm yard manure (10 to 12 t/acre).
- Avoid staggered planting and begin cropping season early. If possible, use resistant or early/short-duration types to avoid the thrip's peak incidence.
- To develop resistance against thrips, apply 500 kg of vermicompost and 200 kg of neem cake per acre to the soil.
- Using silver-colored polythene sheets with a thickness of 25–30 micron as a mulch will restrict thrip's ability to pupate in the soil.
- Chilli is intercropped with maize/sorghum, and cowpea in a ratio of 10:3:1 as a barrier and reservoir for the growth of natural enemies, resulting in the biological control of thrips.
- Mechanically destroying plants that are heavily infected by uprooting and burying or burning them.
- Setting up blue sticky traps at a density of 25–30 traps per acre at crop canopy level for the purposes of mass monitoring and trapping.
- By using as little chemical pesticide spraying as possible, natural enemies can be preserved. Instead, evenly cover the entire plant with botanical pesticides such as NSKE 5 per cent or Neem oil 3 per cent @ 2ml/L, *Pongamia* oil @ 3 ml/L or microbial pesticides like *Beauveria bassiana* @ 4.00 g or ml/L (spore load - 1x108 cfu/g or ml), *Pseudomonas fluorescence* - NBAIRPFDWD @ 20 g/L, or *Bacillus albus* - NBAIR-BATP @ 20 g/L.

Table 1: CIB & RC approved registered Insecticides for thrips in chilli (Anonymous, 2022b).

Insecticides	Dosage per ha in required water	Waiting period (in days)
Acephate 95 % SG	790 g in 500 L	07
Acetamiprid 20 %	50-100 g in 500-600 L	03
Carbofuran 03 % CG	33.30 kg	--
Cyantraniliprole 10.26%	600 g in 500 L	03
Dimethoate 30 % EC	600 ml in 500-1000 L	--
Emamectin benzoate 05% SG	200 g in 500 L	03
Emamectinbenzoate1.90%EC	375 ml in 500 L	14
Ethion 50 % EC	1.50-2.00 L in 500-1000 L	05
Fenpropathrin 30 % EC	250-340 ml in 750-1000 L	07
Fipronil 05 % SC	800-1000 g in 500 L	07
Fipronil 80 % WG	50.00 -62.50 g in 500 L	05
Imidacloprid 70 % WS	1.00 -1.50 kg	--
Imidacloprid30.50%m/m SC	125-150 g in 500 L	05
Imidacloprid 17.80 % SL	125-250 ml in 500-700 L	40
Lambdacyhalothrin 4.90%CS	500ml in 500 L	05
Lambda-cyhalothrin05% EC	300 ml in 400-600 L	05
Methomyl 40 % SP	0.75-1.12 kg in 500-1000 L	5-6
Oxydemeton-methyl25% EC	1 L in 500-1000 L	--
Spinosad 45 % SC	160 g in 500 L	
Thiacloprid 21.70% SC	225-300 g in 500 L	05
Thiamethoxam 30 % FS	Used as seed dresser	
0Tolfenpyrad 15 % EC	1 L in 500 L	07
Diafenthiuron 47 % + Bifenthrin 09.40 % w/w SC	625 ml in 500 L	07
Emamectin Benzoate 01.50 % + Fipronil 03.50 % SC	500-750 g in 500 L	03
Emamectin benzoate5 % w/w + Lufenuron 40 % w/w WG	60 g in 500 L	03
Flubendiamide 19.92 % + Thiacloprid 19.92 % w/w SC	200-250 ml in 500 L	05
Fipronil 07 % + Hexythiazox 02 % w/w SC	1 litre in 500 L	07
Hexythiazox 3.5% + Diafenthiuron 42% WDG	650 gm in 500 L	07
Indoxacarb 14.5 % + Acetamiprid 7.7 % w/w SC	825-875 ml in 500 L	05
Profenofos 40 % + Fenpyroximate 2.5 % w/w EC	1 litre in 500 L	07

CONCLUSION AND FUTURE SCOPE

The pest, *Thrips parvispinus* is known as a global pest and it is reported across the worldwide. The presence of this invasive pest on ornamental plants meant for export poses major risks and causes quarantine authority's great concern. Systematic surveillance of *T. parvispinus* in other regions of India is also necessary since it may become a pest or vector. Thrips are better managed when a community-based strategy to pest control is used, especially when the infestation is spreading widely. In order to create insecticide resistance management techniques as part of IPM, baseline toxicological data describing the pest's susceptibility to various insecticides indicated for thrips management must be developed. Understanding the causes of the *T. parvispinus* epidemic caused by shifting climatic conditions as well as other ecological and genetic factors aids in being ready in case similar circumstances arise in the future. Overall, it is advised to use an integrated pest management strategy to control *T. parvispinus*, which includes a variety of eco-friendly tools like host plant resistance, biological control options like entomopathogens, physical and mechanical control measures, and the use of eco-friendly insecticide molecules.

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Conflict of interest. None

REFERENCES

Ahmed, M. Z., Revynthi, A. M., McKenzie, C. L. and Osborne L. S. (2023). *Thrips parvispinus* (Karny), an emerging invasive regulated pest in the United States. [https://mrec.ifas.ufl.edu/lsolab/thrips/thrips-parvispinus/]. [accessed on 28 April 2023].

Ananthakrishnan, T. N. (1984). Bioecology of thrips, *Indira Publishing House, Michigan*, USA, pp. 233.

Anonymous (2019). The Netherlands Plant Protection Organization, *Thrips parvispinus*, QS. Ent., pp. 001.

Anonymous (2021a). Pest Alert: Invasive thrips, *Thrips parvispinus* (Karny) threatening chilli cultivation in India, ICAR-NBAIR.

Anonymous (2021b). Thrips infestation threatens chilli production in 12,000 acres in Guntur district. The New Indian Express, 16 November, 2021, pp. 7.

Anonymous (2022a). Proceeding of the 18th PPSC of AGRESCO held at AAU, Anand on 4-5 March, 2022.

Anonymous (2022b). Monitoring, diagnosis and management of South East Asian Thrips, *Thrips parvispinus* in Chilli, technical booklet IPM, DPPQ&S, pp. 1-26.

Borror, D. J., Triplehorn, C. A. and Johnson, N. F. (2005). An introduction to the studies of insects. 7th ed. United States of America: Brooks/Cole.

DPPQ&S. (2021). Joint survey report on chilli flower thrips conducted in Telangana state and Directorate of Plant Protection Quarantine and Storage, Faridabad, India.

Hulagappa, T., Baradevanal, G., Surpur, S., Raghavendra, D., Doddachowdappa, S., Shashank, P. R. and Bedar, J. (2022). Diagnosis and potential invasion risk of *Thrips parvispinus* under current and future climate change scenarios. *Peer J., 10*, e13868.

Hutasoit, R. T., Triwidodo, H. and Anwar, R. (2017). Biology and demographic statistic of *Thrips parvispinus* Karny (Thysanoptera: Thripidae) in chili pepper (*Caspicum annuum* Linnaeus). *Indonesian Journal of Entomology, 14, 107-116.*

Janyala, S. (2021). Insect hits 9 lakh acres of chilli crop in South India; experts point to use of pesticide. The Indian Express, 12.

Johari, A., Herlinda, S., Pujiastuti, Y., Irsan, C. and Sartiami, D. (2014). Morphological and genetic variation of *Thrips parvispinus* (Thysanoptera: Thripidae) in chilli plantation (*Caspicum annuum* L.) in the lowland and highland of Jambi Province, Indonesia. *American Journal of BioScience*, *2*, 17–21.

Kirk, W. D. J. (1984). Pollen-feeding in thrips (Insecta: Thysanoptera). *Journal of Zoology* (London), *204*, 107-118.

Kirk, W. D. J. (1997). Feeding. In: Thrips as crop pests. [ed Lewis T]. *CAB International, Wallingford*. pp. 119-174.

Lacasa, A., Lorca, M., Martinez, M.C., Bielza, P. and Guirao, P. (2019). *Thrips parvispinus* (Karny 1922), un nuevo trips en cultivos de plantas ornamentales. *Phytoma Espana*, *311*, 62-69.

Lewis, T. (1973). Thrips: Their biology, ecology and economic importance. *Academic Press Inc., London Ltd*. pp. 349.

Maharijaya, A., Vosman, B., Steenhuis-Broers, G., Harpenas, A., Purwito, A., Visser, R. G. F. and Voorrips, R. E. (2011). Screening of pepper accessions for resistance against two thrips species (*Frankliniella occidentalis* and *Thrips parvispinus*), *Euphytica*, *177*, 401-410.

Moritz, G., Brandt, S., Triapitsyn, S. and Subramanian, S. (2013). Identification and information tools for pest thrips in East Africa. QAAFI Biological Information Technology (QBIT), The University of Queensland, Brisbane, Australia.

Mound, L. A. (2005). The Thrips orientalis group from South-east Asia and Australia: some species identities and relationships (Thysanoptera: Thripidae). *Australian Journal of Entomology*, *44*, 420-424.

Mound, L. A., & Collins, D. W. (2000). A South East Asian pest species newly recorded from Europe: *Thrips parvispinus* (Thysanoptera: Thripidae), its confused identity and potential quarantine significance. *Journal of European Entomology*, *97*, 197–200.

Mound, L. A. (2010). Species of the genus Thrips (Thysanoptera, Thripidae) from the Afro-tropical region. *Zootaxa*, *2423*, 1-24.

Musalamah, R. I. B., Lia, S. and Soehendi, R. (2021). Resistance selection of 12 genotypes of *Chrysanthemum* against *Thrips parvispinus* (Thysanoptera: Thripidae). *Jurnal Hortikultura Indonesia*, *12*(1), 1-9.

Patel, N. B., Bhagora, J. K., Raghunandan, B. L. and Patel, N. M. (2022). First report of new invasive Thrips, *Thrips parvispinus* (Karny) (Thripidae: Thysanoptera) in chilli fields of Umreth in Anand district of Gujarat state. *International Journal of Environment and Climate Change*, *12*(3), 73-78.

Prabaningrum, L., Moekasan, T. K., Udiarto, B. K., den Belder, E. and Elings, A. (2008). Integrated Pest Management on Sweet pepper in Indonesia: Biological control and control thresholds for thrips. *Acta Horticulturae* (ISHS), *767*, 201-210.

Rachana, R. R. and Varatharajan, R. (2017). Checklist of Terebrantian Thrips (Insecta: Thysanoptera) recorded from India. *Journal of Threatened Taxa*, *9*(1), 9748-9755.

Rachana, R. R., Roselin, P. and Varatharajan, R. (2018). Report of invasive thrips species, *Thrips parvispinus* (Karny) (Thripidae: Thysanoptera) on *Dahlia rosea* (Asteraceae) in Karnataka. *Pest Management in Horticultural Ecosystems*, *24*(2), 187-188.

Rachana, R. R., Roselin, P., Amutha, M., Sireesha, K. and Narasa Reddy, G. (2022). Invasive pest, *Thrips parvispinus* (Karny) (Thysanoptera: Thripidae) a looming threat to Indian agriculture. *Current Science*, *122*(2), 211-213.

Rahardjo, I. B., Yanda, R. P., Diningsih, E., Nuryani, W., Budiarto, K., Sanjaya, L. L. and Soehendi, R. (2021). Effectiveness of botanical insecticides in controlling *Thrips parvispinus* on chrysanthemum. In II International Symposium on Tropical and Subtropical Ornamentals, *1334*, pp. 171-182.

Riley, D. G., Chitturi, A. and Sparks, J. A. N. (2007). Does natural deposition of pine pollen affect the ovipositional behavior of *Frankliniella occidentalis* and *Frankliniella fusca*? *Entomologia Experimentalis et Applicata*, *124*, 133-141.

Seki, M. and Murai, T. (2012). Responses of five adult thrips species (Thysanoptera; Thripidae) to high carbon dioxide atmospheres at different temperatures. *Applied Entomology and Zoology, 47*(2), 125-128.

Sethy, S., Narayana, S., Twinkle, Arya, V. and Sunda, S. (2022). First report of invasive thrips, *Thrips parvispinus* (Karny) infestation on chilli from Eastern part of India. *Ecology, Environment & Conservation*, *29*, pp. 498-503.

Setyawan, T. T., Harahap, I. S. and Dadang. (2015). Application of liquid formulation phosphine against *Thrips parvispinus* Karny (Thysanoptera: Thripidae) on cut flowers of chrysanthemums. *Indonesian Journal of Entomology*, *13*(2), 73-80.

Sireesha, K., Prasanna, B. V. L., Vijaya Lakshmi, T. and Reddy, R.V. S. K. (2021). Outbreak of invasive thrips species *Thrips parvispinus* in chilli growing areas of Andhra Pradesh. *Insect Environment*, *24*(4), 514-519.

Sridhar, V., Chandana, S. P. and Rachana, R. R. (2021). Global status of *Thrips parvispinus* (Karny 1922), an invasive pest. *The Journal of Research, PJTSAU*, *49*(4), 1-11.

Sugano, J., Hamasaki, R., Villalobos, E., Chou, M. Y., Wright, M., Fukuda, S., Swift, S., Ferreira, S., Tsuda, D., Diaz-Lyke, M. D. C. and Nakamoto, S. T. (2013). Damage to Papaya caused by *Thrips parvispinus* (Karny). Poster, Honolulu (HI): University of Hawaii. pp. 1.

Tyagi, K., Kumar, V., Singha, D. and Chakraborty, R. (2015). Morphological and DNA barcoding evidence for invasive pest thrips, *Thrips parvispinus* (Thripidae: Thysanoptera), newly recorded from

India. *Journal of Insect Science*, *15*(1), 105.
Varatharajan, R., Maisnam, S., Chochong, Shimray, V. and Rachana, R. R. (2016). Pollination potential of Thrips (Insecta: Thysanoptera) - an overview. *Zoo's print XXXI*, *4*, 6-12.
Zhi, J., Fitch, G. K., Margolies, D. C. and Nechols, J. R. (2005). Apple pollen as a supplemental food for the western flower thrips, *Frankliniella occidentalis*: Response of individuals and populations. *Entomologia Experimentalis et Applicata*, *117*, 185-192

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