

Phytophagous Mites: Ecofriendly Management

The agricultural sector witnessed an exacerbation of the phytophagous mite problem following the widespread introduction and use of pesticides in recent decades. While pesticides effectively controlled targeted insect pests, they inadvertently decimated the natural enemies of phytophagous mites. Consequently, formerly inconspicuous mite species have emerged as significant pests in present times. The shift from minor to major pest status has been observed in various phytophagous mite species, particularly those that subsist on plant material. This article aims to examine the underlying factors responsible for the evolution of phytophagous mites from minor to major pests, elucidating the contributing elements of this process.

MITES, belonging to the phylum Arthropoda, class Arachnida, subclass Acari, and order Acarina, are diminutive organisms that pose significant challenges to cultivated crops, ornamental crops, and wild plants. The initial documented instance of a phytophagous mite in India was reported by Wood-Mason (1884), who documented the presence of *Tetranychus bioculatus* on tea plants in Assam. In recent times, phytophagous mites have emerged as significant pests, causing severe damage to various crops, ornamental plants, fruit trees, and medicinal plants across different regions of India. Previously, apple orchards in Himachal Pradesh exhibited relatively low incidence of phytophagous mite infestations. However, in the early 1990s, infestations of the European red mite, *Panonychus ulmi* (Koch), were recorded in apple orchards in Himachal Pradesh, subsequently spreading to nearby areas. The mites fed on the foliage, extracting juices and chlorophyll, resulting in the discolouration of leaves, which appeared pale and acquired a bronze hue. Effective management of mite infestations in orchards was achieved through regular application of sprays and the utilization of natural predators.

In 2002, an outbreak of the two-spotted mite, *Tetranychus urticae* Koch, occurred in orchards located in Himachal Pradesh. Analysis of spray records from the growers revealed that apple orchards where need-based sprays were implemented exhibited lower mite populations compared to those subjected to excessive spraying. Research findings indicated that the development of *T. urticae* progressed at a faster rate in apple orchards compared to *P. ulmi*. Orchards that received a large number of sprays experienced a complete outbreak of *T. urticae*, leading to the decline of natural enemies and unhindered mite development. Additionally, the scarcity of rainfall during June-July further contributed to the multiplication of *T. urticae*.

Previously, the *P. ulmi* and *T. urticae* held minor significance in apple orchards until the 1980's. However,

with the increased usage of pesticides, primarily insecticides, outbreaks of these mite species have been observed. The European red mite exhibits a polyphagous nature and inflicts damage on various deciduous fruits such as apricot, plum, walnut, pear, peach, and apple. The two-spotted mite displays a high degree of polyphagy and has been reported to feed on various crops like vegetables, fruits and ornamental plants.

The extent of yield reduction caused by phytophagous mites varies across different crop types. For instance, brinjal may experience yield losses ranging from 13% to 31%, bhendi from 23% to 25%, gourd at 36%, cucumber at 14%, ornamental crops from 5% to 15%, tea from 5% to 50%, cereals from 5% to 50%, sugarcane from 5% to 20% and cotton from 20% to 30%.

Factors responsible for making mites a major pest

Adaptability: Mites possess remarkable adaptability and display rapid evolution, enabling them to successfully exploit new environments and feed on novel plant species. With the introduction of new plant species or modifications to existing crops, mites can undergo evolutionary changes to exploit these newfound food sources. Consequently, this can result in an increase in mite populations and the subsequent damage inflicted upon crops.

High Reproduction Rate: Numerous mite species exhibit short life cycles and possess the ability to reproduce at a rapid pace, facilitating the rapid buildup of large populations within a short period. This phenomenon can result in substantial crop damage and pose challenges in effectively managing mite populations through conventional pest management approaches.

Climate and Environmental factors: Elevated temperatures and prolonged growing seasons provide favourable conditions for rapid mite population growth. Similarly, shifts in precipitation patterns can impact the availability of water for plants, subsequently affecting mite populations. Notably, the multiplication of *T. urticae* was



Infestation of different mites (a) *Panonychus ulmi* on apple (b) *Tetranychus urticae* on apple (c) *T. urticae* on tomato

found to be more pronounced during dry spells compared to that of *P. ulmi*.

Alternate Hosts: Mites belonging to the families Eriophyiidae and Tetranychidae have emerged as significant pests affecting various crops in Northern India, including apple, citrus, mango, ber, okra, bean, brinjal, cotton and cucurbits. *T. urticae*, being a polyphagous pest, is known to infest multiple crops and weeds, apart from apple, pear, and cherry.

Role of Pesticides and their effect on predators: In orchards, various predatory mite species such as *Amblyscius fallacies*, *Zitzellia mali*, *Typhlodromus himalayensis*, lacewing *Chrysopa carnea*, Anthocoridae bug *Orius* sp., predatory thrips *Laptothrips mali*, coccinellid *Stethorus punctum* and spiders have been reported to effectively suppress mite populations. However, the use of synthetic pyrethroids and other insecticides by growers has been found to cause mortality of these predatory mites and insects.

Changes in Agricultural Practices: Monoculture practices tend to promote higher pest populations, including phytophagous mites, compared to polyculture systems. In polyculture systems with diverse plant species can disrupt mite population dynamics and reduce their overall abundance. For instance, studies have shown that the population of phytophagous mites, including *T. urticae*, *Panonychus citri* and *Brevipalpus phoenicis*, was significantly higher in monoculture systems compared to polyculture systems.

Increased Global Trade: The expansion of global trade and the transportation of commodities can to the introduction of mite species into areas where they may lack natural predators, consequently enabling their population to proliferate rapidly.

Human Factors: Human activities, including the adoption of novel agricultural practices and the introduction of new crop varieties, can exert notable influences on mite populations. The introduction of new agricultural practices, coupled with the cultivation of vulnerable crop varieties, can contribute to the expansion and persistence of mite infestations.

Ecofriendly management of phytophagous mites

Adopting various cultural practices can effectively minimize mite populations in diverse crops. Important practices include maintaining field sanitation, implementing balanced fertilizer use, avoiding monoculture, removing and incinerating plant debris and ratoon crops, adjusting sowing dates, and employing appropriate pruning

techniques, including the removal and destruction of infested plant material. Intercropping with either host or non-host crops can also be employed to reduce pest populations in the targeted crops.

Utilizing resistant varieties such as Japani Longi, GKC-29, Kashi Gaurav, VR-339, and Jwala in chili, RHR58, Muthatakeshi, and Banta in brinjal, EC-329390 and IC-14-1065 in okra, and Sanjam and *Lycopersicon peruvianum* in tomato has proven effective.

The application of Neem oil (3%) and NSKE (5%) in the field has shown efficacy against spider mites.

Furthermore, the use of natural enemies, including predatory mites like *Neoseiulus longispinosus* and *Phytoseiulus persimilis*, coccinellids such as *Menochilus* sp., *Coccinella* sp., *Adalia* sp., and *Scymnus* sp., anthocorid bugs, and entomopathogenic fungi like *Beauveria bassiana*, *Metarhizium anisopliae*, *Hirsutella* sp., and *Paecilomyces lilacinus*, has been proven effective in controlling phytophagous mites.

CONCLUSION

The process of the evolution of phytophagous mites from minor to major pests is intricate and influenced by various factors. Factors such as agricultural practices, international trade, climate change, genetic mutations, and resistance to pesticides have played significant roles in the proliferation of mite populations as major pests across different regions. These factors have facilitated the dispersion and adaptation of mites, while additional factors including host plant diversity, natural enemies, and habitat fragmentation may contribute to the regulation of mite populations. Given the substantial economic and ecological implications of phytophagous mites, it is crucial to develop integrated pest management strategies that consider the multiple factors driving mite evolution. Such strategies may involve reducing reliance on pesticides, promoting sustainable agricultural practices, enhancing biosecurity measures, and improving the effectiveness of biological control agents. By adopting a comprehensive and proactive approach, it becomes possible to alleviate the impact of mites on agriculture and horticulture, fostering a more sustainable and resilient food system.

For further information, please contact:

Department of Entomology, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India 173 230. *Corresponding author: thakurchandersingh008@gmail.com