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Emerging Pests of Horticultural Crops in Northeast and its Management

The horticulture sector is a shining beacon making a vast contribution to the rapidly growing Indian Economy. It supports the sustainable livelihood of many fruit and vegetable farmers. In addition, it also provides employment opportunities through post-harvest value addition to SHGs, entrepreneurs, rural youth, women, etc., across the country. The NE region is home to many unique and underutilised fruits and vegetables, besides many GI-tagged fruits, cash crops and spices. It contains over one-third of the country's total fruit diversity. Such a wide range of economically important horticultural crops are infested by various insect pests, hampering their production and lowering their productivity. Changing climate and cultural practices are a few factors leading to the emergence of many insect species as pests causing economic damage. They include invasive insects alien to the country that could threaten the biodiversity of the region and are polyphagous, capable of feeding on new hosts. Since the NE region is promoted as an organic hub of the country, thrust is given to organic pest management practices to manage these pests.

THE Indian Horticulture scenario is vibrant and thriving. It makes a very significant contribution to the Indian economy. The production of horticultural crops breaks new records every year, and the productivity of horticultural crops is much higher than that of food grains (12.49 tonnes/ha against 2.23 tonnes/ha.). Its productivity and profitability have surpassed that of agricultural crops. India is the second-largest producer of fruits and vegetables. The diverse range of horticultural crops produced in India also gives rise to immense potential for post-harvest processing and value-addition. It opens up another expanding behemoth industry that supports the sustainable livelihood of many people across the country.

The Northeast Hilly (NEH) region contains over one-third of the country's total fruit diversity. The region is also known for being a rich reservoir of germplasms consisting of underutilised and underexploited fruits besides commercial ones. Most fruits and vegetables are rich in vitamins, minerals and antioxidants. Indigenous seasonal fruits contain high bioactive compounds with significant scope and potential for commercialisation.

The richness of fruits and vegetables diversity from the NEH Region can be known from the many GI-tagged horticultural produce from NE India, such as Arunachal Orange (Arunachal Pradesh), Assam Orthodox Tea, Tezpur Litchi, Assam Karbi Anglong Ginger (Assam), Khasi Mandarin, Memang Narang, Lakadang Turmeric (Meghalaya), Mizo Chilli commonly said Bird's Eye Chilli (Mizoram), Naga Chilly commonly known as Bhoot Jalakia, Naga Tree Tomato (Nagaland), Sikkim Large Cardamom and Dalle Khursii (Sikkim), Tripura Queen Pineapple (Tripura) and Kachai lemon, Tamenglong Orange and Sirarakhong Hathei from Manipur.

The horticulture sector and its underlying value-addition/post-harvest industry is the source of valuable foreign exchange for our country while at the same time playing a vital role in doubling farmers' income. It is a shining beacon in providing sustainable livelihood to thousands of rural farmers, SHGs, and entrepreneurs through the length and breadth of India. The growing demand for horticulture products, driven by increased health consciousness, rising income levels, export requirements, and population growth, presents a significant challenge in increasing the production and productivity of horticultural crops.

Pest of Horticultural crops in Northeast India

The phenomenon of climate change has shown heightened levels of uncertainties and dangers, hence imposing additional limitations on production systems. Insect pest has always been a limiting biotic factor in crop cultivation. The fight between arthropod insects and humanity competing for natural resources is an evolutionary saga continuing till the present times. Climate change regimes favouring the incidence and intensity of insect pest populations on agri-horticultural cropping systems is a new normal. The shifting of habitat, range expansion of arthropod insects and finding new host plants are also becoming common. As awareness of health effects and the consequences of prolonged reliance on synthetic chemical pesticides increases, their management cannot be solely on the aim of pest control. Tackling them with new

Spiralling Whitefly on King Chilli

strategies and techniques with minimal adverse effects on human health, non-target organisms, and the environment is a challenge that plant protection experts face together with agrochemists. Recently, some arthropod pests are commonly found causing economic damage to several horticultural crops, fruits and vegetables. Most of them are polyphagous and feed on several hosts. In NE India, the organic hub of the country, the use of chemical pesticides is usually discouraged, and farmers are encouraged to adopt a multi-pronged strategy that integrates different pest management techniques to manage the pest.

MANAGEMENT OF PEST IN NORTHEAST INDIA

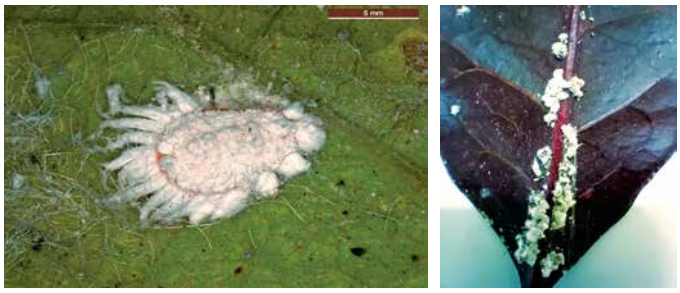
Spiralling whitefly

The spiralling whitefly, *Aleurodicus dispersus* Russell, is indigenous to Central America, the Caribbean, and the Pacific islands. It was so named because it lays eggs in a spiralling pattern. The whitefly has successfully spread across Africa, Asia, and Australia, colonising nearly all tropical regions globally. Their hosts encompass a wide range of vegetation, including vegetables, fruits, decorative plants, and avenue trees. Within a few years, this pest has established itself and now spread to other crops such as guava, banana, brinjal and ornamentals and has become a severe pest in NE India since the past decade. It has been reported on endemic crops like king chilli, too.

After sucking sap from leaves, nymphs and adults release honeydew and a white waxy flocculent. The insect's white flocculent wax gave the plant a cotton-like appearance from afar. This white waxy material prevents insecticidal sprays from contacting the insect body, making them less effective. Some plant-sucking insects emit honeydew, which causes sooty mould. This mould can worsen plant damage.

The best pest management method is monitoring and scouting to prevent pests from appearing in a field or garden. Under favourable weather conditions, a few surviving nymphs or adults can rapidly colonise the population, making population management difficult.

Horticultural mineral oils are the most effective and safe pest control approach in many situations. Mineral oils can block the insect's spiracles and dissolve the pest defence formed by the waxy flocculent substance, exposing it to abiotic stress. However, they should not be used under high temperatures reaching 30°C.



Mealybugs on different host plants

Two efficient whitefly treatments are Hortimin and Lastraw horticultural oils. Whitefly populations can be controlled with 5 ml of oil per litre of water. Horticultural oils can manage pests, protect non-target organisms, and decompose quickly, making them potential pesticide alternatives. Spraying of neem oil (2%), neem seed kernel extract (3%), fish oil resin soap (4%) and detergent soap solution (5%), *Pongamia* products, *viz*., oil and soap were also found to be effective in suppressing the nymphal and adult whitefly population under low population level.

Mealybugs

India has 10 economically important mealybug species. The papaya mealybug, from Central America, was introduced to India in 2007. All species belong to Hemiptera and Pseudococcidae. All these organisms are polyphagous, meaning they can eat many plant genera. Furthermore, each species has distinct features.

A few mealybug species are vectors for viruses. Mealybugs that transmit viral diseases pose a greater threat than non-transmitting mealybugs. For instance, the citrus mealybug is a vector of the Banana Streak Virus (BSV). The Mealybug Wilt of Pineapple (Pineapple mealybug wilt-associated viruses 1 and 2) is a virus disease associated with Pineapple mealybug. Three species of pineapple mealybug have already been identified as vectors of the disease. The initial focus of infection usually occurs near the field edges and spreads inward. The pineapple mealybug is associated with the roots of its host plant. Additionally, it can be observed that the organism conceals itself among the pineapple plant's inner bracts and leaf whorls, thereby evading insecticidal sprays that cannot penetrate these specific areas. The primary site of infection typically manifests near the field's boundaries and subsequently expands towards the centre. Both banana and pineapple are important economic fruits of the NE Region.

Mealybugs are 3-4 mm long, cotton-like, spongy arthropods. They appear on leaves, stems, and roots. The insects live in colonies with white mealy matter or wax covering that protects them from insecticides. These organisms form tight, white cotton-like clusters in heavy infestations, making removal more challenging.

These organisms use their piercing and sucking mouthparts to suck sap from foliage and stems, depriving the plant of nourishment. In severe infestations, sooty mould darkens the plant. Ants care for mealybugs for their honeydew secretion and help them move across plants. Mealybugs were once considered minor pests. However, these little insects have become major pests in

many crops, requiring control measures. Shifting climatic conditions may be contributing to mealybug proliferation and damage.

The government is promoting organic production in the NE region, where pineapple is a major commercial commodity with an export market and value enhancement. It's important to note that the pineapple mealybug might threaten its development and destroy orchards.

Hortimin and Lastraw are non-insecticidal mixtures that manage all soft-bodied sucking pests such as mealybugs, thrips, white flies, mites, aphids, scale insects, and plant hoppers. Some organic salt-based mixtures are sold. These are eco-friendly, naturally safe, non-toxic, and biodegradable treatments for persistent insect pests with a mealy/waxy covering that outperforms synthetic chemical insecticides.

Leaf miners

The tomato pinworm, Tuta absoluta (Meyrick) (Lepidoptera: *Gelechiidae*), a damaging invasive pest, was discovered in India in 2014. The pest has spread from South America to Europe, Africa, and India. Tuta absoluta favours tomato but has also been found on potato and other solanaceous plants. It affects tomato growth at all stages and has multiple generations per year. Caterpillars feed on leaves, stems, buds, calyces, young fruit, and ripe fruit and introduce secondary infections through their wounds. Under greenhouse and field conditions, it can reduce productivity and fruit quality by 90%. T. absoluta larvae mine leaves, create enormous galleries and burrow into fruit, reducing tomato production in sheltered and open fields. Mesophyll-eating larvae construct uneven leaf mines. T. absoluta displays strong reproduction potential. In ideal conditions, 10-12 generations occur annually. T. absoluta can overwinter as eggs, pupae, and adults. A female moth can lay hundreds of eggs as an adult. Tomato infestations show black frass on apical buds, leaves, stems, flowers, and fruits. Mostly, aerial sections of potatoes are attacked; however, tuber damage was reported recently.

The citrus leaf miner, *Phyllocnistis citrella* Stainton, is also becoming a major pest on citrus in the region. They mine the leaves of their host plant. The mine consists of a long epidermal corridor with a well-marked central Fras line. The unsightly mine is primarily on the lower-surface, but sometimes on the upper-surface of the leaves and hardly on the rind of the developing fruit. Citrus leaf miner caterpillars are protected from many topical insecticide treatments. Pupation occurs in a chamber at the end of the corridor, under an overturned part of the leaf margin.

Citrus leaf miner and damage on citrus plant

The young pale-yellow larvae immediately start feeding between the epidermal layers of the leaf. The pest usually prefers young leaves and not the hardened older ones. The characteristic symptom of leaf miners is the presence of silvery serpentine mines, usually on the undersurface of the leaf. Each leaf has only a single mine, but there may be several mines per leaf in case of heavy infestation. Mining of the leaves causes them to curl up, distorted and thereby reducing the photosynthetic area of the young foliage. In case of severe infestation, mines can also be seen on the upper side of the leaves and the shoot portion of new twigs. Damage by this pest predisposes the acid lime plants to develop canker disease. The serpentine leaf miner, *Liriomyza* spp., is becoming a significant pest for vegetable crops, posing economic challenges. This highly adaptable pest feeds on nearly 28 plant families, including vegetables and ornamental plants. Female serpentine leaf miners puncture the leaf epidermis to lay eggs, and the hatched larvae feed by creating tunnels between the leaf layers. This damages the plant by reducing photosynthesis, causing leaves to dry up, drop, and hampering overall growth. The pest's life cycle is closely tied to temperature, with one generation completing in 14-15 days at a consistent temperature of 28°C. In the favourable climate of Northeast India, this pest has rapidly become a significant threat to vegetable crops.

It is strongly advised to conduct regular monitoring of the pest. An effective method to manage leaf miners is by collecting the mined and dried leaves and disposing of them. Chemical management options involve spraying Cyantraniliprole 10.26 OD @ 1.8 ml per litre. Botanical solutions such as 5% neem seed kernel extract in sprays can significantly reduce egg laying and deter larval feeding. Spinosad and horticultural oils, including neem oil, are very good organic control agents for leaf miners. Farmers can apply these during the flush and spray on young, developing leaves. While average temperatures are below 25° C, spray the leaves for 10-14 days until they have hardened. The oils may also help inhibit eggs from hatching.

Hemipteran Bugs

Recently, bugs have also become an emerging pest of many economically important horticultural crops of NE India. The Kachai Lemon is a rough lemon landrace known for its exceptional yield and significant commercial worth. Due to its uniqueness, Kachai Lemon has been accorded geographical indication (GI) registration (GI-466). It is considered to have the highest ascorbic acid, 51%, while other lemon cultivars have only 20 to 30%. The fruit is commonly consumed in its raw form and is utilised to produce juice and pickles.

It was reported that the hemipteran bugs are attacking sporadically throughout the crop growth stage of Kachai Lemon, *Citrus jambheri* Lush all year round in various parts of Kachai lemon-growing areas of Ukhrul, Manipur. The nymphs and adults of pentatomid bugs, *Cappaea taprobanensis*, attack by sucking the sap of young shoots and leaves, thereby causing the leaf yellowing and drying

Cappaea taprobanensis and *Tessaratoma javanica*

up of the leaves and stem. They also attack fruits, which reduces the quality of the juice sac and affects the market value. The punctured point may cause further bacterial secondary infection on the fruit. Litchi is also another fruit that is coming up very well in Manipur.

It is already an established crop in Assam, Tripura, Arunachal Pradesh, Sikkim, Mizoram and Nagaland. Its production is also quite good in these NE states.

The litchi bug, *Tessaratoma javanica* (Thunberg), is also becoming a menace in recently developed litchi-growing areas of Manipur. Due to its sucking habit, both the nymphs and adults of the stink bug cause injury to the newly appeared shoot at the start of the winter season. Its infestation has led to hampering the growth and development of the parts of the plants. Once the fruit formation starts, they puncture the peduncle of the newly emerged fruits and block the nutrient supply for further fruit development. The marketable quality of the fruit was drastically reduced by the accumulation of excreta or younger nymphs after ripening.

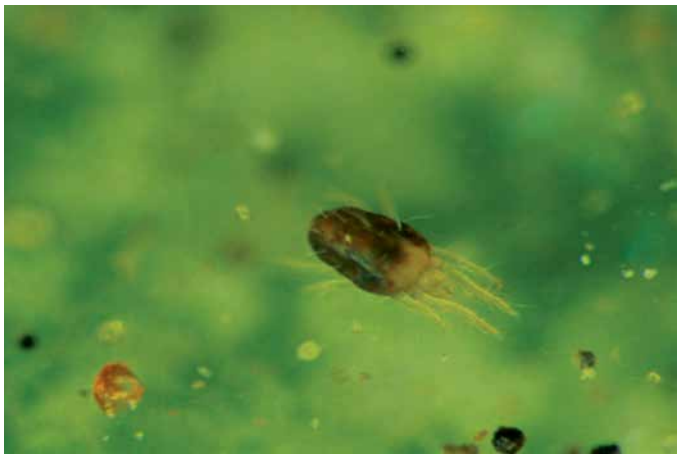
The black citrus aphid, *Toxoptera aurantii,* which is highly polyphagous, is rapidly becoming a major threat to many vegetables, trees and ornamental crops. The adult is microscopic and only 2 mm long with four nymphal wingless stages and brownish. The infested leaves show yellowing and stunted, which affects the formation of fruits.

Mites

The incidence of mites has been increasing over the past decade in ornamental plants and horticultural fruits and vegetables. The NE region has seen alternate spells of dry, hot weather and rain; such weather conditions are known to favour the incidence of mites. One mite species increasingly observed in fruits and vegetables is red spider mite or two-spotted spider mite, *Tetranychus urticae.*

Dense vegetation and dense canopy cover also favour their incidence and establishment. Fruit trees and vegetables are increasingly under attack from this pest. It is observed underneath the leaf and produces a good amount of webbing, which protects from insecticidal sprays. So, timely pruning is an excellent cultural practice to reduce and prevent mite infestation.

The Litchi mite, *Aceria litchii*, is a common pest in all litchi-growing areas of NE India. Gall mites, *A. tripuraensis* are usually soft-bodied, having an elongated and worm-like body. They are reported from Tripura from *Hibiscus macrophyllus*, largeleaf rosemallow plants. The mites' saliva produces a pouch or bead-like or finger-like, which are



Tetranychus urticae

bright colours and cause leaf bronzing. They made the plant produce cottony patches of velvety called erineum. Recently, phytoseiid mites such as *Euseius tripuraensis* sp. nov., *Euseius tripurii* sp. nov., *Euseius spontaneum* sp. nov., *Phytoseius khowaiensis* sp. nov., *Phytoseius birbikrami* sp. nov., *Typhlodromus (Anthoseius) sonajhuriae* sp. nov., and *Phytoseius baramuracus* sp. nov., were reported from the ornamental crops of Tripura. While, *Amblyseius azaliae* sp. nov., from Azalea plants, *Okiseius jainticus* sp. nov., from golden Himalayan raspberry, *Okiseius unisetatus* sp. nov., from litchi and *Typhlodromus campana* sp. nov., from raspberries were reported from Meghalaya, attacking sporadically throughout the crop growth stage.

To kill mites, pesticides should be applied before gall formation begins when mites are active. For mites that can spend the winter on the host plant, it is suggested to use oil-based biopesticides such as neem oil before mites' activity starts in the spring. Dimethoate, Diafenthiuron and Spiromesifen are very good acaricides for conventional farmers, and for organic farmers, wettable sulphur is a good option for managing mites.

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