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Report on heavy infestation and damage by invasive thrips species, *Thrips parvispinus* (Karny) on chilli in Telangana state of India

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Abstract
Chilli, *Capsicum annum* L. is an important cash crop cultivated over large area in southern states of India. During *Kharif* 2021, chilli growing farmers witnessed heavy infestation and damage by thrips pest. To study the status of pest infestation, to identify the thrips species and to suggest suitable control tactics, we conducted surveys in major chilli growing areas of Warangal and Mulugu districts of Telangana. Taxonomic identification revealed it as newly invaded exotic thrips species, *Thrips parvispinus* (Karny). We reported heavy infestation of invasive thrips causing heavy flower drop and upward leaf curling. In Darmapuram and Parakal blocks of Mulugu districts of Telangana, 100% crop loss was noticed due to feeding and flower drop caused by this pest. We recorded the infestation to the tune of 10-13 male and 18-25 female thrips flower^{-1}; with 30-100% flower drop. *T. parvispinus* was first reported in India in 2015 from Karnataka on papaya plants. Our study reported the heavy infestation and severe damage to chilli crop by this exotic pest since its invasion in India. Very little is known about its biology, host range, damage mechanism, population dynamics and distribution of this thrips species in India. Hence, there is an urgent need to initiate research programs to recommend the timely monitoring, alert message and suitable control tactics to restrict the spread of this pest to other Chilli growing areas in the country.

Keywords: Chilli, sucking pests, invasive pest, *Thrips parvispinus*

Introduction
Chilli (*Capsicum annum* L.) is one of the most important vegetable and spice crops cultivated in sub-tropic and tropical regions, especially in Telangana, Andhra Pradesh and Karnataka states of India. Telangana is one of the top Chilli growing states in the country and stands second in area and production. During 2020-21, Chilli was grown in 3.78 lakh acres of area and produced 5.53 lakh metric tons in Telangana. Further, the area under Chilli crop has increased during 2021-2022, at present an area of 3.78 lakh acres is under Chilli cultivation in the State (Anonymous, 2021) [1].

Many biotic and abiotic factors are responsible for reducing the potential yield of Chilli crop in India. Among biotic stresses, the incidence of insect pests is identified as major bottleneck for chilli production. In chilli, sucking pests *viz*., thrips (*Scirtothrips dorsalis* Hood), mites (*Polyphagotarsonemus latus* Banks) and whiteflies (*Bemisia tabaci* Genn) have been observed as key pests, which are accountable for major yield loss in chilli. The yield losses due to insect pests in chilli ranges from 50-90 per cent (Kumar *et al*. 1995) [7]. The damage due to mites and thrips together had been estimated to the tune of 50 per cent (Kandasamy *et al*. 1990) [5]. About 21.29% crop losses due to mite infestation and 30-50% due to thrips have been reported (Jeyarani and Chandrasekaran, 2006) [3].

Tobacco thrips, *Thrips parvispinus* (Karny) is highly invasive thrips species native to Asian tropics. *T. Parvispinus* has recently invaded India and was first reported in 2015 infesting papaya plants from Karnataka state (Tyagi *et al*., 2015) [12]. This species has also been reported to invade several other countries in Asia and Oceania and causing severe losses to vegetable and fruit crops (Mound and Collins 2000) [9]. In Indonesia, it is one of the most important economic pests on Chilli pepper causing drastic yield reduction (Vos and Frinking, 1998) [13]. It has also been recorded as a vector of tobacco streak ilarvirus, known to transmit the virus from infected tomato pollen to seedlings of *Chenopodium amaranticolor* (Klose *et al*., 1996) [6]. From India, morphological and molecular evidences verified that the specimens collected from Karnataka on papaya represent *T. parvispinus*.

Molecular evidence indicated that, Indonesia may be a probable source of invasion of this species to India (Tyagi *et al*., 2015) [12]. Rachana *et al*, (2018) [11] reported *Dahlia rosea* Cav. has been reported as new host for the quarantine thrips, *Thrips parvispinus* (Karny) from karntaka, India

T. parvispinus has been identified as polyphagous pest infesting mainly fruit, vegetable and ornamental crops *viz*., coffee, chilli pepper, *Gardenia* sp., papaya, potato, sweet pepper, green bean, tobacco, *Vigna* sp., strawberry, watermelon, eggplant and other Cucurbits (Moritz *et al*., 2013) [8]. Life cycle is completed in 13-14 days under controlled condition on chili pepper (*Capsicum annuum* L.) in greenhouse. Reproduction is sexual and, on an average, female lays 15 eggs. Eggs stage lasts 4 to 5 days, nymphal stage goes through two molts in 4 to 5 days, mature and pupates. The pupal stage completes in 2 to 3 days. (Hutasoit *et al*. 2017) [2]. *Thrips parvispinus* (Karny) is diagnosed by having uniformly light brown body of females (males almost yellow), females and males differ in size, antennae 7-segmented and the segment III and bases of IV and V are pale, segments III and IV each with forked sense cone; Head broader than long, ocellar pair III arising at the anterior margin of ocellar triangle; postocular setae I and IV longer than III. Abdominal sternites III–VI with accessory setae, absent on II and VII (Tyagi *et al*., 2015) [12].

The present study was aimed to gauge the quantum of infestation by this invasive thrips species in major chilli growing regions of Telangana state. We conducted extensive surveys in chilli fields and reported the presence of this invasive thrips species in severe scale. In this study, we reported the severe damage caused by this exotic pest to chilli crop in Warangal and Mulugu districts of Telangana.

Materials and Methods

Some chilli growing farmers of Warangal and Mulugu districts complained about the heavy infestation and damage by sucking insect pests in their fields during October-November, 2021. In order to identify the insect pest species, its severity of infestation, level of damage and to recommend suitable management practices, scientists of Regional Agricultural Research Station, Warangal, conducted diagnostic field visits with Department of Horticulture, Department of Agriculture, State Chilli Task Force, Progressive farmers of the concerned villages. In other visits we associated with scientists of ICAR-National Bureau of Agricultural Insect Resources (NBAIR), ICAR-Indian Institute of Horticultural Research, Bangalore and Sri Konda Laxman Telangana State Horticultural University, Hyderabad

Field surveys were conducted in chilli fields severely infested with flower thrips at different locations in Warangal and Mulugu districts of Telangana. Random roving surveys were conducted in the month of November, 2021, when the chilli crop was at flowering to fruiting stage. Most chilli fields surveyed were sown with varieties, Tejaswini, Chapata and Bydagi. Zig-zag or diagonal pattern of scouting was adopted to record the severity of flower thrips infestation. Random 10 chilli plants were selected in a field. In a plant, top five leaves and flowers were observed for the presence of thrips. Observations recorded on total number of thrips present on leaves and flowers, number of male and female thrips present per flower, number of male and female thrips present per leaf and flower drop was counted. Specimens of flower thrips were collected from individual fields and identified under compound microscope at Regional Agricultural Research Station (RARS), Warangal. Further species level taxonomical confirmation received from ICAR- National Bureau of Agricultural Insect Resources (NBAIR), ICAR, Bangalore.

Results and Discussions

The thrips specimens collected from infested leaves and flowers of chilli crop from all the visited sites were identified as *Thrips parvispinus* (Karny). Both, males and female thrips were seen infesting leaves and flowers of chilli crop (Figure 1). Small sized yellow coloured specimens collected were males and large sized brown bodied specimens were females of *Thrips parvispinus* (Figure 2). During the field survey, we observed that all chilli fields of Warangal and Mulugu districts were severely infested by the newly invaded thrips species *Thrips parvispinus*. From the farmers we understood that, thrips infestation started in the first week of November and it exponentially increased in subsequent days. At the time of visit to Thimmampet, Duggondi, Bhanjipet, Narsampet blocks of Warangal district, we recorded high population of thrips leaf^{-1} and flowers^{-1} in the surveyed fields. We could record the thrips population as high as 6-8 male and 15-18 female thrips flower^{-1}; and 5-8 male and 8-10 females leaf^{-1}. Furthermore, we recorded 30-80% flower drop and severe upward curling of chilli leaf. Visits to Venkatapur, Darmapuram, Incherla, Parakala and Mulugu blocks of Mulugu district, we observed severe thrips infested chilli fields and the infestation is in the tune of 10-13 male and 18-25 female thrips flower^{-1}; and 6-10 male and 10-15 female leaf^{-1} with 50-100% flower drop and upward curling of leaves (Table 01 & Figure 01).

Table 1: Severity of infestation of *Thrips parvispinus* in chilli in two districts of Telangana

SN.	Districts	Block	Surveyed area (ha.)	No. of nymph/adult per leaf/flower	Severity level
1	Warangal	Thimmampet, Duggondi, Bhanjipet, Narsampet	68	6 - 8 male and 15 - 18 female thrips flower^{-1}; 5-8 male and 8 - 10 females leaf^{-1}	30-80% flower drop and upward curling of leaves
2	Mulugu	Venkatapur, Incherla, Darmapuram, Parakala and Mulugu	122	10 - 13 male and 18 - 25 female thrips flower^{-1}; 6-10 male and 10 - 15 female leaf^{-1}	50-100% flower drop and upward curling of leaves

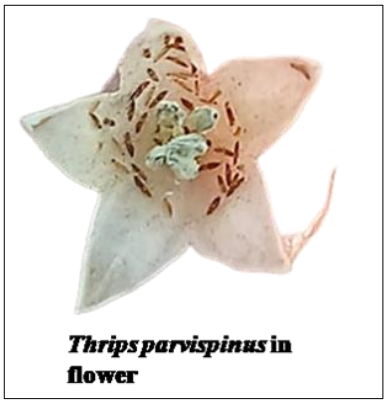

Fig 1: *Thrips parvispinus* infesting chilli flower

Fig 2: Male (Smaller in size & light bodied) and female (larger in size & dark bodied) of *Thrips parvispinus*

This is the first instance of heavy outbreak of this newly invaded exotic thrips in India since its first report in 2015. As it is an alien pest to Indian conditions, there is no knowledge on management strategies of this pest. Also, the natural enemies responsible for natural suppression of this pest is lacking in new environment. In such conditions, management of this pest becomes very difficult for the farmers. Heavy infestation of thrips forced the farmers to deploy a massive pesticide spraying program on chilli crop as an emergency response in Telangana state to manage *T. parvispinus*. Due to heavy damage to chilli crop, some farmers have applied different types of un-registered synthetic insecticides. Farmers have resorted to 3 to 4 sprays of different insecticides without the knowledge of their efficacy. This study shows that, chilli crop of the surveyed sites was totally devastated by this pest. This species was seen infesting every leaf, flowers and flower buds present on the chilli plant. Both nymphs and adults of male and females were found sucking sap from lower side of leaves, flowers, buds and also from tender pods due to which the growth and development of crop is affected. All the leaves of plant were heavily curled upward and ventral part of the leaf turned completely bronze coloured. Furthermore, we also recorded the heavy flower drop to the tune of 30-100% in some visited fields. Approximately 200 acres Chilli crop of Darmapuram, Parakal and Warangal districts were completely destroyed by the infestation of this newly invaded pest. Chilli growing farmers from these chilli growing regions are in complete disgrace and sorrow due to complete crop loss caused by this pest. Severity level of thrips also observed on blue and white sticky traps installed in the field on which approximately 3000-5000 nymphs and adults were seen.

During interaction with chilli growing farmers and local authorities, we could find out some of the probable reasons for sudden outbreak and control failure of *T. parvispinus* in chilli in Telangana state. This being an exotic pest, no natural control mechanism is functional in the chilli fields. Lack of native biological control agents for this invasive pest is one of the most important reasons for rapid build-up of thrips population. Further, higher adaptability and wide host range helped this pest to establish in new regions and crop species. As this is a new and unknown pest to the farmers, no timely and correct diagnosis was done by the farmers. Also, it was initially mistaken for some other sucking pest infestation. Post thrips infestation, panic reaction forced farmers to spray non-recommended insecticides which led to outbreak of this pest. Indiscriminate and continuous use of chemical insecticides, spraying of novel chemicals and synthetic combinations products at early stage of the crop induced the huge thrips population development in the chilli fields.

Further, farmers blindly followed input dealer's suggestion for selection of chemical sprays, and in that quest they indiscriminately sprayed pseudo bio-pesticides, fungicide and foliar nutrients in combination. Also, the environmental factors like higher day time temperature following intermittent rains favoured the development of large thrips population in chilli crops in our region. In some districts, farmers follow continuous mono cropping of chilli crop on large acreage, which paved the way for continuous pest presence in the field. Higher doses and in-discriminate application of complex fertilizers, poor nutrient management and micro nutrient deficiencies are also some of the reasons for pest population development in chilli crop. Finally, ignorance and non-compliance with integrated pest management (IPM) practices by farmers led to control failure and higher damage by thrips in chilli. These are array of factors which may have provided congenial condition for *Thrips parvispinus* to devastate large areas within a short period of time.

Across the world, *Thrips parvispinus* has been designated as the pest of quarantine importance. In Thailand and Australia, this pest has been recorded as a serious pest on a number of plant families (Mound and Collins, 2000) [9]. It is reported as a pest on papaya in Hawaii, greenhouse Gardenia plants in Greece, vegetable crops like chili, potato, green beans and eggplant from other countries (Murai *et al*. 2009) [10]. In Indonesia, field pepper yield losses due to *T. parvispinus* reached 23 percent (Johari *et al*. 2014) [4]. However, out study reported 30 to 100% yield loss in chilli due to *T. parvispinus*. Most damage is produced by direct feeding of nymphs and adults on leaves and growing buds.

This is the report of *Thrips parvispinus* outbreak and heavy damage to chilli crop from India. At Darmapuram, Parakal and Warangal districts of Telangana, 100% crop loss was noticed due to feeding and flower drop caused by this pest. Little is known about the biology, host range, damage mechanism, population dynamics and distribution of this thrips species in India. Earlier this pest was reported as an invasive pest infesting papaya, rose in India, and Indonesia was elucidated as probable source of invasion (Tyagi *et al*., 2015) [12]. Chilli is cultivated as one of the major commercial crops in India with high input cost.

Conclusion

Recent outbreak of this exotic pest has caused havoc among the chilli growing farmers in southern parts of India. Hence, there is an urgent need to initiate research programs to

recommend the timely monitoring, alert message and suitable control tactics to restrict the spread of this pest to other Chilli growing areas in the country. Strict quarantine measure should be adapted to confine the spread of this pest within country.

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Competing Interests disclaimer
Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge.

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