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GRAFTING OF GRAPEVINES – THE FACTORS THAT INFLUENCE THE OBTAINING OF QUALITY PLANTING MATERIAL. STUDIERS AND RESEARCHES CARRIED ON

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ABSTRACT

After the decimation of vineyards caused by the attack of the Phylloxera insect (Daktulosphaira vitifoliae) in the end of XIX century, a real industry of producing planting material had to be developed with relatively high costs and often low yields. In order to provide answers to these problems, researchers in the field have studied all the technological stages and factors that can influence this complex process with the aim to obtain new healthy and vigorous plants that gives quality harvests.This paper presents the current situation of the issue of producing vine planting material in the world and in Romania. Emphasis is placed on revealing the critical points encountered in the production process of grafted vines, starting from the quality and health status of the scions and rootstocks, their storage method, the grafting technique, callus and the communicating vessels formation and the nursery management.

INTRODUCTION

Currently, the nursery industry is limited to small to medium-sized family businesses, with modest progress in modernizing classic technology (Waite et al. 2015).

The quality of planting materiel has suffered, with early declines in plantations reported worldwide. Many of these plantations have been affected by pathogens that cause wood diseases or by other factors that cause a decrease in their vigor and longevity (Smart et al. 2012).

The rapid decline of vineyards has become a common problem worldwide (Gramaje & Armengol 2011, Borsellino et al. 2012, Smart et al. 2012, Witelaw-Weckert et al. 2013), which has led authorities to establish quality standards such as the European one issued by the “European and Mediterranean Plant Protection Organization” in 1998 or the Australian one – AS 5588 from 2013.

These standards explain as clearly as possible how different factors can influence the quality of grapevine planting material.

Following studies conducted over the last 30 years, the next factors have been identified as determining factors for the poor quality of grapevine plants: the quality and health of the scion and rootstock, nursery practices, and storage conditions (Gramaje & Armengol, 2011).

MATERIAL AND METHODS

To document this work, 30 reference works **in the field were studied.**

RESULTS AND DISCUSSIONS

Factors affecting the quality of grafted vines

The propagation of grapevine plants is relatively easy, but to produce the quantities of millions of plants required by the market for the establishment of new plantations, solid knowledge in the fields and the most efficient organization of the entire process are needed (Waite et al. 2013).

In addition to the classic grafting method - the use of a 300-400 mm scion and rootstock cuttings, other methods are also practiced such as "in vitro" propagation, green grafting or directly in the field on rooted rootstocks.

Among the factors that can affect the quality of grafted vines, the following have been highlighted:

1. *The source of grafting material* – scion and rootstock must be certified, specialized for such mother plantations – usually organized in national germplasm collections such as the one in France – ENTAV – INRA or the one in the USA – Plant Material Service (Waite et al. 2015);

2. *The quality of the material* of the two partners, scion and rootstock, is influenced by the physiological affinity - the interaction between the two genotypes (Winkler et al. 1974), cellular incompatibility, the formation of plasmodesmata, vascular tissue connections (Pina & Errea, 2005), the environmental conditions in which the cords are produced (drought, late frosts, hail) and the way in which the mother plantations were cared for (Vršič et al.2015);

3. *How to prevent infections* with pathogenic fungi or viruses: it is very important that mother plantations are certified in terms of their phytosanitary status, with mandatory periodic analyses demonstrating that they have low infections that cause diseases or attacks by pests such as phytoplasma diseases, crown gall, Pierce's disease, mildew, rot, nematodes and fungi that cause trunk diseases (Rego et al. 2009).

- To prevent viral infections, the thermotherapy method is used (Gribaudo et al. 2006);
- In recent years, an increasingly acute problem is that of infection with fungi that cause trunk diseases (TD) that can be asymptomatic in young plants (Billones-Baaijens et al. 2013).

4. *Management of mother plantations* supplying scion ropes and rootstocks – although the plantations supplying scion ropes are carefully maintained, many of the rootstock plantations are minimally worked in countries such as France, Italy, Australia, the plants being left to grow freely on the ground, without using a support system, a cheap way of maintenance but which favors infections with pathogens that cause trunk diseases (Witheman et al. 2007); these pathogens are spread very easily by wind and raindrops; it should be noted that, at present, there are few studies regarding the support system in rootstock plantations (Waite et al. 2015).

5. *Organization of the grafting hall and storage area* – essential for the success of the propagation of viticultural material are the quality of the grafting material, the care with which it is handled, the state of health and the way of keeping the evidence as meticulous as possible (Hartmann et al. 1990); an important factor is the way of storing the grafting material (Morton, 2000) for control the hydric stress; other important factors are extreme temperatures, water contaminated with TD inoculum (Cardoso et al. 2013),

hypoxia and bud intoxication (Ophir et al. 2009), inadequate temperature of the treated water (HWT) (Grahan 2007, Granaje et al. 2009).

6. *Technologies for producing high-quality grafted vines* – standardization of operating processes (SOPs) is being attempted that focus on preventing disease and pest attacks (Daughtrey & Benson 2005); the grafted material, previously disinfected, is stored in sanitized warehouses, at temperatures of 1-2 ^{0}C, wrapped in clean materials, provided with small holes for ventilation.

7. *The critical stages in the multiplication process* are grafting and callus formation (Fourie & Halleen 2004); contaminated graft wounds and size mismatch between scion and rootstock generate spaces between the two partners that are easily infected and prevent their healthy welding (Stamp 2001); the factors that ensure good callus formation at the grafting point are:

- thorough and regular cleaning, including sanitation of installations and equipment, wastewater and waste management are essential factors in controlling disease and pest attacks (Stewart-Wade 2011);
- a grafting room must be sanitized daily and the flow between activities must be continuous, without pauses and delays in handling grafted vines (Waite & Morton 2007);
- callusing is done in special, clean boxes, the vines being placed in sterilized and moistened material, such as perlite or vermiculite for 2-3 weeks at 26-29 ^{0}C; the callus formed must not spill more than 2-3 mm from the area of union between partners; callus in dark and humid rooms favors the development of pathogens (Hartmann et al. 1990);
- humidifying the forcing room is important but spraying with a hose or sweeping should be avoided, preferring to use a mop or washing the floors and walls (Becker & Hiller 1977);
- grafting area can be protected from dehydration by using strips or by soaking in grafting wax, but callus development and graft health require high amounts of oxygen, so a thick layer of wax can hinder the callus process (Hartmann et al. 1990),

8. *Organization of work in the nursery*:

- when moving to the field, the wax layer is important both to avoid callus dehydration and for possible protection against low temperatures (Hartmann et al. 1990);
- before moving to the field, it is preferable to use, instead of another layer of wax, an acrylic polymer called “Envy” (Waite et al. 2015);
- the quality of the nutrient pots or the soil where the nursery is planted is very important; nutrient pots ensure a healthy environment, free of weeds and nematodes (Daughtrey & Benson 2005); the nursery soil must be loose, clean, free of nematodes; to avoid infection with pathogens transmitting black foot disease (*Cylindrocarpon ssp* and *Ilyonectra ssp*) the planting area is alternated or rotated with others where mustard is grown, which has biofumigating properties (Bleach et al. 2010); it is useful to soak the young roots of the vines in a fungicidal solution just before planting (Alaniz et al. 2011);
- the phytosanitary treatment program is particularly important and must be strictly respected;
- In the middle of the season, a plowing between rows at a depth of 30 cm is useful, which favors the balanced and uniform development of plant roots (Waite et al. 2015).

9. *Organization of strict and clear records* – records throughout the technological process are very important and can provide information regarding the efficiency of the entire activity, the consumption of materials, labor, etc. (Sorensen et al. 2011).

10. *Clear national and European regulations* – for the success of obtaining quality vine planting material, clear and simple rules are needed, multi-actor actions involving the owners of mother plantations for scion and rootstock, suppliers of materials and equipment, nurseries, inspection bodies, etc. Regional or country standards developed such as the "European and Mediterranean Plant Protection Organization – 1998" can lead to the uniformity of the success of this activity (Waite et al. 2015).

The situation in Romania

In Romania, the method of using the grafting technique on resistant rootstocks of American origin led to the emergence of an entire network of grafted vine producers organized innitially by the state, with the role of restoring vineyards. Among them, in 1907, the Valu lui Traian Viticultural Nursery, Constanta, was established in Murfatlar, on an area of 5 ha. In addition, nurseries were established in Pietroasele – Buzau, Niculitel, Tulcea, Ciumbrud – Alba.

In the 1980^{s}, there were 6 viticultural nurseries in Dobrogea alone that provided the planting material – tens of millions of grafted vines – for the new plantations established in SE Romania and beyond: Murfatlar Research Station (SCDVV Murfatlar), IAS Murfatlar, IAS Medgidia, CAP Niculitel, IAS Sarica-Niculitel, IAS Isaccea. Within the research stations there were "approving inspectors" who checked the purity, authenticity and health of the vines in the mother plantations and in the nursery.

In order to join the European Union, Romania aligned itself with its legislation through the order of the Ministry of Agriculture and Rural Development 1267/2005 approving the Rules and Technical Norms regarding the production for commercialization, control, quality certification and commercialization of vegetative propagation material of the vine.

At the national level, the research carried out by Grecu and his team in the 70^{s}-90^{s} on the techniques of preserving the cords, paraffining, stratification, grafting affinity, etc. is noteworthy (Grecu et al, 1990).

The technology for producing vegetative propagation of grapevines was extensively described by Ţârdea and Dejeu in „Viticultura" (1995) and by Dejeu in the „Viticultura práctica" book (2004).

Similar research was conducted by Corbean et. al (2009, 2011) on the forcing process, the types of paraffins used and the forcing substrate.

A valuable study was carried out in the Jidvei nursery on the economic impact of the type of paraffin and the substrate mixture in the process of producing grafted vines (Călugăr et al., 2020).

Although there was uninterrupted activity in the production of planting material within the Murfatlar viticultural research station, there is relatively little research in the field, carried out in the 50^{s}-60^{s} by Mujdaba F. and Văleanu L., Alexandrescu I. et al., 1962, Babeș S. 1965, Oșlobeanu M. 1966, Mihai Șt. 1978, 1979, Bian C., 1989 (Ranca A.& Filip I., 2008).

CONCLUSIONS

The research in the field carried out at SCDVV Murfatlar aims to study certain technological links in production of viticultural planting material, especially the forcingand rooting of grafted vines

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