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TEMPERATE FRUITS ROOTSTOCK PROPAGATION: AN OVERVIEW

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ABSTRACT

A concise overview of temperate fruit tree rootstock growth causes is provided, alongside key propagation techniques. Recently, attributes like pest and disease resistance, tolerance to adverse climates, and the ability to dwarf the scion have become more important than ease of propagation when selecting clonal rootstocks. This shift is due to advanced propagation methods that allow for the cultivation of resistant clones. However, these novel techniques can lead to partial rootstock renewal, and micropropagated rootstocks may show increased burr knotting and frequent suckering, presenting challenges in their use.

KEYWORDS: Budding, Cuttings, Grafting, Layering, Micropropagation, Propagation, Stooling

INTRODUCTION

The rootstock, or subterranean component of the plant, is where the desired cultivar's scion wood or bud is inserted through the processes of grafting and budding. As the name implies, rootstock is resilient and has a robust root system. Seeds and vegetative methods are both used to propagate rootstocks. Seedling rootstocks and eventually clonal rootstocks are the names given to stocks that are grown from seeds. Clonal rootstocks have a shorter lifecycle than the seedling rootstocks, but they function better. Prior to choosing a rootstock, one should be aware of all of its characteristics as well as the growing environment. Such rootstocks that are more likely to be able to tolerate the chilly winter temperatures should be considered for temperate fruit production. Many rootstocks have different characteristics, including resilience to cold, drought, salt, pests, and diseases. These characteristics affect the scion cultivars in different ways, such as tree vigor, precocity, and fruit size.

Most tree fruit species' cultivars have historically had poor root propagation, regardless of whether layering or cutting techniques are applied. While propagation studies conducted over the previous 15 years has made some of the issues related to having scions growing from their own roots (Jones et al. 1985), subpar cropping results, sucking, and burr knotting still show issues with trees that root themselves (Webster et al. 1985). All rootstocks were produced from seed at first. original fruit species were harvested from their original populations, and the seeds were removed, allowed to germinate, and then planted to serve as rootstocks. In many regions of Europe, there were plentiful wild populations of apples (*Malus domestica* Borkh.), pears (*Pyrus communis* L.), plums (*Prunus domesticica* L.), sweet cherries (Prunus avium L.), and sour cherries (Prunus cerasus L.). These days, a lot more focus is placed on the qualities of rootstocks, such as their capacity to dwarf scions and their resilience to diseases and pests carried by the soil. As a result, several rootstock clones that are challenging to propagate have been chosen. This has made it necessary to modify and enhance conventional rootstock propagation methods.

METHODS OF PROPAGATION OF ROOTSTOCKS

The primary techniques used for rootstock propagation is given in Table 1. Most rootstocks are cultivated from seed around the world, but more and more clonal rootstocks are being utilized to propagate varieties of apples, pears, and sweet cherries. The majority of clonal apple and sweet cherry rootstocks are propagated using division methods, such as layering or scaffolding, while a smaller number are raised through cutting methods, such as root cuttings and micropropagation. Sometimes, a rootstock clone with highly desirable traits that is hard to root is employed as an interstock by grafting it between the scion and a more readily propagated rootstock clone

. **Table 1. Methods of rootstock propagation**

Plant part	Technique
Seed	Sexual Apomictic
Division	Stooling, Layering, Marcotting
Cutting	Soft wood cutting, Root cutting, Hardwood cutting, Semi-hardwood cutting, Micropropagation

PROPAGATION BY SEED

Most rootstocks for a wide variety of temperate and subtropical fruit and nut species, such as apricots, peaches, and nectarines (*Prunus persica* L.), (*Pyrus armeniaca* L.), and *Pyrus pyrifolia*, the Asian pear and citrus species are raised from seeds (Nakai). There are many benefits to seed propagation for the nurseryman; specifically, it's easier and less expensive to do than vegetative techniques. If trees were grown from seedlings, rootstocks offer any benefits to fruit growers, Nevertheless, is far less evident and frequently trees grown on seedling rootstocks are far less good than individuals using clonal rootstocks.

Seedling rootstocks may have obvious advantages in species like apples, where viruses are believed not to spread through seeds and where nurseries around the world struggle to keep virus-free clonal rootstocks healthy. Another benefit of seedling propagation is the ability to stop the spread of root-borne illnesses such crown gall (Agrobacterium tumefaciens). This problematic disease is often transferred to the new scion tree and the new site by rootstock liners from infected feces or layer beds. This issue is avoided by seedling stocks grown in soil free of crown gall.

However, there are three ways to improve the uniformity of performance of seedling rootstocks: (1) using seed from a single clonal variety (like the "Red Delicious" apple or "Bartlett" pear) or from a self-fertile cultivar grown in a monoculture; (2) using seed collected from virus-free mother orchards planted in isolation (like the Pontavium and Pontaris Prunus avium lines of Mazzard rootstocks available in France); and (3) using seed of apomictic rootstock selections.

In comparison with vegetative propagation relatively little research is now conducted into the techniques of seedling rootstock propagation for temperate fruits. The techniques of after-ripening and dormancy-breaking, essential with seed of many Rosaceae, are now well elucidated. Aids to dormancy-breaking, such as scarification, and stratification are widely adopted by commercial nurserymen. Treatment with hormones, which may also aid dormancy breaking are less frequently adopted, however. Treatment with gibberellic acid (GA3) and benzyl adenine (BA), (both at 20 mg/litre), of peach seeds which had previously been stratified at 10 and 15°C enhanced germination, whereas treatment with thiourea was ineffective in Thai trials (Siyapananont 1990). Similar results were recorded by Shatat and Sawwan (1985) who demonstrated that germination of Prunus mahaleb seed was improved significantly by treatment with Promalin (a mixture of GA4+7 and BA) at 3000 mg/litre.

STOOLING AND LAYERING

The division procedures employed in tree rootstock propagation, known as stooling or layering, were skill fully documented many years ago (Knight et al., 1927), and not much has changed in terms of how these processes are carried out since then (M AFF1969). They entail stimulating a portion of the rootstock stem to grow adventurous roots while it is still attached to the parent plant. Typically, to promote rooting, the targeted area of the stem is made darker by blanching or etiolation; this can be done with soil, another medium (such as sawdust or peat), or by covering it with an opaque material like plastic. Adequate temperatures must be combined with enough moisture and oxygen in the edaphic zone that is immediately surrounding the intended rooting zone. Stooling and stacking issues are typically caused by the above parameters not being met. Poor stool or layer bed performance is frequently caused by inadequate natural soil conditions or by using the wrong media when earthing up stools or layer beds. In many regions of the world, sawdust is frequently used to dirt up stool/layer beds; however, care must be taken to ensure that the wood species utilized contain no contaminants, either naturally occurring or introduced, that could prevent stool shoot roots. To promote stool shoot roots, some British nurserymen have added a coating of moist peat near the base of the shoots. Poor roots can also often be caused by other common issues, such as delayed earthing-up and inadequate moisture.

The use of plant growth agents to facilitate stool or layer bed proliferation has been minimal. The number of rooted shoots on stool beds of M.26 apple rootstock was found to increase in response to mid-June ethephon sprays at modest doses (300 mg/litre), according to Polish testing. Nevertheless, additional investigation conducted in Poland revealed no advantage to spraying the growth retardant Cyclocel on the layer beds or stool of the dwarfing apple rootstock clone P.2. Numerous soil-borne pests and illnesses can also harm stool and layer beds. Production is severely limited by a number of nematode species as well as by bacterial (Agrobacterium spp.) and fungal (Thielaviopsis, Phytophthora spp.) disease assaults.

PROPAGATION BY CUTTING

In rootstock propagation, two primary cutting kinds are used: summer-grown softwood and winter-grown hardwood cuttings. More and more recently, recalcitrant subjects have been propagated using another cutting technique called micropropagation, which also helps quickly multiply rootstocks that are in short supply. Semi-hardwood (greenwood) cuttings are a less common method that are occasionally used to propagate Primus rootstocks. And lastly, root cuttings are also sometimes used to propagate rootstocks. The development of effective hardwood cutting methods for apple, plum, and quince (Cydonia oblonga Mill.) rootstock clones has been a major area of research in Britain.

Three factors are essential for any kind of cutting propagation to be successful. Prior to cutting excision, the propagule needs to be healthy and in the proper physiological condition. This is accomplished by practicing good stock plant care. Secondly, in order to facilitate rooting, the cutting can require chemical or physical treatment. Lastly, the cutting needs to be put in an environment that promotes root formation, induction, and/or survival.

MICROPROPAGATION

In recent years, rootstocks have been the focus of many commercial micropropagation facilities due to their suitability as subjects for this growing field of study. Over the past ten years, numerous rootstocks have benefited from the development of new and improved micropropagation techniques. These include the apple clones M.9 (Webster and Jones 1989), M.26 (Lee et al. 1990), M.27 (Amitrani et al. 1989), and MM.lll (Arello et al. 1991), as well as pear, quince, plum, and peach rootstocks, quince, plum, and sweet cherry rootstocks and peach rootstock. The sole means of clone propagation, its application is fully warranted. The method can also be used to quickly develop novel rootstock varieties or to make it easier to transport healthy materials across national boundaries while adhering to plant importation and health standards. Recalcitrant rootstocks, including the apple clones Ottawa 3 (Pua et al. 1983) and M.9 (Webster and Jones 1989), as well as the Brossier pear rootstocks, have shown to be especially amenable to micropropagation. Not every rootstock is suitable for micropropagation. In lengthy testing conducted at East Mailing by Webster and Jones (1991), the Polish and Russian apple rootstocks, P.2 and Budagovski 9, respectively, both responded badly to the approach.

ROOTSTOCKS USED AS INTERSTOCKS

While some rootstock clones have many favorable qualities, like good control over scion vigor, resilience to winter cold injury, and good induction of cropping, they are highly challenging to root using traditional propagation methods. The apple rootstock Ottawa 3 is one instance. One workaround for such circumstances is to use micropropagation; another is to use the clone as an interstock instead of a rootstock that is simpler to root. Incompatibilities between rootstocks—such as those between many pear scions and quince rootstocks—can also be mitigated using interstocks. When trees grown directly on dwarfing clones are too weak or have root systems that are not suitable for the edaphic circumstances, dwarfing interstocks are frequently utilized to increase tree development and anchoring on marginal soils.

Regretfully, dwarfing interstocks are often far less effective when used for stone fruits, even though they have positive results when used to raise apple and pear trees. While genetic dwarf clones of Prunus avium and a clone of Prunus mugus efficiently dwarfed sweet cherry trees when used as rootstocks, their effects on tree vigor as interstocks were negligible, according to research conducted at East Mailing. Studies conducted on apples showed that the dwarfing effect increased with the length of the interstock employed when dwarfing rootstock clones were used as interstocks. This is comparable to the increased dwarfing impact that is observed when budding height increases with dwarfing rootstocks.

CONCLUSION

In conclusion, the propagation of temperate fruit tree rootstocks has evolved significantly, prioritizing traits like disease resistance, climatic adaptability, and scion dwarfing over traditional propagation ease. Advanced techniques such as micropropagation have enabled the cultivation of resistant clones, offering benefits in commercial production. However, these methods are not without challenges, including issues like increased burr knotting and excessive suckering in micro propagated rootstocks. As the field progresses, balancing the advantages of novel propagation techniques with their drawbacks will be crucial to optimizing rootstock performance and ensuring sustainable fruit production in temperate regions.

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