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A COMPREHENSIVE CHECKLIST OF MITE PESTS ASSOCIATED WITH HORTICULTURAL CROPS IN INDIA: ECONOMIC IMPACT, DIVERSITY, DISTRIBUTION AND MANAGEMENT

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Abstract

The horticulture sector is essential for enhancing farm income and contributing to India's agricultural GDP, with fruits and vegetables comprising 90% of its production. India leads in growing crops like mangoes, bananas, and potatoes due to its varied agro-climatic conditions. However, mite pests, particularly phytophagous species, pose a major threat. These mites cause damage such as speckled leaves, galls, and malformed fruits, reducing quality and impacting marketability. This article precise the information on mite species affecting fruits and vegetables, including their host range, ecological roles, and sustainable, eco-friendly management strategies."

Keywords: Phytophagous mites; Horticultural crops; Economic impact; Management.

Introduction

India has experienced notable growth in horticultural production in recent years, driven by increased farmer interest and expanding cultivation areas. Over the last decade, the area devoted to horticulture has increased by approximately 2.7% annually, with a 7% rise in production. According to *Horticultural Statistics at a Glance 2021*, fruit and vegetable production has grown by 28.23% and 34.10%, respectively, in recent decades. Alongside fruits and vegetables, floriculture has also flourished, catering to both domestic and international markets. This expansion in horticultural production has significantly contributed to the economy, providing both income and employment opportunities. However, mites, small arachnids from the order Acarina, pose a serious threat to horticultural crops. These non-insect pests extract sap and chlorophyll from plants, leading to discoloration of leaves and fruits. The study of mites, or acarology, began in the 18th century with the description of *Acarus siro* by Linnaeus in 1758. Phytophagous mites, resembling spiders in their feeding behaviour and morphology, cause damage through their piercing mouthparts, resulting in symptoms like leaf curling, speckling, mottling, chlorophyll depletion, and gall formation. Yield losses due to mites vary by crop, with brinjal experiencing a 13% to 31% reduction, okra 23% to 25%, cucumber 14%, ornamental crops 5% to 15%, and tea 5% to 50%. On average, horticultural crops face a 17% to 23% loss from mite infestations if proper sanitation and management practices are not implemented. Effective control requires a deep understanding of mite ecology, behaviour, and integrated management approaches to ensure sustainable pest control.

Phytophagous Mites

Phytophagous mites, classified under the Phylum Arthropoda, Class Arachnida, Subclass Acari, and Order Acarina, are small organisms that pose significant threats to cultivated crops, ornamental plants, and other arthropods and vertebrates. In India, over 700 mite species have been identified, with approximately half being phytophagous (Gupta, 2021). These tiny mites

are characterized by an oval or elongated, sometimes microscopic shape, and can be distinguished from insects (Class Hexapoda) by three main features: two body regions (cephalothorax and abdomen), four pairs of legs in adults, and the absence of wings, antennae except eriophyoid mites which have two pairs of leg which differs them from all other group of phytophagous mites. Mites possess unique mouthparts called chelicerae, adapted for piercing, sucking, and lacerating plant surfaces. They lack a true head and clear body segmentation, with their bodies divided into shields such as the podonotal shield, which bears legs and mouthparts, and the opisthonodal shield. Phytophagous mites reduce agricultural productivity and act as vectors for crop diseases. They affect a wide range of crops and can also harm other arthropods, including honey bees, where species like *Varroa* and *Acarapis woodi* damage the tracheal tubes of adult bees. Mites also harm livestock, including cattle, sheep, goats, and poultry, either by feeding on them or transmitting diseases. However, not all mites are harmful; some, like predatory mites from the family Phytoseiidae, such as *Phytoseiulus persimilis*, *Neoseiulus californicus*, and *Amblyseius* species, are beneficial natural enemies of soft-bodied insects and other phytophagous mites. These predatory mites can be utilized in biological control and integrated pest management strategies. Additionally, species like *Oribatida* and *Cryptostigmata* mites play a role in breaking down organic matter, contributing to nutrient cycling in the soil. While mites were once considered minor pests, various factors have led to their emergence as significant agricultural threats.

Underlying reasons for mites evolving into critical pest threats

1. Mites have become major pests due to their high reproductive potential, broad host range, and polyphagous feeding habits.
2. They exhibit remarkable adaptability and rapid evolutionary changes, allowing them to colonize new environments and utilize diverse plant species as food sources.
3. Environmental conditions such as rising temperatures, extended dry spells, and low humidity create favorable conditions for the rapid growth of mite populations.
4. Human-induced factors, including agricultural practices like monocropping, ratooning, and the presence of wild host plants, significantly influence the population dynamics of mites. For example, species like *Tetranychus urticae*, *Panonychus citri*, and *Brevipalpus phoenicis* show notably higher populations in monoculture systems.

Check list of mite species infesting horticultural crops

In India, approximately 12 types of mites are recognized as significant pests. These primarily belong to four major families: *Tetranychidae* (Red spider mites), *Eriophyidae* (Gall mites), *Tenuipalpidae* (False spider mites), and *Tarsonemidae*. These families encompass the majority of phytophagous mites affecting horticultural crops.

1. Tetranychid Mites (Red Spider Mites/Two-Spotted Spider Mites)

Tetranychid mites (Family: Tetranychidae), commonly known as spider mites, are highly destructive phytophagous pests affecting a variety of horticultural crops, including fruits, vegetables, ornamentals, plantation crops, and flowers. These mites can cause significant yield losses, ranging from 9.15% to 100% under severe infestations in India. While approximately 1250 species infest 3877 host plants worldwide, only about 100 species are economically important. The group's taxonomy remains unclear, suggesting the presence of cryptic species. Morphologically, Tetranychid mites have a specialized feeding structure (gnathosoma) and a body divided into three regions: propodosoma, metapodosoma, and opisthosoma. Their lifecycle includes an egg, larval, nymphal, and adult stages, with overlapping generations under favorable conditions. Infestations result in

chlorosis, necrosis, bronzing, and defoliation, and severe cases cause webbing, deformed inflorescences, and scab formation on fruits. Dry conditions and low humidity further promote mite proliferation by aiding in water excretion.

Tetranychid Mites infesting Horticultural crops

Sl. No.	Common Name	Mite species	Host Plants
1.	Brown Clover Mite	*Bryobia praetiosa* (Koch)	Pear, Clove, Cardamom
2.	Carmine Spider Mite	*Tetranychus cinnabarinus T. neocaledonicus*	Beans, Brinjal, Tomato, Cucurbits, Papaya, Passion fruits, Pepper, Ornamentals e.g. carnation, Chrysanthemum, Marigold, Rose, Gladiolus etc.
3.	Citrus green/ Leaf mite	*Eutetranychus banksi*	Citrus
4.	Citrus mite	*Eutetranychus anneckei* (Meyer)	Citrus, Peach, Pear, Almond
5.	Citrus red mite	*Panonychus citri* (Mcgregor)	Citrus, Apple, Mandarin, Orange
6.	Cucurbitaceous Mite	*Tetranychus macfarlanei* (Baker & Pritchard) and *T. cucurbitae*	Cucurbits vegetables
7.	European red mite	*Panonychus ulmi* (Koch)	Apple, Nuts, Peach, Pear
8.	Fig Spider Mite	*Eotetranychus hirsti* (Pritchard & Baker)	Fig
9.	Kanzawa spider mite	*Tetranychus kanzawai*	Tea, Palm
10.	Mango red spider mite	*Oligonychus mangiferus* (Rahman & Sapra)	Mango
11.	Oriental red mite/ Citrus brown mite	*Eutetranychus orientalis* (Klein)	Citrus, Peach, Pear, Apple, Ber, Cucurbits
12.	Red Tea Mite	*Oligonychus coffeae* (Nietner)	Coffee, Tea, Mango, Peach, Pear
13.	Red vegetable mite	*Tetranychus neocaledonicus* (André)	Fig, mango, ornamental plants and Brinjal, Tomato, Potato and other vegetables
14.	Red-legged spider mite/Bean spider mite	*Tetranychus ludeni* (Zacher)	Beans and vegetables
15.	Two Spotted Spider Mite	*Tetranychus urticae, Schizotetranychus urticae*	Vegetables: Snake Beans, Winged Beans, Brinjal, Tomato, Okra and cucurbits etc. Fruits: Watermelon, Apple, Peach, Pear, Small & Large cardamom and Plantation crops (tea), Ornamentals: Rose, Carnation, Gladiolus, Marigold
16.	White Mite	*Oligonychus indicus (*Hirst)	Arecanut, Cashew nut, Oil palm

2. Eriophyoid Mites / Gall Mites (Family: Eriophyidae)

Eriophyid mites, also known as Gall Mites, Blister Mites, or Rust Mites, are significant pests due to their ability to cause galls and deformities on plants. These mites have a worm-like body with two pairs of legs and are divided into a Gnathosoma and Idiosoma. They not only induce visible damage but also transmit viral diseases like Sterility Mosaic and Streak Mosaic. Eriophyid mites have a simple lifecycle, consisting of eggs, two nymphal stages, and an adult stage, with some species alternating between female-only (Deutogynes) and male-female (Protogynes) generations. Females lay eggs on vegetative buds or leaf undersides, with hatching occurring in 2-3 days. Damage symptoms include the formation of various galls (Bladder, Bead, Pouch) covered with mite-induced hairs (erinea), abnormal bud growth, and leaf rolling. Their saliva induces plant deformities, leading to "giant buds," velvety growth, and brown lesions.

Eriophyoid Mites infesting Horticultural crops

Sl. No.	Common Name	Mite Species	Host Plants
1.	Bud gall mite	*Eriophyes parapopuli*	Mango, Plum, Prunus spp., Peach
2.	Citrus Rust Mite	*Phyllocoptruta oleivora*	Citrus, Mandarin, orange, Grape
3.	Coconut Perianth Mite	*Acceria guerreonis*	Coconut
4.	Erineum mite	*Eriophyes calaceris*	Rocky mountain maple, Grapevine
5.	Fingergall mite	*Phytoptus emarginated*	Chokecherry, Plum
6.	Jasmine Eriophyid Mite	*Aceria jasmine*	Jasmine, Chrysanthemum
7.	Jujube gall mite, Ber gall mite	*Eriophyes cernuus* Massee	Ber, Fig
8.	Litchi Erineum mite	*Aceria litchii* (Kiefer)	Litchi
9.	Mango Bud Mite	*Aceria mangiferae* (Sayed)	Mango
10.	Peach silver mite	*Aculus cornutus* (Banks)	Almond, Peach, Pear
11.	Pear Leaf Blister mite	*Phytoptus pyri*	Pear, Peach, Other vegetables
12.	Pear Rust Mite	*Epitrimerus pyri*	Pear, Peach, Apple
13.	Pink mite	*Acaphylla theae*	Tea, Coffee, palm
14.	Pouchgall Mite	*Eriophyes negundi*	Boxelder
15.	Purple mite	*Calacarus carinatus*	Tea, Coffee, palm
16.	Rose bud mite	*Phyllocoptes fructiphilus* (Keifer)	Rose, Gerbera, Tuberose and other flower crops
17.	Stem gall Mite	*Aceria sp.*	Maple, Apple, Woody Shrubs.
18.	Tomato/Brinjal erineum mite	Aceria lycopersici (Wolff.)	Brinjal, Tomato, Beans

3. Tarsonemid Mites

The third most significant mite family in agriculture and horticulture, includes species commonly known as "White Mites," "Thread-Footed Mites," and "Broad Mites." Some species feed on fungi and algae, while others are parasitic. These mites are small, with oval or flattened bodies, and their posterior Idiosoma features 1-3 sclerotized shields. Their chelicerae are fused to form a stylophore-capsule, with a partially retractable stylet-like digit. Tarsonemid mites have a short lifecycle, consisting of two active stages: nymph and adult. Males are small and pale, while females are larger and yellowish. Damage caused by these mites includes mottling and curling of young leaves, with leaves curling downward and elongating into a "rat tail" shape due to sap-sucking. Broad mite damage results in dark brown edges, brittle, dry, and crinkled leaves, along with necrosis. In severe infestations, fruits become deformed, cracked, and develop corky patches, while flowers may become malformed. Some species, such as *Steneotarsonemus* sp., can also cause secondary fungal infections. Damage is most common in cool, humid environments.

Tarsonemidae Mites infesting Horticultural crops

Sl. No.	Common Name	Mites Species	Host Plants
1.	Broad Mite/ Chilli Mite/ Citrus Silver mite/ Yellow mite	*Polyphagotarsonemus latus*	Chilli, Tea, Coffee, Beans, Potato, Tomato, Brinjal, Cucurbits, Papaya, Capsicum, Cowpea, other ornamental flowers (Marigold, Rose, Gerbera)
2.	Bract Mite/ Sheath Mite	*Steneotarsonemus ananas*	Pineapple
3.	Cyclamen mite	*Phytonemus pallidus* (Banks)	Strawberry, Blueberry
4.	Citrus mite	*Fungitarsonemus sp.*	Citrus

4. False Spider Mites

Tenuipalpidae, also known as False Spider Mites or Flat Mites, are significant pests in agriculture, affecting fruit trees, vegetables, and ornamental plants. These mites resemble spider mites but lack silken webbing and have dorso-ventrally flattened bodies. Over 1,100 species exist globally, with 102 species recorded in India, primarily in the genera *Brevipalpus* and *Tenuipalpus*. Their life cycle includes eggs, larvae, two nymphal stages (Protonymph and Deutonymph), and adults. Females lay reddish-orange eggs in clusters on plant surfaces. Larvae are orange-red, and nymphs develop into larger, opaque-colored stages. Adults, about 275 µm long, are light green or reddish-orange. The life cycle lasts 30-60 days. Damage includes scabby, corky outgrowths on leaves and fruits due to feeding on cell contents, leading to defoliation. These mites are also vectors of viral diseases, despite not producing webbing.

False Spider Mites infesting Horticultural crops

Sl. No.	Common Name	Mite Species	Host Plants
1.	Citrus flat mite	*Brevipalpus californicus* (Banks)	Citrus, Tea, Papaya, Pomegranate,

2.	Scarlet Tea mite/Reddish black flat mite/Leprosis mite	*Brevipalpus phoenicis* (Geijskes)	Citrus, Guava, Orange, Tea, Papaya, Coffee, Tomato, Brinjal, Orchids
3.	Pineapple flat mite	*Dolichotetranychus floridanus* (Banks)	Pineapple
4.	Ber gall mite	*Larvacarus transitans* (Ewing)	Ber
5.	Flat Scarlet Mite	*Cenopalpus pulcher* (Canestini & Fanzago)	Apple, Pear, Peach
6.	Scarlet mite	*Brevipalpus obovatus*	Citrus, Pomegranate, Pistachio nut, Walnut, Grapevine, Rose, Gladiolus
7.	Red Palm mite	*Raoiella indica* (Hirst)	Coconut, oil palm, date palm, Ornamental palm trees.

Management strategies

Effective management of mite infestations can be achieved through various strategies, including cultural, physical, biological, and chemical methods.

Cultural practices such as summer ploughing, avoiding the use of partially decomposed farmyard manure (FYM), and maintaining field sanitation by removing affected plant parts and weeds help reduce mite populations. Selecting resistant varieties, like Japani Longi and GKC-29 in chili, RHR58 in brinjal, and EC-329390 in okra, can minimize damage. Pruning infested plants and promoting crop rotation or intercropping also reduce mite spread. Increasing humidity through shade and mulching can create less favorable conditions for mites, which thrive in hot, dry weather.

Physical management includes adjusting environmental factors, such as reducing oxygen and increasing carbon dioxide to suffocate mites, and applying kaolin clay as a deterrent, though it should be done carefully to avoid impacting photosynthesis. Biological control involves using predatory mites from the *Phytoseiidae* family, such as *Neoseiulus longispinosus* and *Phytoseiulus persimilis*, as well as coccinellid beetles, anthocorid bugs, and entomopathogenic fungi like *Beauveria bassiana* and *Metarhizium anisopliae*, which effectively control phytophagous mites.

Chemical management should be based on regular monitoring and scouting to assess the damage potential. Botanicals like neem oil and dormant horticultural oils can control Eriophyid mites, while sulfur remains effective in some cases, though it should not be applied during high temperatures. New acaricides, such as Dicofol, Fenazaquin, Propargite, and Dimethoate, are also effective for mite control. In polyhouses, especially for roses and carnations, Abamectin is recommended for controlling mite populations.

Conclusion

Horticulture sector has witnessed an exacerbation of the phytophagous mite problem in recent scenario. Currently in some past few decades, the damage incidences of phytophagous mites are increasing significantly, and gradually they become potential major pests from the title of minor pest. Due to their heavy proliferation in population, mites are significantly diminishing the both qualitative and quantitative values of horticultural produces like the insect-pests. If they’re not adequately managed below the ETL level, mites are surely reducing the quality standards of horticultural crops, mainly fruits and vegetables in both international and national trade.

Application of ample amount of acaricides to control this devastating damage can able to develop resistance issues, development of new strains, and also pest resurgence. That's why it becomes very crucial to formulate integrated pest management strategies by analyzing the biology, occurrence and mode of damage of mites very efficiently. By adopting such proactive approaches, it becomes possible to alleviate the impact of mites on horticulture, as well as it gives assurance of promoting sustainable agricultural practices, enhancing biosecurity measures, and improving the effectiveness of biological control agents.

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