Indian Farmer
Volume 9, Issue 02, 2022, Pp. 55-67.
Available online at: www.indianfarmer.net
ISSN: 2394-1227 (Online)

ORIGINAL PAPER

Menace of thrips in indian agriculture- present status, challenges and management strategies.

A.Venkat Reddy*[1], Ch.Anusha[1], Ch.Yashaswini[1], K.Gopika[1] And M.Bal Ram[1]

Professor Jayashankar Telangana State Agricultural University (PJTSAU), Agricultural College, Mulug Road, Warangal-506007, Telangana State, India.

**Corresponding author:* venkatreddyakkati1968@gmail.com

Article Received: 31 January 2022 Published Date: 03 February 2022

ABSTRACT

Of late, upsurges of several new stresses have also been noted. Several factors are responsible for buildup of biotic stresses such as shift of secondary causal agents to primary status, injudicious use of pesticides, climate change, resistant pest populations, invasive pests, biotype development, human interventions, etc. There are many species of thrips, some of which are serious pests of crops. Often, thrips that are highly adaptable and polyphagous tend to be serious crop pests, whereas species that only breed on a single species of plant tend to be minor pests . Thrips feeding can cause injury to leaves, flowers, and fruit of a great diversity of crops . While direct injury alone can be devastating to crop yield, the ability of some species of thrips to transmit tospoviruses. Hence, this insect group has been elevated to one of the most serious economic pests in agriculture. In addition, some of the main pest thrips have developed resistance to commonly used pesticides, which further complicates pest management.It is therefore wise to employ other methods for thrips control using an integrated pest management (IPM) approach, which utilize several tactics to reduce pest populations without relying completely upon a single pesticide.

Key Words: Agriculture, Damage, Invasive Thrips, Management, Thrips

INTRODUCTION

Thrips are tiny insects that belong to the order Thysanoptera. There are many species of thrips, some of which are serious pests of crops. Often, thrips that are highly adaptable and polyphagous tend to be serious crop pests, whereas species that only breed on a single species of plant tend to be minor pests . A recent appraisal of thrips in India reflects the presence of 307 species in 105 genera (Rachana and Varatharajan 2018). Thrips feeding can cause injury to leaves, flowers, and fruit of a great diversity of crops. Feeding injury to fruit can result in discoloration, deformity and reduced marketability (Mound and Marullo 1996). While direct injury alone can be devastating to crop yield, the ability of some species of thrips to transmit tospoviruses. Hence, this insect group has been elevated to one of the most serious economic pests in agriculture. In addition, some of the main pest thrips have developed resistance to commonly used pesticides, which further complicates pest management.The polyphagous nature, minute size, special mode of reproduction, tolerance to commonly used insecticides have made thrips very difficult to manage. Hence, an integrated pest management (IPM) approach, which utilize several tactics to reduce pest populations without relying completely upon a single pesticide is the most reliable and efficient way.

Thrips are minute insects, usually 1–3 mm in length and not readily noticeable. Typically the adults have four slender wings, each with a long fringe of marginal cilia, but the most remarkable feature of thrips is the asymmetry of their mouthparts, that is only the left mandible is present. Moreover, the larvae have a pair of tarsal claws, these are reduced in the adult to a pair of ensheathing spoon-shaped sclerites between which lies the bladder-like arolium (Mound and Marullo,1996). Most thrips species overwinter as either adults or as pupae. A typical flower thrips generation time varies between 7 and 22 days depending on the temperature. The eggs are about 0.2 mm long and reniform (kidney-shaped); these take, on average, 3 days to hatch. Thrips have two larval stages and then go through prepupal and pupal stages. Adults take between 1 and 4 days to reach sexual maturity. The females of the suborder Terebrantia are equipped with an ovipositor that is used to cut slits into plant tissue into which they insert their eggs at a rate of one per slit, while females of the suborder Tubulifera, which lack an ovipositor, lay their eggs on the outside surface of plants, either singly or in small groups (Khanzada *et al*., 2016).

A majority of the thrips species are considered as agricultural pests as they cause considerable loss to many economically important crops. Some of them are predaceous and feed on other thrips species, mites, aphids, scales and other soft-bodied insects. The beneficial aspect of thrips is that they aid pollination of flowers.

General Morphology and Life Cycle of Thrips

Thrips are mostly yellow, orange, black, black or whitish-yellow in colour. They crawl leisurely or fast when disturbed. The apex of the abdomen is flexed upward to leap from the plant surface. Adult thrips are usually very small in size, 1–2 mm in length

and slender in shape. The head is quadrangular in shape with two prominent compound eyes and three ocelli. The filiform antennae are projected forward and bear six to nine segments with short, simple or forked sensory organs. The prothorax is broad and freely movable. The mesothorax and metathorax are firmly fused together. The legs are with one to two segmented tarsi and a pair of weak claws. A protrusible vesicle on the tarsus helps them to walk on any type of surface. Wings are membranous and fringed with long setae. The base of hind wings bears hooks which engage with an anal portion of forewing to aid in the flight. They are not good fliers and usually make short flights, however long distance migration occurs through the wind, atmospheric convection, and turbulence. The abdomen is 11 segmented, long and tapering in shape. The first and terminal segments are reduced. The genitalia in the adult female is curved downward and saw like. The apex of the abdomen is bluntly rounded in the case of male. The life cycle of thrips consists of eggs, first and second instar larvae, pre-pupa, pupa, and adults. The eggs are mostly reniform, opaque in colour. The mature eggs turn yellowish-orange in colour. The newly hatched larvae resemble adult but lack wing pads, have lesser number of segments in the antennae. The first instar larvae molt into the second instar within a day time. The second larval instar is similar to the previous instar but bigger in size. Second instars develop into pre-pupae within 4–5 days . Both pupal instars have wing-pads but lack protrusible vesicle on the tarsi of legs. The pre-pupae and pupae do not feed and remain mostly inactive. They move very slowly only if disturbed. The pupation generally occurs in soil or sometimes on plants. The longevity of the adult female is around 4–5 weeks. The adult female makes a slit with their ovipositor in tender plant parts and eggs are embedded in the upper epidermal layer of plant tissues. One female can lay around 50 eggs in their life time . The developmental period varies depending on the temperature. The reproduction of thrips is haplodiploid and capable of parthenogenesis. Some species display arrhenotoky and others follow thelytoky. The sex ratio and rate of reproduction are influenced by the temperature and biotic factors.

PRESENT PEST STATUS OF THRIPS IN AGRICULTURE

Approximately, 7,700 species of thrips has been recorded to date, of which only less than 1% are considered as pests of agricultural crops . The phytophagous thrips damage leaf tissue by probing into cells and imbibing the sap. Feeding of thrips causes damage to the leaves, flowers or fruits and sometimes induces galls. Besides being important insect pests, thrips act as vectors of deadly tospoviruses of the genus Tospovirus, family Bunyaviridae . Significant losses by tospoviruses in the yield and quality of vegetables, legumes and ornamentals have been recorded in different countries . Annual losses due to tospovirus outbreaks are estimated at over $1 billion worldwide (Mandal and Jain,2012). Tospoviruses are not seed-transmitted and thrips play a critical role in the survival and spread of tospoviruses. Eleven species of thrips as vectors of tospoviruses and more than 20 tospoviruses are recorded throughout the world (Pappu *et al.* 2009).

Thrips feed on over 600 different plants and crops, especially on flowering plants where these also feed on pollen. Many thrips are pests of commercial crops owing to their damage to flowers. Also, their feeding causes stunting, resulting in deformed and unmarketable fruits and vegetables. The phytophagous thrips cause direct damage by piercing plant tissue and imbibing sap. Thrips feeding makes the plant parts appear silvery as the empty cells are filled with air. As the damaged leaves, flowers, and fruits grow in size, they become scarred, malformed, and distorted .

Thrips damage in cotton

Thrips damage in chilli

In India, the studies on different thrips species were initiated during pre-independence period. The research on tospoviruses got momentum during 1960s. In India, altogether 693 species of thrips under 249 genera are known to occur in India . Among them, only six thrips species are concerned in realtion to transmission of tospoviruses. The most recent addition is the *Frankliniella occidentalis,* the well-known vector of TSWV, from Karnataka and Tamil Nadu (Tyagi *et al*, 2017). The tospovirus research in India started much later. Since the 1960s, the disease symptoms similar to tospovirus has been reported in black gram, brinjal, chili, cowpea, groundnut, mung bean, pea, potato, soybean, and tomato. In 1992, the first report of Groundnut bud necrosis virus (GBNV) was published. Subsequently, Peanut yellow spot virus (PYSV), Watermelon bud necrosis virus (WBNV) , Iris yellow spot virus (IYSV) , and Capsicum chlorosis virus (CaCV) were reported from India. Tomato spotted wilt virus (TSWV) infesting chrysanthemum in Nilgiri district of Tamil Nadu has been reported in recent time (Suganthy *et al*. 2016).

NEWLY RECORDED AND INVASIVE THRIPS

Caliothrips punctpennis (Hood) and the male of Western Flower Thrips *Frankliniella occidentalis* (Pergande) have been recorded for the first time from India(Rachana and Varatharajan, 2018). *F. occidentalis* was collected on the leaves of *Erythrina indica* from Ooty in the Nilgiris, the Western Ghats, southern India, whereas *C. punctpennis* was collected from yellow pan traps laid at Great Nicobar, India. Considering the quarantine importance of the pest *F. occidentalis*, the report of the male for the first time in India needs attention and concern. Males are also known to be more effective vectors of tospoviruses than females. *Xerochrysum bracteatum*, the Common

Golden Everlasting Daisy, is often taken out of Ooty by tourists to other parts of the country. This along with other planting materials carried by tourists and farmers could aid in the dispersal of *F. occidentalis* to the temperate regions of northern and southern India, where it is likely to thrive in the congenial climatic conditions prevalent there. Under these circumstances, it is imperative that quarantine mechanisms within the country are activated and strengthened, to prevent the spread of this notorious pest to the rest of India from the pockets of its occurrence in southern India - particularly the Nilgiris., *F. occidentalis* is responsible for the transmission of five species of tospoviruses (Chrysanthemum Stem Necrosis Virus, Groundnut Ring Spot Virus, Impatiens Necrotic Spot Virus, Tomato Chlorotic Spot Virus, Tomato Spotted Wilt Virus / Groundnut Bud Necrosis Virus).

A New Invasive thrips: *Thrips parvispinus* is a cosmopolitan species of quarantine importance and has been reported from Thailand to Australia. In India, this species was first reported on *Carica papaya L*. (Caricaceae) in Bengaluru (Tyagi *et al*. 2017) and later on *Brugmansia sp.* (Solanaceae) and *Dahlia rosea Cav*. (Asteraceae) (Rachana and Varatharajan,2018). It is a polyphagous pest, infesting beans, eggplant, papaya, pepper, potato, shallot and strawberry . Since 2015, this species has been collected from nine host plants belonging to seven families from five Indian states viz. Andhra Pradesh, Chhattisgarh, Karnataka, Kerala and Tamil Nadu. Out of nine recorded host plants, four were fruit crops, three were ornamentals, one each of vegetable and field crop, reflecting the adaptability of this thrips to feed and breed in diverse agro-ecosystems. This thrips cause large scale shedding of flowers, malformation of fruits and fruit drop in chillies, leading to severe yield loss. About 90 to 95 per cent flowers were badly damaged by the thrips, and on an average, 18-20 thrips were recorded per flower. Serious damage was recorded in Andhra Pradesh, Telangana , Chhattisgarh and Karnataka on *Capsicum annuum* and in Tamil Nadu on *Mangifera indica*. Although not currently reported to be a vector of Tospoviruses, it may likely acquire viruliferous trait. Therefore, it is imperative that the domestic quarantine mechanisms are to be strengthened further to check the spread of this notorious pest to the rest of India.(Rachana and Shylesha ,2021). This invasive thrips species affected chilli crop in approximately 9 lakh acres during 2021 in Telangana and Andhra Pradesh. The yield loss in Guntur district (total area surveyed: 106656 ha) alone was 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 (Sireesha, 2021).

T.parvispinus in chilli flowers

The economic status of important thrips species which are concern to India are detailed below.

***1.Thrips palmi*:** *T.palmi* is commonly known as melon thrips. It was first described by Karny in 1925. In India, *T. palmi* is recorded from Delhi, Haryana, Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharastra, Karnataka, Tamil Nadu , Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Odisha, and West Bengal (Ghosh *et al*,2017). It is a polyphagous pest, attacks more than 50 plant species representing over 20 taxonomic families. It is a major insect pest in solanaceous and cucurbitaceous vegetables. It occurs in eggplant, potato, pepper, cucumber, pumpkin, squash, watermelon, muskmelon, zucchini, cowpea, soybean, cotton, groundnut, sesame, spinach, amaranthus, chrysanthemum, dahlia, orchid, plumeria and mango etc. *T. palmi* is also responsible for indirect losses by transmitting GBNV, WBNV, CaCV viruses etc. in economically important crop plants. Seventy to 90% losses in groundnut are recorded in India due to infection of GBNV . Around 29% losses in potato are due to *T. palmi* transmitted GBNV have been recorded.

2. Thrips tabaci : *T. tabaci* is also known as Onion thrips. It was first described by Lindeman .*T. tabaci* is a cosmopolitan species has been reported from Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Punjab, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharastra, Rajasthan and West Bengal. Onion thrips are reported from more than 25 plant families including grasses and broad leaves. This is a key pest in onion. The other major hosts are garlic, broccoli, cabbage, cauliflower, leek, carrot, beans, cotton, cucumber, melon, orchids, papaya, pineapple, rose, carnation, eggplant, and tomato etc. *T. tabaci* is the most serious pest in onion inflicting 34–43% loss in yield

3. *Ceratothripoides claratris*: *C.claratris* is also called as oriental tomato thrips. *C. claratris* is probably originated in Asia and adapted to the hot humid tropical climate of South East Asia. In India, *C. claratris* reported from Delhi, Maharashtra, Orissa and Tamil Nadu. Tomato is considered as the main host of *C. claratris*. This thrips species is also known to feed on the foliage, stems, and fruits of solanaceous crops like capsicum, eggplants, and tobacco etc. It is also observed on cucurbitaceous, fabaceous and

asteraceous crop plants. *C. claratris* may cause both direct and indirect damages to host plants. This is one of the most destructive insect pests of tomato causing considerable yield losses in both field and glasshouse conditions. *C. claratris* is enlisted as the thrips species transmitting tospoviruses in India (Mandal *et al*. 2012).

4. *Scirtothrips dorsalis*: *S. dorsalis* is an important pest of vegetable, ornamental and fruit crops. This thrips is commonly known as chilli thrips or strawberry thrips. In India, it has been reported from Andhra Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *S. dorsalis* was first reported from chili and castor , Since then it has been recorded from more than 100 plant species under 40 families. This is a serious problem in groundnut ,cassava and taro roses, onion, garlic, okra, cucumber, capsicum, watermelon, soybean, beans, citrus, cashew nut, tea, cotton, sunflower, peach, pomegranate, pears, and grapes etc.. *S. dorsalis* is a key pest of chili and one of the limiting factors in chili production in India. More than 90% yield reduction in chilli was experimentally observed due to *S. dorsalis*. At least three tospoviruses were reported to be transmitted by *S. dorsalis* throughout the world viz. GBNV, peanut chlorotic fanspot virus and PYSV.

5. *Frankliniella schultzei*: *F. schultzei* is a polyphagous pest feeding on different vegetable and ornamental crops. This is also known as common blossom thrips. In India, this is reported to infest different vegetables, legumes, and ornamental plants. *F. schultzei* is polyphagous in nature and prefers to feed on ornamental and vegetable crops. More than 83 plant species representing 35 families are reported to host *F. schultzei* . Due to their feeding, abortion of the flowers is often noticed. In the case of severe infestation, discoloration and stunted growth of the plant is reported. The indirect damage caused by *F. schultzei* is it acts as as a vector of TSWV causing groundnut bud necrosis disease in India.

6.*Frankliniella occidentalis:* *F. occidentalis* is one of the important pests in agriculture, commonly known as western flower thrips. This is native to the Southeastern USA and has successfully invaded to South America, Europe, Africa, Australia and Asia. It is reported from Bangalore area of Karnataka (Tyagi *et al,* 2017) and has become a major concern for the quarantine authorities. The occurrence of *F. occidentalis* in Nilgiri hills of Tamil Nadu was confirmed by Suganthy *et al.* (2016). *F. occidentalis* is a polyphagous pest infesting more than 500 species in 50 plant families. It attacks flowers, fruits and leaves of a wide range of cultivated crops like capsicum, cucumber, beans, strawberry, eggplant, onion, lettuce, watermelon, tomatoes, chrysanthemum, carnation, rose, tuberose and orchids and indirectly by transmitting more than five tospoviruses.

Strategies for avoiding spread of the invasive thrips:

1.The main objective should be to evade further spread of this thrips to other chilli growing areas of India by complete destruction of the infested plants in the specific areas.

2.Use healthy and pest free seedlings for planting.

3.Constant exhaustive monitoring and inspection for its infestation in new areas through surveys in chilli growing areas.

4.Microbial biopesticide based management practices- *Beuveriabassiana, Lecanicilliumlecani*@ 5g/lt spray focusing on flowers and fruits.

5.Use of neem oil, pongamia oil or soap solution in heavily infested sites.

6.Judicious use of chemical insecticides as well as fertilizers as per the package of practices (POP) recommended by the local regions/Universities/Departments.

STRATEGIES FOR MANAGEMENT OF THRIPS

Management of thrips is difficult because of their wide host range, resistance to insecticides and lack of durable resistance in crop hosts. Control measures against thrips include phytosanitary, cultural, host plant resistance, biocontrol measures and chemical that need to be integrated appropriately.

1.Monitoring:

- If thrips are a suspected cause of plant damage, thrips adults and larvae can be monitored by branch beating or gently shaking foliage or flowers onto a light-colored sheet of paper, beating tray, or small cloth.

- Adult thrips can also be monitored by hanging bright blue sticky traps in or near host plants.

Installation of Blue Sticky traps

2.Cultural Control:

- Agronomic practices followed for crop cultivation strongly influence build-up of thrips population and tospovirus infection. This damage can be reduced by sowing the crop when the most sensitive stage is least invaded by thrips. Adjusting sowing date so as to avoid thrips vectors markedly influences disease build-up .

- Physical barriers that limit the movement of thrips have been shown to reduce incidence. For example-Intercropping of groundnut with maize, pearl millet and in watermelon, border cropping with two rows of maize significantly reduces incidence.

Maize as border crop in chilli

- Aluminum-surfaced plastic mulch give significant reduction in WBNV incidence in cucurbit crops and was superior to black plastic mulch.Silver or gray is the most effective color for synthetic reflective mulch or mesh, but white also works.Commercially available synthetics include aluminum-metalized polyethylene and silver-embossed polyethylene plastic films. If handled carefully, these may be used for more than one season.

Plastic mulching

- Control nearby weeds that are alternate hosts of pest thrips.

- Provide appropriate cultural care to keep plants vigorous and increase their tolerance to thrips damage.
- Keep plants well irrigated, and avoid excessive applications of nitrogen fertilizer, which may promote higher populations of thrips.
- Investigate the availability of resistant cultivars. For example, western flower thrips more often damages fragrant, light-colored or white roses.

3. Biological Control:.

Exploiting natural enemies and predators of thrips to manage populations has been the subject of many studies .

Ex: Eulophid parasitoids, *Ceranisus sp, Thripobius sp*., predatory anthacorid bugs, *Orius maxidentex* (Ghauri) and *O. tantillus* (Motschulsky), phytoseiid predatory mite *Euseilus sp*. Among several entomopathogens such as *Verticillium lecanii, Metarhizium anisopliae var. anisoliae, Beauveria bassiana,* and *B. brongniertii* were recorded as effective in controlling thrips under field conditions. Predatory thrips (*Neoseiulus (= Amblyseius) cucumeris, Amblyseius swirskii*), green lacewings help to control plant-feeding thrips. To conserve and encourage naturally occurring populations of these beneficials, avoid persistent pesticides, and grow a diversity of plant species.

4. Chemical Control:

Many thrips species are also resistant to insecticides, and their population may not be effectively controlled by chemical measures. However, insecticides still constitute an important tactic in managing thrips. Various application schedules of imidacloprid, thiamethoxam, acetamiprid, fipronil, Acephate, dimethoate, fenvalerate, and azadirachtin were effective in managing thrips .

If you use pesticides to control thrips, follow these general guidelines:

- Begin applications early, before the thrips population grows too large. Thrips are more easily managed when population levels are low.
- Although it is important to rotate chemical classes, use only one chemical class for the duration of the thrips life cycle. This generally means using a different class every 2-3 weeks, depending on the time of year.
- Apply pesticides in early morning or late afternoon, when flight activity of thrips is at a peak. This increases exposure of the thrips to the pesticides.

Insecticides used at planting for thrips control are applied to the seed (Imidacloprid or Thiamethoxam @ 5 gr/ Kg seed) or placed in the furrow with seed as

liquid or granular formulations. These insecticides systemically enter a seedling plant through water uptake in the root system and control thrips that feed on above-ground tissue. The neonicotinoids- thiamethoxam and imidacloprid, the organophosphate- acephate and the carbamate, thiodicarb are commonly used as seed treatments. Acephate and imidacloprid can also be applied as in-furrow liquid sprays.

Utilisation of indigenous materials have confirmed that garlic chilli kerosene extract (GCK at 0.5 per cent) +nimbecidine (2.5 ml/lit) can effectively combat the problem.

CHALLENGES

1. **The accurate identification of thrips** is crucial for effective pest management strategies. However, morphology based identification has limitations and warrants integration of molecular data. The erroneous identification of an economically important species may have parallel and serious ramifications as it will generate confusing data for other fields of biology.

Their small size, cryptic habit, color morphs, secondary sexual characters, and genetic variants render the identification of thrips species challenging . Conventional insect taxonomy mostly relies on external morphology-based dichotomous keys for species delimitation. Several such resources are available for the identification of thrips specimens . However, species identification based on morphological characters is time-consuming as it involves processing of specimens, preparation of microscope slides, and magnification using a microscope, as well as expert morphological knowledge of the genera. Furthermore, available keys are generally limited to the adult stage, and economically important or prevalent thrips species have been illustrated. Moreover, morphological characters do not take into account the presence of cryptic species or genetic variants. Advancements in molecular biology over the last decade offer a variety of tools for specific and accurate identification of thrips, alleviating the limitations of morphological key-based identification. Nucleic acid and protein-based techniques such as polymerase chain reaction (PCR), random amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), sequence-characterized amplified regions (SCAR) markers, quantitative PCR (qPCR), loop-mediated isothermal amplification (LAMP), and monoclonal antibodies (MAb) have been shown to successfully discriminate between several thrips species (Amalendu Ghosh, 2021) . DNA Barcoding employs the partial fragments of mitochondrial cytochrome *c* oxidase I gene (mtCOI) for species-level identification, and this has gained wide acceptance as a supplementary method to resolve taxonomic ambiguities. Mitochondrial genes have also been used to estimate genetic diversity below species level

2. Thrips can rapidly develop resistance to insecticides which results in the rapid loss of effectiveness of new insecticides (Reitz , 2014). Insecticides resistance has been documented in a number of chemical classes, including the organochlorines, organophosphates, carbamates, pyrethroids and spinosyns.One species of thrips that is particularly difficult to manage due to insecticide resistance is *Frankliniella occidentalis* (Pergande), the western flower thrips. Sustainable use of these insecticides entails a pesticide resistance management program, which can be achieved, among others, by rotational application from different insecticide classes, prevent or slow down insect resistance to insecticides is the use of a penetrating surfactant. Surfactants could improve deposition of sprays applied to the leaves and the efficacy of insecticides against thrips. Inclusion of a penetrating surfactant is critical for improving the efficacy of insecticides that have systemic and translaminar movement within onion plants to control onion thrips.

CONCLUSION

Thrips as phytophagous insect pests are considered as major challenge to various agricultural and horticultural crops due to severe economic damage they cause. These insects not only cause direct damage to crops by feeding but also act as vectors of several virus diseases specially tospoviruses. Recent reports indicate that, some of the new species identified and invasive thrips are posing threat to some of the economically important crops for which strict quarantine measures are to be adopted to prevent their further spread from one place to another place. Because of their minute size, highly polyphagous nature, development of resistance to insecticides , thrips have emerged as major pest status and posing several challenges. An integrated management strategies only can save the crop from the damage by thrips instead of solely depending upon insecticides.

REFERENCES

Amalendu Ghosh ,SumitJangra , Ralf G. Dietzgen and Wen-Bin Yeh .(2021). Frontiers Approaches to the Diagnosis of Thrips (Thysanoptera): How Effective Are the Molecular and Electronic Detection Platforms?. Insects, 1-26.

Ghosh, A., Timmanna Basavaraj , B. Mandal , R.K. Jain. (2017). A Century of Plant Virology in India. Springer Nature, Singapore Pte Ltd. B. Mandal *et al*. (eds.).

Khanzada Muhammad Siddique, Tajwar Sultana Syed, Shagufta Rani Khanzada, Ghulam Husssain Abro, Muhammad Salman, Sajjad Anwar, Muhammad Sarwar, Adeel Aslam Perzada, Su Wang, Azmat Hussain Abro . (2016). Occurrence and abundance of thrips, whitefly and their natural enemy, *Geocoris Spp*. on cotton crop at various localities of Sindh. Pakistan Journal of Entomology and Zoology Studies. 4(1): 509-515.

Laurence A. Mound and Alice Wells. (2015). Endemics and adventives: Thysanoptera (Insecta) biodiversity of Norfolk, a tiny Pacific Island. Zootaxa , 3964 (2).

Mandal, B. and R. K. Jain. (2012). Emerging Problems of Tospoviruses (Bunyaviridae) and their Management. Plant diseases. 96(4):468-479.

Mound, L. A. &Marullo, R. (1996). The Thrips of Central and South America: An Introduction. Mem. Entomol. Int. 6, 1–488 .

Pappu, H. R., Jones, R. A. C. & Jain, R. K. (2009). Global status of Tospovirus epidemics in diverse cropping systems: successes achieved and challenges ahead. Virus Res. 141, 219– 236 .

Rachana R.R and Shylesha A.N. (2021).Pest Alert: Invasive thrips, *Thrips parvispinus* (Karny) threatening chilli cultivation in India.Scientist, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka, India. Rachana.r@icar.gov.in. Director In-charge, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka, India. director.nbair@icar.gov.in.

Rachana R.R. and R. Varatharajan. (2018). Two new reports of thrips (Thysanoptera: Thripidae) from India . Journal of Threatened Taxa. 10(2): 11312–11315.

Reitz, S. 2014. Onion thrips (Thysanoptera: Thripidae) and their management in the Treasure Valley of the Pacific Northwest Florida. Florida Entomologist. 97(2): 349-354

Sireesha ,K..(2021). The outbreak of chilli thrips in Andhra Pradesh: A matter of great concern. Indian Entomologist. Dec 29, 2021.

Suganthy, M, S. Rageshwari, C. Senthilraja, S. Nakkeeran, V. G. Malathi , K. Ramaraju and P. Renukadevi. (2016). New Record of Western Flower Thrips, Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae) in South India. International Journal of Environment, Agriculture and Biotechnology. 1(4).

Tyagi Kaomud , Vikas Kumar, Devkant Singha, Kailash Chandra, Boni Amin Laskar, Shantanu Kundu, Rajasree Chakraborty and Sumantika Chatterjee .(2017). DNA Barcoding studies on Thrips in India: Cryptic species and Species complexes. Scientific Reports. volume 7, Article number: 4898 .