



AGRI MAGAZINE

(International E-Magazine for Agricultural Articles)

Volume: 01, Issue: 05 (December, 2024)

Available online at <http://www.agrimagazine.in>

© Agri Magazine, ISSN: 3048-8656

Rootstock and Further Management of Horticultural Plants

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Rootstocks (RTS) play a crucial role in the growth, development, and productivity of horticultural plants, especially fruit trees. In horticulture, rootstocks are used to influence various aspects of plant performance, including size, disease resistance, drought tolerance, and yield. Rootstock management, along with general plant management techniques, is essential for optimizing the health and productivity of horticultural crops.

1. Role of Rootstocks (RTS) in Horticulture

Rootstocks are the portion of a plant that supports the scion (the upper part of the plant that is grafted onto the rootstock). The interaction between the rootstock and the scion has significant implications for the performance of the plant. Rootstocks are commonly used in fruit crops such as apples, citrus, grapes, and stone fruits like peaches, plums, and cherries. Some key functions of rootstocks include:

a. Control Plant Size

- **Dwarfing Rootstocks:** These rootstocks limit the growth of the scion, keeping the tree smaller and more manageable. For instance, in apples, dwarfing rootstocks like M9 or M27 are commonly used to create compact trees, which makes it easier to manage and harvest.
- **Standard Rootstocks:** These rootstocks allow for normal or larger tree growth and are generally used for varieties that need more space and better anchorage.

b. Improve Disease Resistance

- Rootstocks can be selected for their resistance to specific soil-borne diseases and pests. For example, certain rootstocks are resistant to **Phytophthora** (root rot) or **nematodes**, which can be critical in regions where these pathogens are prevalent. Rootstocks for citrus plants like the **Troyer** citrange have resistance to **Citrus tristeza virus (CTV)**.

c. Enhance Drought and Stress Tolerance

- Some rootstocks provide improved tolerance to water stress, salinity, and other environmental challenges. For instance, **Poncirus trifoliata**, used in citrus rootstocks, is more tolerant to drought conditions and extreme temperatures.

d. Influence Fruit Quality and Yield

- The combination of rootstock and scion can have a significant impact on fruit size, taste, and the amount of yield. For example, certain rootstocks may improve the fruit's sugar content or enhance its disease resistance, leading to healthier, more productive orchards.

e. Increase Root Development

- Strong, deep roots from certain rootstocks can allow the tree to better access water and nutrients from deeper soil layers, ensuring that the plant remains vigorous, especially in poor soils.

2. Selecting and Managing Rootstocks

The choice of rootstock depends on several factors such as soil type, climate, disease pressure, and the specific horticultural goals (e.g., fruit size, tree vigor, resistance to pests). Effective management of rootstocks involves the following practices:

a. Grafting Techniques

- **Grafting** is the process of joining the rootstock and scion. There are different grafting techniques, such as **cleft grafting**, **whip-and-tongue grafting**, and **side-veneer grafting**, each suited to different types of plants and rootstocks.
- Grafting should be done at the right time (usually during dormancy) and under proper conditions to ensure successful union of the scion and rootstock.

b. Rootstock-Scion Compatibility

- It is crucial to select rootstocks that are compatible with the chosen scion. Incompatibility can lead to poor growth, stunted development, or even graft failure. Ensuring genetic compatibility between the rootstock and scion is essential for healthy plant growth.

c. Hardening and Transition Period

- After grafting, plants need to be carefully hardened and acclimatized to field conditions. Young grafted plants should be kept in a protected nursery environment until they are strong enough to be transplanted into the field. This period should include hardening off and acclimatization to temperature and humidity changes.

3. Further Management of Horticultural Plants

Effective management of horticultural plants requires comprehensive practices that go beyond just rootstock selection. The following techniques help to maintain the health and productivity of horticultural crops:

a. Irrigation Management

- **Drip Irrigation:** Drip irrigation is one of the most efficient methods for horticultural crops. It delivers water directly to the root zone, reducing water wastage and preventing diseases that occur with wet foliage.
- **Irrigation Scheduling:** Proper irrigation scheduling is essential to prevent overwatering or underwatering, both of which can stress the plants. Water stress can cause poor fruit development or excessive leaf drop.

b. Fertilization and Soil Management

- **Nutrient Management:** Fertilization should be based on soil tests to determine the necessary nutrients required for optimal growth. Micronutrients like magnesium, calcium, and potassium are especially important for fruit trees.
- **Organic Amendments:** Incorporating organic matter such as compost or cover crops can improve soil structure, water retention, and microbial health, which in turn benefits root development.
- **Soil pH and Drainage:** Most horticultural plants prefer slightly acidic to neutral soils. Soil amendments like lime can be used to adjust pH. Proper drainage is also crucial for preventing root rot and ensuring that the roots receive adequate oxygen.

c. Pest and Disease Management

- **Integrated Pest Management (IPM):** IPM involves using a combination of biological, physical, cultural, and chemical methods to control pests and diseases in a sustainable manner.
- 1. **Biological Control:** Introducing natural predators or beneficial insects (like ladybugs or nematodes) can help control pests without harming the environment.
- 2. **Cultural Practices:** Crop rotation, proper spacing, and sanitation practices like removing diseased plant parts can prevent the spread of pests and diseases.
- 3. **Chemical Control:** Use of pesticides should be done judiciously, only when necessary, and in compliance with regulations to minimize harmful effects on pollinators and the environment.

d. Pruning and Training

- **Pruning:** Regular pruning helps maintain the shape, health, and productivity of fruit trees. Removing dead, diseased, or damaged wood promotes better air circulation and sunlight penetration. For example, in apple orchards, pruning is essential to maintain tree shape, ensure good fruiting, and reduce pest pressure.

- **Training Systems:** Using different training systems like **central leader**, **modified central leader**, or **open vase** systems can optimize space utilization, airflow, and sunlight exposure, leading to better fruit production.

e. Mulching

- **Mulch Application:** Mulching helps conserve moisture, suppress weeds, and regulate soil temperature. Organic mulches like straw, wood chips, or grass clippings are commonly used in horticultural crops.
- **Weed Management:** Mulching helps reduce weed growth by blocking sunlight and can prevent competition for water and nutrients.

f. Pollination Management

- Many fruit crops require pollination by insects or wind. Ensuring a good population of pollinators (such as bees) in the orchard can improve fruit set and yield.
- **Bee Pollination:** In orchards where insect pollination is required, beekeepers are often introduced to the farm to enhance fruit set. Ensuring that the orchard is planted with suitable pollinator varieties (for cross-pollination) is also key.

g. Harvesting and Post-Harvest Management

- **Timing of Harvest:** Harvesting at the right time ensures the fruit is at its peak quality in terms of size, color, and taste.
- **Post-Harvest Handling:** Proper handling, sorting, and packaging help prevent fruit damage. This includes using soft handling methods, appropriate storage temperatures, and transporting fruits in the right conditions to ensure they reach the market in good condition.

4. Sustainability and Advanced Practices

Sustainability is becoming increasingly important in modern horticulture. Practices such as precision agriculture, agroforestry, and the use of organic inputs are gaining popularity. Here are some advanced strategies:

- **Precision Agriculture:** Using sensors, GPS, and data analytics to monitor plant health, soil moisture, and nutrient levels in real-time can help make more efficient use of resources.
- **Agroforestry:** Integrating trees into agricultural systems provides multiple benefits, including biodiversity conservation, improved soil health, and better water retention.
- **Organic Practices:** Growing fruits and vegetables without synthetic chemicals promotes soil health, reduces the risk of pesticide residues in food, and encourages biodiversity.

Conclusion

The management of rootstocks (RTS) and further horticultural plant management are interconnected and vital for the successful cultivation of fruit trees and other horticultural crops. Rootstocks influence plant size, disease resistance, and fruit yield, while proper cultural practices like irrigation, pest management, and pruning ensure healthy plant growth. Sustainable practices and advanced techniques are increasingly important in maintaining plant health, improving productivity, and reducing environmental impact in horticulture. Through effective management, growers can optimize the growth and profitability of their horticultural enterprises.