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Mites of Horticultural Crops and Their Management

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Abstract

Horticultural crops are infested by four types of mites under families Tetranychidae, Tenuipalpidae, Tarsonemidae and Eriophidae. This problem is increasing due to their diverse habits, habitats, feeding nature along with climate change and indiscriminate use of insecticides. Except Eriophidae, most mites have broad hosts. Spider mites under Tetranychidae produce white to reddish leaf blotches leading to dry leaves. Pinkish leaf blotch without webbing is formed by Tenuipalpids. Stunted plant growth with downward leaf curling is common for Tarsonemids. Specific damage occurs by different Eriophid species. Including all of these, Integrated Mite management (IMM) has been highlighted here in details.

Introduction

The Horticulture production has become a key driver for economic development in many states of country and it contributes 30.4 percent to GDP of agriculture (Surendran, 2014). India is globally second largest producer of fruits and vegetables which are infested by different mites belonging to the family Tetranychidae, Tenuipalpiae, Tarsonemidae and Eriophidae. They are generally negatively phototrophic either in colony or solitary form (Gupta, 1985). Most mites except Eriophidae can feed on diversified hosts through modified chelicerae. Their population dynamism is influenced throughout the year by different abiotic condition of the environment and hosts' availability. Generally dry humid weather helps them for rapid multiplication. Economic loss by mites on horticultural crops is now a great concern everywhere. Mite problems are increasing due to changed climate, indiscriminate use of chemical insecticides etc. So, present discussion targets to enhance knowledge on some economically important phytophagous mites (Table 1) of horticultural crops and their integrated management.

Damage and Symptoms Produced by Phytophagous Mites under Tetranychidae

Nymphs and adults feed on ventral leaf surface, under protective cover of fine silken webs. Piercing host plants through stylet-like chelicerae release cellular content of epidermal cells to suck up by mites. Mesophyll cells are collapsed leading white chlorotic spots on leaves due to removal of chlorophyll. Continuous feedings produce a stippled appearance of the foliage. In long run, necrotic spots begin to develop and leaves will turn yellow to gray and collapse. In some cases, affected leaves gradually start curling, finally wrinkled and crumpled. Adults are ovate and reddish brown (Figure 1).

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Table 1: Some important mite species along with their hosts and damage symptoms

Sl. No.	Species	Family	Hosts	Damage symptoms
1	*Tetranychus urticae*	Tetranychidae	Rose, Beans, Brinjal, Okra, Tomato, Cucumber, Chrysanthemum, Onion, Garlic, Chilli, Citrus, Cowpea, Grapes, Mary gold *etc*.	1) White blotches on leaves 2) Reddish leaf 3) Drying of leaves 4) Spin delicate webs
2	*Tetranychus ludeni*		Brinjal, Okra *etc*.	
3	*Tetranychus cinnabarinus*		Okra	
4	*Tetranychus fijiensis*		Arecanut, Citrus *etc*.	
5	*Oligonychus indicus*		Arecanut, Coconut	
6	*Oligonychus coffee*		Tea, Coffee	
7	*Oligonychus mangiferous*		Mango	
8	*Eutetranychus orientalis*		Citrus, Papaya	
9	*Brevipalpus phoenicis*	Tenuipalpidae	Guava, Tea, Pointed gourd, Citrus	1) Formation of pinkish blotches
10	*Brevipalpus californicus*		Citrus	2) Transmit leprosy virus in citrus
11	*Raielle indica*		Arecanut, Coconut	3) No webbing
12	*Polyphagotarsonemus latus*	Tarsonemidae	Chilli, Potato, Tea, Dahlia	1) Downward Curling of leaves 2) Formation of longitudinal tissues
13	*Aceria litchi*	Eriophidae	Litchi	Erineum
14	*Aceria jasmini*		Jasmine	Felt-like dense hairy out growth
15	*Aceria guerreronis*		Coconut	Formation of warts
16	*Phyllocoptruta oleivora*		Citrus	Russeting of leaves and fruits
17	*Aceria mangifera*		Mango	Crowded buds, crumpled shoots, witches broom effect

Damage and Symptoms Produced by *Brevipalpus spp*. under Tenuipalpidae

Brevipalpus mites inject toxic saliva into fruits, leaves, stems, twigs, and bud tissues of numerous plant species, including citrus. Feeding injury symptoms on selected plants include: chlorosis, blistering, bronzing, or necrotic areas on leaves. Several mites in the genus *Brevipalpus* may transmit the Citrus leprosis virus (CiLV). Citrus leprosis causes yield reduction and eventual death of the trees if its mite vectors are not controlled.

Damage and Symptoms Produced by Broad Mite or Yellow Mite in Chilli *(Polyphagotarsonemus latus)* under Tarsonemidae

The typical pattern of damage consists of malformation and distortion of the leaves. The mites show a preference for stylet feeding on young, developing leaf tissue. Whilst

Figure 1: Spider mites with their eggs

sucking out the contents of plant cells, secrete substances that disturb local growth. Leaf feeding is mainly concentrated on the underside near the leaf stalk, which tends to cause the leaf to turn brown, downward curling and crinkling with elongated petioles and stunted growth (Figure 2).

Figure 2: Yellow mites with eggs

Damage and Symptoms Produced by Mites under Eriophidae

Aceria litchi

Both nymphs and adults of mite damage the leaves, inflorescence and developing fruits through sucking the cell sap. Due to continuous sucking of sap, leaf tissues become aggravated and formed erineum. The symptoms occurs as velvety growth on the lower leaf surface which enlarges and turn to brown-chocolate colour with deep lesion resulting in reduction in photosynthetic area. Very severe infestation recorded in unmanaged litchi orchards, and spread takes place from the neighboring plants and orchards. In such orchard, very poor flowering and fruiting takes place and growers suffer from huge economical losses. The maximum incidence of the mite is noticed during the July-October and February-March especially in un-pruned and poorly managed orchard. Saplings should be prepared only from non-infested plants.

Coconut Perianth Mite *(Aceria guerreronis)*

Numerous numbers of both nymphs and adults mites inhabit just under the perianth part of the green coconut. Due to their continuous feeding, pale yellow triangular patches are seen below the perianth which becomes brown to black necrotic lesions. Severely affected buttons may fall. Uneven growth results in distortion and stunting of nuts leading to reduction in copra yield. In severe cases, the nuts are malformed with cracks and hardened husk (Figure 3).

Mango Bud Mite (*Aceria mangiferae*)

This mite lives within closed adventitive leaf buds. Due to feeding it produces stunted and malformed leaves with stubby and shrubby branches popularly known as witches' broom. Young plants are more susceptible to attack. The most common symptom is abnormal, compact development of leaves, flowers and shoots. Both normal growth and growth affected by mango malformation disease may be present on the same tree. The growing points (buds) produce misshapen shoots with short internodes and brittle leaves. The leaves are much smaller than those of healthy plants and re-curve towards the stem giving a squat, bunchy-top appearance. Actually mango malformation disease is caused by fungus *Fusarium mangiferae* after vectoring through *Aceria mangiferae*.

Figure 3: Perianth mite infested coconuts

Integrated Management of Mites in Horticultural Crops

Monitoring

Check the undersides of leaves for mites, their eggs, and webbing. Be sure mites are present before you treat. Sometimes the mites will be gone by the time you notice the damage; plants will often recover after mites have left.

Preventive Control

i) Hosing leaf undersides dislodges mites, ii) Reduce plant stress through proper watering and fertilizing practices, iii) Clean up overwintering sites, especially plant debris, iv) Encourage predatory mites by avoiding toxic sprays, v) Keep the field and surroundings free from weeds, vi) Treating seeds with thiamethoxam + abamectin to avoid attack of mites at seedling stage.

Biological Control

The insects included in the order Coleoptera, Thysanoptera, Hemiptera, Diptera, and Neuroptera are known to act as a biological agent of mites (Ramzan *et al.,* 2019).

Coccinellidae

Some generalist feeder for mites under Coccinellidae is *Hippodamia convergens* and *Harmonia axyridis*. The specialist feeders are *Stethorus spp.* If in a filed there is much population of *Stethorus* sp. it is evident that mites have been attacked by them and is under control.

Staphylinidae

It includes the well-known insect *i.e.* rove beetles. The beetles in the genus *Oligota* acts as a biological agent and feeds on the biological life of mites. The important predators against mites are *O. coffeae, B. arborea* and *O. yothersi.*

Thysanoptera

The families of Phlaeothripidae, Aeolothripidae and Thripidae include some predatory species which are problematic for the survival of mites. The important predator belonging to thrips are six spotted thrips *Scolothrips sexmaculatus* feeds on *Eotetranyhcus sexmaculatus, T. urticae, P. citri, O. punicae,* and *P. ulmi*.

Anthocoridae

Anthocoris, *Orius* feeds on different stages of mites. Some species such as *Orius tristicolor, Orius albidipennis* and *Orius insidiosis* have been used globally in the biocontrol programmes of different countries.

Miridae

Predators of Miridae are known to be used on large scale in European region. Notable species is *Macrolophus caliginosus* feeds on the two-spotted spider mite.

Lygaeidae

Geocoris sp. is noted to feed on many species of mites. It only feeds on the adults and eggs of mites. It has been observed that a single predator of *Geocoris* sp. can eat 1600 spider mites during in its young stages and at the older stages an adult can consume 80 mites per day.

Cecidomyiidae

It possesses threat to the mites. *Feltiella acarisuga* is used as bio-control agent in different countries to manage different stages of mites.

Chrysopidae

The globally famous insects *Chrysoperla carnea* is being included in this family. *Mallada spp.* and *Chrysoperla carnea* are potential predators of mite pests such as *T. urticae,, P. citri* and *T. ludeni*.

Coniopterygidae

The common features of these insects are the appearance of dusty wings and adults and larvae spend their life by consuming spider mites. *Conwentzia psociformis* feeds primarily on the spider mite.

Hemerobiidae

Fauna of Hemerobiidae is found all over the world and commonly known as the brown lace wing. They have been watched to feed on spider mites.

Predatory Mites

Mites are also threatened by its own species. The species are included in the family of Ascidae, Bdellidae, Cheyletidae, Cunaxidae, Phytoseiidae, Stigmaeidae, Tydeidae etc. Common predatory mites include *Phytoseiulus persimilis* (good against Tetranychids), *Mesoseiulus longipes*, *Galendromus occidentalis* and *Amblyseius andersoni* (a native predatory species).

Pathogenic Control

A few records have shown that on the different crops pathogenic control is successful to control mites. *Neozygites floridana* a fungus controlled the mite population. *Hirsutella thompsoni* is used to control eriophid mite in coconut.

Chemical and Botanical Control

Several chemicals including some insecticides are recommended against different types of mites. They are called as acaricides or miticides (Table 2). Synthetic pyrethroids can kill predatory mites resulting spider mite outbreak. Again certain insecticides stimulate mite reproduction. For example, spider mites exposed to carbaryl and some organophosphates have been shown to reproduce faster by increasing leaf nitrogen level. Organic insecticides like mineral oil, neem oil etc. are used at low populations of mites. Insecticides applied during hot weather usually appear to have the greatest effect, causing dramatic spider mite outbreaks within a few days. If a treatment for mites is necessary, use selective materials, preferably insecticidal soap or insecticidal oil. Both petroleum-based horticultural oils and plant-based oils such as neem, canola or cotton seed oils are acceptable. There are also a number of plant extracts formulated as acaricides that exert an effect on spider mites. These include garlic extract, clove oil, mint oils, rosemary oil, cinnamon oil and others. Don't use soaps or oils on water-stressed plants or when temperatures exceed 90 °F. These materials may injure some plants, so check labels and/or test them out on a portion of the foliage several days before applying a full treatment. Oils and soaps must contact mites to kill them, so excellent coverage, especially on the undersides of leaves, is essential, and repeats applications may be required.

Sulfur sprays can be used on some vegetables, fruit trees and ornamentals. This product will burn cucurbits and other plants in some cases. Don't use sulfur unless it has been shown to be safe for that plant in your locality. Use liquid products such as sulfur and potash soap combinations rather than sulfur dusts, which drift easily and can be breathed in.

Don't use sulfur if temperatures exceed 90 °F and don't apply sulfur within 30 days of an oil spray. Sulfur is a skin irritant and eye and respiratory hazard, so always wear appropriate protective clothing.

Chemical intervention can be needed to keep the crop alive if spider mites are abundant. When a mite infestation is limited, fields should be scouted. Miticide should be applied as a spot treatment to isolated infestations. Mite control is better when higher volumes of water are used. Several pesticides are registered for mite control; some are restricted use and some are for general use for vegetable and fruit crops. At some locations, organophosphates are still effective for mite control, with Dimethoate being the best and Metasystox as another choice. Dimethoate is an option for melons but is not allowed on squash or cucumbers. Dimethoate is prohibited from use on ornamental crops in high tunnels and greenhouses but is not prohibited from vegetable crops in high tunnels and greenhouses. Where organophosphates are not effective, abamectin is generally the most effective product for mite control but it is a restricted-use product. While bifenazate and spiromesifen are nearly as good but are not restricted-use products. Although bifenthrin and fenpropathrin are labeled for mite control, they are generally not as effective as the true miticides. Dicofol is an old miticide that is still effective at some sites, but does not perform well at sites where resistant populations have developed. Oxamyl is a restricted use product that is registered for use on eggplant for mite control. On organic farms, insecticidal soap can be used for mite control but thorough coverage of the undersides of leaves is needed for good control.

Table 2: List of some chemicals used as acaricides

Group	Example(s)
Macrocyclic lactones	Abamectin
Oragnochlorines	Dicofol
Carbamates	Carbaryl, Carbofuran, Aldicarb
Formamidine	Chlordemiform, Amitraz
Organophosphates	Monocrotophos, Chlorpyrifos, Dimethoate, Ethion, Formothion, Phorate, Phosalone, Triazophos
Phenyl Pyrazole	Fipronil
Pyrethoids	Cypermethrin, Fluvalinate
Thiourea derivatives	Diafenthiuron
Pyrroles	Chlorfenapyr
Thiazolidine	Hexythiazox
Sulfite ester	Propargite
Ouinazoline	Fenazaquin
Tetraonic acid derivatives	Spiromesifen
Pyridazinones	Fenpyroximate

Special Care for Perianth Mite in Coconut

The recommended dose of fertilizers, azadirachtin and micronutrients showed significant role for percent reduction of mite population. Among the micronutrients, boron is quite essential to prevent cracking of nuts. Cracking is associated with mite feeding of coconut meristem. Boron deficiency produces more quinines which leads to cell damage, cessation of growth and browning of tissues. Boron activates certain dehydrogenase enzymes, facilitate sugar translocation and synthesis of nucleic acid and plant hormones which are essential for cell division and development of meristematic tissues, flowering and fruit setting. Therefore plant got developed physiological resistance against the mite infestation.

Conclusion

Mites' microscopic size and less knowledge apropos its identification, habit, habitat, damage, management strategies etc. on horticultural crops create difficulty for their economic suppression. So, detailed findings in present article from different authentic sources on some mites of horticultural crops could be helpful for their identification. Accordingly, judicious decision might be adopted for sustainable management of mites through integrated approaches.

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