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Healthy Rootstock Cuttings are Essential for the International Nursery Industry

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Rootstock cuttings infected with latent Grapevine Trunk Diseases (GTD's) pathogens are a major problem for nurseries. These fungal pathogens include several species of the genera *Phaeoacremonium, Phaeomoniella, Cadophora, Dactylonectria, Ilyonectria, Diaporthe* and the family *Botryosphaeriaceae*. Infected rootstock cuttings can cause losses of up to 60 % during propagation and post planting, and can be a reservoir of disease in the vineyard. This article presents a protocol for sanitary production of rootstock cuttings and is a guide to improving health of the grafted vine, and the profitability of nurseries and vineyards.

Introduction

Grafting to rootstocks remains the principal control method for phylloxera and is also used for other soil pests and soil conditions. Since the 1980's, bench grafting has become almost universal in nurseries. However, the change from field grafting (where dormant scion buds are grafted onto a field grown rootstock) to bench grafting has resulted in the appearance of 'Young Vine Decline' (YVD) historically including a condition now known as Petri Disease, a disease caused by GTD fungi that are transmitted in infected rootstock cuttings and spread by grafting and associated nursery processes. YVD was especially apparent in California in the 1980's when the failure of ARG-1 rootstock with phylloxera resulted in massive replanting. However, Grapevine Trunk Diseases (GTD's) occur worldwide and are generally associated with *Phaeoacremonium* spp. and or *Phaeomoniella chlamydospora* fungal pathogens[1]. Other trunk disease fungi also transmitted in propagation and associated nursery processes include *Botryosphaeriaceae* spp., *Ilyonectria, Cadophora, Dactylonectria* and *Diaporthe* spp.

Cuttings from rootstock mother vines have been documented as a primary source of GTD fungi in the propagation process[2, 3, 4]. Infections in scion cuttings also occasionally occur. Rootstocks mother vines are particularly vulnerable to GTD infection because they are typically grown with short trunks (< 50 cm) and the crown is intensely spur-pruned, usually without wound protection. Further, shoot growth sprawls along the ground, making shoot stems and pruning wounds vulnerable to infection by spores splashed up from the soil by rain and irrigation. Cuttings can become infected while growing on the mother vine, either directly through hyphal growth in conducting tissue from the infected mother vines, and/or by penetration of shoot bark lenticels from spores spread by wind and rain splash. Symptoms are not seen in the conducting tissues of cuttings until the end of the propagation cycle when the vines are ready to be distributed for planting.

Infected planting material is considered as the reason why GTD's are currently spreading internationally; GTD's have been identified in every vineyard region of the world[5]. There are reports of commercial losses of the order of 40-60 % within nursery operations. Many factors are responsible for this, but GTD's can make a significant contribution. Despite what can be high rates of symptom presence in young vines, immediate post-planting losses can vary from a few percent to almost 100 %, depending on the levels of biotic and abiotic stresses. Usually, most of the young vines survive the first season, although growth is often variable. GTD infection can spread in new vineyards if young vines become stressed and produce exterior fruiting bodies and aerial spores which can infect pruning and other wounds on healthy vines.

This article summarizes propagation research that can be used to reduce GTD infection of rootstock and scion cuttings. It is based on two recent reviews, see Gramaje and Armengol (2011)[3] and Waite *et al.* (2018)[4] and literature therein, and aims to summarise knowledge into a succinct action protocol which can be used by the international nursery sector.

A Protocol for Managing Mother Vines to Reduce Transmission of GTD pathogens in Cuttings

The following management procedures apply both to rootstock and scion mother vines:

1. Protect pruning wounds. Fungicidal products should be applied on the day of pruning. Pruning spurs to leave a long internode above the top bud helps reduce infection. Registered biological control agents can also be applied. Products may be applied directly after pruning or, if the sap is flowing, when the sap stops bleeding from the cuts. Alternatively, prune to 20-30 cm long spurs, followed by a second pruning and product application as plants begin budbreak. Treatments can be applied by painting or spraying by hand or with machines. Ensure thorough coverage of all wounds including one year-old wood, irrespective of size. This operation takes a little time but is strongly recommended.

2. Avoid pruning in rainy/heavy dew weather. Moisture encourages release and dispersal of spores, leading to infection of pruning wounds. Furthermore, sprinkler irrigation and rain during the growing season also favour trunk disease transmission. Drip irrigation is preferable.

3. Remove and destroy pruning debris. Pruning debris (tendrils, laterals, pieces of cane and trunk) can be a reservoir of infection if left on the soil. The easiest solution is to transport cut canes on an open trailer to an on-site shed with a concrete floor. Under cover staff can make cuttings, and the floor can be swept clean at the end of the day so as not to raise a spore cloud, and debris destroyed or composted. An advantage is that workers have some more comfort and can work

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irrespective of rain. Another alternative is to use plastic sheeting to catch debris in the vineyard, but this has many practical problems.

4. Assess health status of mother vines. Rootstock mother vines are susceptible to GTD infection, especially if trained to a low, self-supporting trunk with spur pruning, and with NO history of pruning wound protection. Infected mother vines produce infected cuttings and need to be removed and destroyed. Rootstock cutting-source vineyards, regardless of pruning wound protection, should be inspected every few years and suspect samples should be sent for laboratory testing. Infected vines can show extensive internal necrosis and staining[6]. As a rule, trunks and permanent vine parts should be periodically replaced approximately every five years. For mother vines trained on trellises with crowns well above the ground (≥ 50 cm approx.), Timely Trunk Renewal[7] can be used to save the plant. This practice involves training a basal trunk sucker (preferably 20-30 cm below any trunk staining) to form a new trunk, prior to removal of the old trunk. This practice requires constant monitoring of crown and spur infection to facilitate a timely response.

5. Avoid shoots/canes growing on the soil. Sprawling shoots is a widespread practice, favoured because of low-cost. However, it promotes GTD infection. Rootstock leaves shade the soil and can create a wet and humid environment following rain or sprinkler irrigation, encouraging spread of fungal infection especially if the soil is contaminated with pruning debris.
Shoots from rootstock mother vines should be trained on a trellis. Different configurations can be used to facilitate ease of operation and perhaps mechanization. Trellising allows vine spacing in the row to be reduced, and access to the interrow soil for weed control etc. Trellising also allows for the development of a longer trunk that makes Timely Trunk Renewal easier if/when the vine becomes infected. Trellised rootstock mother vines may also be sprayed with fungicides to reduce GTD infection.

6. If infection is suspected, cuttings can be treated by soaking in a carbendazim solution (0.5 ml/L) for short duration (30 min) or by hot water treatment prior to grafting[5]. Duration and temperature of hot water treatment should be appropriate for the climate. In cool climates the usual temperature of 50 °C can result in the death of cuttings, but the lower temperatures of 45-48 °C is effective and does not result in the death of cuttings[8].

7. Avoid stress to the mother vines. Ensure good management of mother vines that avoids stress by appropriate irrigation and nutrition. Avoiding stress helps the vine suppress pathogen development.

Discussion

Following these simple seven sanitation principles at the mother vine source will help provide GTD-free cuttings, with subsequent savings for the nursery and grower. ■

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