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Integrated Management of Mite Pests in Tropical Environment

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Mites are among the most notorious non-insect pests in tropical environment .The agricultural sector in India witnessed an aggravation of the phytophagous mite problem following the widespread introduction and use of pesticides in recent time. Worldwide there are more than 6000 species of mites that feed on plants but only about 100 species cause economic damage to crops and ornamentals (Hoy, 2011). Indian tropical characteristics like high humidity and warm condition accelerate mite life cycles, leading to rapid population explosion.

Integrated Management Of Mites

Planting schedule: The planting schedule is an important cultural practice used to reduce pest incidence by avoiding overlap between the crop growth stages and peak pest populations. Timely sowing of crops helps plants establish well and escape severe pest attack, while early or adjusted planting can prevent pests from completing their life cycle on the crop. Early planting can be used to mitigate damage by *Aceria tulipae* Keifer .A combination of early planting dates and low storage temperatures after harvest can be used to reduce infestations by this mite on tulips (Conjin *et al*., 1996).Cassava can be planted early during the rainy period so that the plants are more mature when Mononychellus mites attack during the dry season (Bellotti, 1985).

Host tolerance and resistance: In the management of mite pests under tropical environments, host plant resistance and tolerance play a crucial role as eco-friendly and sustainable components of integrated pest management. Host resistance refers to the inherent ability of a plant to reduce mite infestation through antibiosis, antixenosis, or both, such as the presence of thick cuticle, leaf pubescence, or biochemical compounds that negatively affect mite survival, development, and reproduction. Several crop varieties grown in the tropics exhibit resistance to mites like *Tetranychus* spp., thereby limiting population build-up even under favourable warm and dry conditions. Host tolerance, on the other hand, is the capacity of a plant to withstand or recover from mite damage without significant yield loss, even when mite populations are present. Tolerant varieties maintain physiological functions through better compensatory growth and stress tolerance, which is particularly important in tropical regions where mite pressure is often continuous. The use of resistant and tolerant cultivars reduces reliance on acaricides, delays resistance development in mites, conserves natural enemies, and forms a strong preventive foundation for integrated mite management in tropical agro-ecosystems.

Host nutrition influence on mite species: Plant nutrients can have a direct effect on mite populations. *Tetranychus urticae* females respond to leaves with high nitrogen availability and low carbon to nitrogen ratio (Hoffland *et al*., 2000). Higher level of nitrogen application increase the nitrogen content in the plant which induces an increase in the population growth of spider mites. In addition, high fertilizer rates and excess soluble elements such as silicon, magnesium, and calcium, also tend to favor spider mite populations (Jeppson *et al*., 1975).

Insect predators of plant feeding mites: A wide range of insect predators naturally suppress populations of phytophagous mites in agricultural ecosystems. These predators belong to several insect orders, including Coleoptera, Diptera, Hemiptera, Thysanoptera, and Neuroptera, although only a limited number are commercially exploited for augmentative biological control. Among them, predatory beetles of the genus *Stethorus* (Coleoptera: Coccinellidae) are considered highly effective and specialized feeders on spider mites. Both larvae and adults of *Stethorus* species actively prey on various spider mite species across diverse cropping systems such as fruit trees, vegetables, plantation crops, ornamentals, and field crops. Their high predation capacity enables them to rapidly reduce mite populations under favorable conditions. In addition to coccinellid beetles, other insect predators such as lacewings (*Chrysoperla* spp.), predatory thrips, and certain hemipteran bugs also contribute to natural regulation of mite pests, particularly when pesticide pressure is low. Conservation and encouragement of these insect predators through judicious pesticide use and habitat management enhance their role in integrated mite management programs, especially in tropical agro-ecosystems.

Predatory mite conservation: In tropical agriculture system conservation strategies for beneficial predatory mites include less use of pesticides that are harmful to them and use of lesser harmful pesticides at low doses cause low predator mortalities. Proper timing of pesticide applications plays a critical role in conserving predatory mites. Applications should be avoided during peak activity periods of natural enemies, and treatments should be targeted to localized pest infestations rather than applied uniformly across fields.

Chemical control: Selective acaricides such as abamectin, fenazaquin, propargite, spiromesifen, hexythiazox, and etoxazole are commonly used to manage mite populations when they exceed the economic threshold level. In tropical conditions, where high temperature favors rapid mite multiplication, timely and need-based application of chemicals is essential to prevent outbreaks. Rotation of acaricides with different modes of action is strongly recommended to delay the development of resistance, which is a major concern in mite management. Spot treatment, correct dosage, and proper spray coverage, especially on the underside of leaves, improve effectiveness while minimizing non-target effects.

Biological control: Biological control of mites in tropical environments involves the use of natural enemies to suppress mite populations in an eco-friendly and sustainable manner. Predatory mites such as *Phytoseiulus persimilis*, *Amblyseius* (*Neoseiulus*) *longispinosus*, *Amblyseius cucumeris*, and *Euseius* spp. Are highly effective against phytophagous mites like *Tetranychus* spp. Under warm and humid tropical conditions. In addition to predatory mites, insects such as ladybird beetles (*Stethorus* spp.), lacewings (*Chrysoperla* spp.), and predatory thrips also contribute to mite regulation. Entomopathogenic fungi, particularly *Beauveria bassiana*, *Metarhizium anisopliae*, and *Hirsutella thompsonii*, play an important role by infecting and killing mite pests, especially during periods of high humidity common in the tropics. Conservation of these natural enemies through reduced use of broad-spectrum pesticides, adoption of selective chemicals, and maintenance of suitable microclimates enhances their effectiveness.

Conclusion

Integrated pest management of mite provides a sustainable, economically viable, and environmentally safe approach to reduce crop losses while conserving biodiversity. By combining cultural practices, use of resistant or tolerant varieties, biological control agents, need-based application of selective acaricides, and regular monitoring, mite populations can be effectively managed under tropical climatic conditions that favor rapid pest multiplication. Emphasis on conservation of natural enemies, judicious pesticide use, and farmer awareness further strengthens IPM strategies. Overall, IPM ensures long-term suppression of mite pests, minimizes pesticide resistance and resurgence, and supports sustainable agricultural production in tropical ecosystems.

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