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Inadvertent introduction of plant parasitic nematodes in orchards through fruit nurseries

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In our country, the horticultural sector comes under five major schemes viz., National Horticultural Mission (NHM), Horticultural mission for Northeast and Himalayan states (HMNEH), National Horticultural Board (NHB), Coconut Development Board (CDB) and Central Institute for Horticulture (CIH). They are playing a pivotal role in the promotion of new plantation of crops especially fruits and flowers across the country and has gained prominence over contributing share in gross value addition of the agriculture and allied sectors.

The production of fruits and vegetables has overruled the production of food grains. India is the second-largest producer of fruits and vegetables in the world and India ranks first in the production of banana, mango, lemon, papaya, okra, etc. Nowadays, more emphasis is given as it is emerging as a promising source of income as well as employment generation and promoting the exports.

The varieties tolerant or resistant to various abiotic and biotic stresses have been developed in fruits, vegetables, medicinal and aromatic plants.For the dissemination of thesetechnologies region and crop-specific training and demonstration programs regarding the production of disease-free and good quality plant materials are being taken up. But for few years, the scientists interpreted hundreds of such cases where the nematode infected planting materials

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that are originated from private or government nurseries are being used to establish new orchards. This had led to heavy plant mortalities duping farmers/ nurserymen of lakhs of rupees. Before going to the main context let's have a glance at the little introduction of plant-parasitic nematodes.

Nematodes are small thread-like worms (300 to 1000 micrometres long and 15 to 35 micrometres wide) invisible to naked eyes and can be easily observed under the microscope. They attack the roots of seedlings in the nurseries. Root-knot nematodes such as *Meloidogyne incognita*, *M. javanica*, *M. enterolobii*, renifrom nematodes (*Rotylen chulusreniformis*), *Heterodera* species (cyst nematodes) are the important nematode s that attack the seedlings of fruits and vegetables and ornamentals in nurseries. Hence the basic problem is unawareness about the nematode infection in plant materials among the frontline workers/officers of the state horticulture departments, nurserymen and orchardists. As a result, the nematode infested material is moving to the other states and contributing towards more nematode dissemination through infected plant materials especially fruits like guava, pomegranate, etc.

The growers are unaware of the fact that nematodes inadvertently spreads easily through infested soils or plant material, equipment's, water, hands, clothes, shoes, seeds, etc. Nematicides are indeed needed for better control but this can be easily avoided by careful cultural practices and strict sanitation procedures. But with the availability of online and sale of live ornamental plants, the situation has become more cumbersome in our country.

Nursery root symptoms below and above ground:

Above-ground symptoms: The plants exhibit chlorosis. *i.e.*, foliar yellowing and slow decline where eventually the plants get stunted and die (Picture 1).

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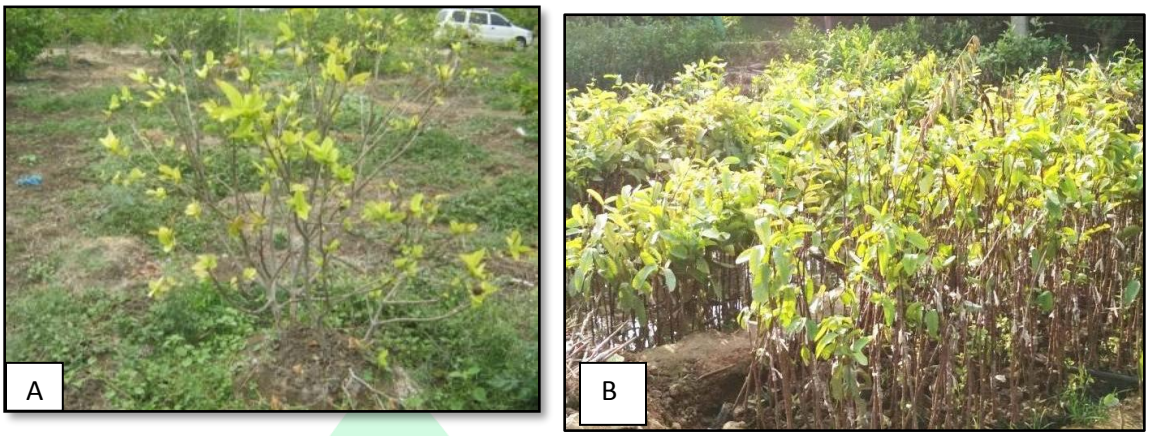

Picture 1: Above ground symptoms of the nematode infected plants after transplanting in main fields (A) and foliar yellowing of the nematode infected seedlings in the nursery (B)

Below-ground symptoms: Root symptoms exhibit root galls, lesions, knots, damaged root tips, stunted and rotted roots, bulbs or rhizomes (Picture 2).

Picture 2:Below-ground symptoms of the nematode infected plants after transplantingin main fields-Root galls and knots of the guava plants infected with root-knot nematodes

What are the preventive measures that the nursery growers should follow?

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- The growers should always tear open the polythene bags before buying the planting material from the private or government nurseries. If he explores knots or galls as shown in picture 2. he should avoid buying the lot as the first step of preventive measure.
- Planting should be done only in pest and pathogen-free soils or planting materials. For this, the soil should be surface sterilized. As a good agricultural practice, solarizationof soil in open by the use of thin polythene sheets (25 micron thickness) for about 2-3 months at the time of summer has proved to be very effective. (Picture 3)
- In the same aspect, solarization of soil-filled polythene bags by covering them with polythene sheets ensures double solarization of soil (Picture 3)

Picture 3: Solarization of the potting soil during summer (A) and solarization of soil-filled polythene bags with plastic sheets during summer (B)

The nursery growers can also use the soil from virgin lands or dry soil from ponds for filling the bags.

In place of soil, they can use soil-less medium such as coir pith or vermicompost which can be drenched with hydrogen peroxide or formaldehyde and then undergo solarization for few weeks to ensure nematode free medium for filling nursery bags.

Apart from these, other methods are the use of plant growth-promoting rhizobacteria (PGPR) that colonizes the roots of plants. This enhances plant growth and reduces the risk of diseases, nematodes or insect damage. eg.*Pseudomonas* spp. and *Bacillus* spp. Even though effective chemicals are available in the market, opting for commercial bioagents formulations like

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Purpure ocilliumlilacinum and *Pochonia chlamydosporia*, etc. which are egg parasitic are highly preferred. Also, *Trichoderma viridae* and *T. harzianum* can be multiplied in FYM and can be added to potting media.

In addition to all these the certification of the nursery, planting materials must be enforced by government agencies to ensure the movement of nematode free plant materials.

Conclusions: Research should be emphasized on the locally available wild seedlings that can be used as rootstocks for grafting as they offer resistance against nematodes. In the case of banana, pomegranate, citrus the growers can grow tissue cultured plants, but for guava cultivation, it is not possible. Guava is affected by *Meloidogyne graminicola* which is reported as an emerging problem as it is spreading fast throughout the country through thenursery stock. The growers must adopt few measures like

- Propagation through healthy planting material
- Ensuring root-knot nematode free planting site for new orchards, by getting the soil tested from the nematology laboratories
- Addition of mycorrhizae in the rhizosphere zone
- Growing *Tagetes*spp. (Marigold) around the basin area

The growers and extension workers have little awareness regarding these issues. Hence, it is very important to educate all the stakeholders and farmers about the prevailing nematode problems in nurseries, their biology, nature of damage, symptoms and options for their management.