

Tree uniformity: Determining factors – A field observation

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Abstract.

Tree uniformity in a commercial orchard is a key factor in utilising the genetic potential of a particular cultivar. This is of great importance to secure a high and sustainable return on investment. Through tree uniformity the supportive advantages of certain tree characteristics will also be optimised, of which precocity and production forms the basis. This is usually determined by tree shape and growth vigour (less vegetative). The choice of a rootstock-scion combination for a specific location, climate and soil condition is determining factors in optimising the genetic potential of a particular scion cultivar. It is important for rootstocks to be selected for not only resistance to soil borne diseases (*Phytophthora cinnamomi*) and soil/climatic conditions but also for its horticultural abilities supporting high production. The known factors influencing tree uniformity are:

- Genetic variability of seedling rootstocks.
- Clonal rootstock (genetically identical combination).
- Genetic influence of the rootstock on the production potential of the scion.
- Rootstock-scion combinations.
- Avocado sunblotch viroid.
- Adaptability of rootstocks to specific soil (high salinity; calcitic; saturated) and climatic conditions (temperature extremes).

It has been reported that non-uniformity in clonal rootstock orchards could exist. Through field observations it was found that variation in uniformity is not genetically induced by the attached nurse seed (Frolich technique). Poor uniformity with clonal rootstocks is the result of:

- Uneven root distribution.
- Poor root quality and quantity.
- Heavy callus formation.

It can therefore be concluded that to ensure tree uniformity among clonal rootstock trees in the field implies the use of a reliable rooting technique.

Key words: Tree uniformity, genetic variability, clonal rootstock, root quality, root quantity, reliable rooting technique.

Uniformidad de los árboles: Determinación de factores – Una observación de campo

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Resumen.

La uniformidad de los árboles en un huerto comercial es clave en el uso del potencial genético de un cultivar en particular. Esto es de gran importancia para asegurar un retorno de la inversión alto y sustentable. A través de la uniformidad de árboles las ventajas de apoyo de ciertas características de los

árboles también se optimizarán, de cuya precocidad y producción se forma la base. Esto generalmente está determinado por la forma del árbol y el vigor de crecimiento (menos vegetativo). La elección de una combinación de rizoma y esqueje para un lugar específico, clima y condición del suelo determina los factores de la optimización del potencial genético de un cultivar de esquejes en particular. Es importante que los rizomas se seleccionen no sólo por la resistencia a las enfermedades transmitidas por suelos (*Phytophthora cinnamomi*) y condiciones climáticas/del suelo, sino también por las capacidades hortícolas que apoyan la alta producción. Los factores conocidos que influyen en la uniformidad de los árboles son:

- Variabilidad genética de rizomas de plántulas.
- Rizoma clonal (combinación genéticamente idéntica).
- Influencia genética del rizoma en el potencial de producción del esqueje.
- Combinaciones de esqueje-rizoma.
- Viroide de mancha de sol de las paltas
- Adaptabilidad de los rizomas a suelos específicos (alta salinidad; calcídicos; saturados) y condiciones climáticas (temperaturas extremas).

Se ha informado que podría haber falta de uniformidad en los huertos de rizoma clonal. A través de las observaciones de campo se descubrió que la variación en la uniformidad no está genéticamente inducida por la semilla adjunta (técnica de Frolich). La mala uniformidad con los rizomas clonales es el resultado de:

- Distribución despareja de raíces.
- Mala calidad y cantidad de raíces.
- Formación pesada de callos.

Por lo tanto se puede concluir en que asegurar la uniformidad de árboles entre árboles de rizoma clonal en el campo implica el uso de técnicas de enraizamiento confiables.

Palabras clave: Uniformidad de los árboles, variabilidad genética, rizoma clonal, calidad de raíces, cantidad de raíces, técnicas de enraizamiento confiables.

1. Introduction.

The genetic variability of seedling rootstocks is a given and even more so with Mexican type seeds compared to West Indian types. Because of this, non-uniformity in seedling rootstock orchards is a huge problem. According to Hartman & Kester (1975,p.662) clonal rootstocks are desirable not only to produce uniformity but to preserve special characteristics and specific influences on scion cultivars, such as disease resistance, growth and flowering habit. De Villiers & Ernst (2007,p.14) stressed that a well-developed, evenly distributed and healthy clonal root system ensures maximum utilization of the tree's genetic potential and also significantly supports uniformity of the trees in the field. However non-uniformity of clonal rootstocks and the possible influence of the nurse seed (Frolich technique) on the characteristics of the clonal rootstock has been suggested (Ben-Ya'acov 1985,p.22). Brokaw (1987a) concluded that if variability among clonal trees exists it might be explained by differences induced in the nursery.

It is a known fact that clonal propagation of avocados is the only way to conserve and utilize the outstanding characteristics of a rootstock. Ben-Ya'acov (1995,p.385) confirmed that with clonal propagation where the nurse seedling is eliminated, only the identity of the clonal rootstock and the cultivar source is preserved. It is therefore neither logical nor acceptable that any genetic material will move through the plant system from the nurse seed to the clonal rootstock. De Villiers & Ernst (2007,p.14) suggested that due to the fact that plants produced with the Frolich technique are still partially supported by a seedling root system, the possibility of a poorly developed clonal root system can lead to poor tree uniformity and even high mortalities.

Anon (2005,p.1) reported non-uniformity among clonal Velvick in an evaluation trail with Hass trees on clonal Dusa and Velvick rootstocks in the Soekmekaar area, Limpopo Province. The Velvick trees were micro clonally propagated trees

The objective of this study is therefore to investigate and determine the reasons why non-uniformity does occur in certain clonal rootstock avocado orchards.

2. Materials and methods.

Observations at three stages of the two well known clonal propagation techniques were made with regard to root quality, quantity and distribution:

- Micro cloning: - Rooted micro clonal plant in 55ml micro container
 - Grafted micro clonal plant when transplanting in 7L containers (plant bags)
 - Field observations
- Frolich: - Rooted clonal plant in 1L liner bag
 - Grafted clonal plant when transplanting in 7L containers (plant bags)
 - Field observations

Field observations with reference to tree uniformity were made in the KwaZulu-Natal Province as well as the Mooketsi, Soekmekaar and Tzaneen areas of the Limpopo Province of South Africa.

3. Results and discussions.

The inspection of the clonal root system for quality, quantity and distribution during the nursery propagation stages is possible without destruction with the micro cloning technique but not with the Frolich technique. Due to the fact that both the nurse seedling and clonal root systems are still intact in the 1L liner bag with the Frolich method, identifying plants with poorly developed clonal roots is impractical if not impossible. It is therefore possible to transplant grafted plants with no or poorly developed clonal roots and if transplanted in the field will be the reason for non-uniformity in the orchard.

By severing the micro clone from the nurse seedling as reported by Ernst (1999,p.218), the clonal root system can effectively be inspected for quality and quantity and discarded if not on standard during transplanting in the 7L containers (plant bags). However with the Frolich technique poor clonal root quality, quantity and uneven distribution is concealed by the presence of the nurse seedling's root system and not easily detectable.

A thorough investigation into the reasons for the non-uniformity among micro clonally propagated Velvick trees revealed that the trees which were small and stunted all had poorly developed clonal roots with heavy callus formation. Further observations revealed that the poor root quantity, uneven distribution and heavy callus formation relates back to the rooting stage in the nursery. It was obvious that these plants should have been culled in the nursery and that the reasons for the non-uniformity could not be blamed on the Velvick rootstock.

4. Conclusion.

There is enough evidence to conclude that tree uniformity observed in the field directly relates to the rooting technique used. Non-uniformity has no genetic explanation except, with the Frolich technique, when the nurse seedling survives the clonal root system. It is also important that the technique used should make provision for the execution of proper quality surveys to inspect root development and quality at different stages of development in the nursery. Of all these stages the inspection of each plant's clonal root system before transplanting into the 7L bag is the most crucial one to ensure the culling of plants with no or poorly developed clonal roots.

It is also conclusive that poor uniformity with clonal rootstocks is the result of uneven root distribution, poor root quality and quantity and heavy callus formation. This supports the findings of Ernst (1984,p.24) that uneven root distribution with poor quality and quantity is directly associated with heavy callus formation during root initiation. This finding is in contrast with that of Anon (2005,p.1) who suggested that the non-uniformity among Hass on Velvick trees is genetic.

According to the observations a uniform clonal orchard can only be guaranteed if each tree relies totally on a well developed clonal root system. Only then will certain tree characteristics like precocity and production be optimized. This supports the findings of De Villiers & Ernst (2007,p.15) who found that where plants are partially supported by a seedling root system of a nurse seedling, a poorly developed clonal root system is a possibility, which correlates with poor tree uniformity and even high mortalities.

This study confirms the importance for producers to ensure that when buying clonal avocado trees, each plant must have a well developed and distributed clonal root system with good quality and quantity of roots. To ensure tree uniformity among clonal rootstock trees in the field therefore implies the use of a reliable rooting technique.

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