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Review Article

Optimizing Germination Percentage and Reducing Germination Time for Lemon Seeds to Attain a Viable Rootstock for Sweet Orange (*Citrus Sinensis*) Production: A Simple Guide

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ABSTRACT

Precision in crop production amidst agricultural system challenged by climatic vagaries is very key to an increased productivity. Precision in raising and selecting the ideal rootstocks is crucial in modern citrus production. While growing citrus from rootstocks is more recommended, selection of an ideal rootstock remains a challenge to many farmers. This guide gives the recommended agronomic practices aimed at reducing germination time and increasing percentage emergence of lemon seeds. It will be useful for small scale citrus farmers in rural areas whose accessibility to extension services is limited. The kind of rootstock for budding determines the health, vigor, and the productivity of the crop. Increased precision is one of the key fundamentals in citrus production, and entails selection of the best lemon seed, testing its viability, optimizing germination and percentage emergence. Removing seed coat of the lemon seed, using light growth media, and optimizing factors such as temperature and humidity reduces germination time as well as optimizing percentage emergence.

Keywords: Precision; Root stocks; Percentage emergence; Extension services

INTRODUCTION

Sweet orange (*Citrus sinensis*) is an evergreen tree that belongs to the Rutaceae family and is grown for its fruit. Its leaves are oval, and conform to an alternate leaf mosaic. Sweet orange has a narrow-winged petiole, a distinguishing feature from bitter orange whose petioles are broad. Orange production is heavily dependent on lemon, as the principal rootstalk. Lack of extension services to enlighten farmers on key agronomic practices in orange production is a key challenge facing the orange farmer. In Kenya, oranges are an important crop after bananas, pineapple and mangoes. Araujo documents that orange is a main source of employment in poor rural settings, contributes to rural economy, and a source of human nourishment [1]. Obukosia and Waithaka list inadequate planting material such as scions and rootstocks as one of the challenges facing citrus production in Kenya [2]. Increased precision is key when establishing crops and the selection of rootstalk has a great role to play in modern citrus production [3]. Rootstalk selection influences the plant's tolerance to abiotic and biotic stress, fruit quality, and the expected yields [4-6]. Therefore, this guide will focus on attaining the best rootstock for sweet orange propagation as a way of addressing an agronomic gap in sweet orange propagation.

LITERATURE REVIEW

Propagating oranges

There are two main ways of propagating sweet oranges, either from seed or grafting. Knowing the right variety of citrus is the first step in oranges propagation. Oranges that are grown from

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their own seed tend to produce sour, a characteristic that attracts market stigma. Orange propagation is mostly done by budding lemon seedling with a scion from a desirable sweet orange variety. Often, buddings are selected from a fully mature, vigorous and a good plant that is known to produce good fruit. Budding is a type of grafting whereby, the scion is joined to the desirable rootstalk with a single bud is shown in Figure 1.

Figure 1: Orange plant (pixie) growing in an orchard in Makueni County, Kenya. A highly productive plant depends on a good rootstock (Photo: Justus M. Munywoki).

Objectives

a) Selecting the best lemon seed that guarantees a higher germination percentage.

b) Removing barriers and activating the lemon seed for faster germination and emergence.

Choosing the best lemon seed

The attribute of the 'best' lemon seed is a seed that is obtained from a fully-grown lemon plant, and is also viable. Most lemons turn their color to yellow when ripe. Seeds that are obtained from unripe lemon fruits or immature lemon trees have poor germination rate and most of them are not viable. There are three ways of getting the seed from the fruit.

The first method entails cutting the lemon across and then squeezing out the juice, after which you sieve the seeds. This method may be risky because it can cause mechanical injury to the seeds, which makes them unviable for germination. The second method involves burying the lemon fruits and covering them with soil for them to decompose after which you remove the pulp to obtain the seeds. This method can be time wasting in cases where the farmer needs the seeds promptly to set the nursery bed. Alternatively, the third method involves peeling or chipping around the lemon and then digging out the seeds with your fingers.

Testing viability: Viability tests are done to ensure a high-quality seed are selected. The quality is determined by its purity, germination, and freedom from disease [7]. The seed quality has a high influence on the economic production of all crops in determining yields, crop establishment and growth. To test for viability, the freshly obtained seeds are put in a bowl of water; those seeds that float are dispensed off because they fail the viability test. Seeds that sink at the bottom have the right bulk and are viable.

In addition, small and unhealthy-looking seeds should be selected and discarded to remain with relatively big and healthy-looking seeds. Although small seeds may pass the floatation viability test, they may not keep the quality of the parent tree.

Removing barriers and activating the lemon seed for faster germination and emergence

A lemon seed is an orthodox type of seed. An orthodox seed is known to survive either drying or freezing out during *ex-situ* conservation. The characteristic seed coat of lemon seed allows them to survive in dry or cold conditions. Normally, under optimum conditions, lemon seeds take 15-17 days to germinate.

Removing the seed coat: However, by carefully peeling off the outer seed coat (normally white) promptly activates the biochemical and molecular mechanisms inside the seed for germination. Removing the seed coat is ideal for smaller nurseries and can be time-consuming when setting larger nurseries. In cases where the seed coat is not peeled, a thorough washing off pulp is recommended. Failure to remove the clinging pulp will trigger fungi to thrive, leading to development of fungal diseases that kills the seeds.

Choosing ideal media: The growth medium plays a key role in determining how fast the seeds germinate and the percentage of emergence. The best medium would be the one that is light, drains well, and free of soil-borne pathogens such as root knot nematodes. While humus is ideal, it may harbor soil-borne diseases that kill the seed and the young seedling once it shoots. Coarse River sand is an ideal growth medium due to its excellent drainage and free of living matter that may attract pathogens. Predisposing the sand soil to a sun bath for about 1-2 days before planting is recommended to kill any pathogen present in the soil.

Optimizing temperature and humidity: Providing the optimum environment substantially reduces germination time, increasing both uniformity and germination percentage.

The germination of lemon seeds is slowed by exposing them to low temperatures, which in turn retards the biochemical processes necessary for germination.

Lemon seeds need warm and moist (not soggy) conditions for faster germination. Watering of the nursery bed should be regulated, and should be avoided during cold weather. One of the main methods of keeping constant temperatures within the nursery environment is by covering the nursery bed with a transparent polythene paper to create an environment of relatively constant temperature and humidity [8].

When the lemon seed are filled with water through imbibition, the enzymes necessary for germination are activated, which further initiates germination process. However, care should be taken to remove the paper at times because too much water causes the seeds to rot are observed in Figures 2 and 3.

Figure 2: A jerry can cut in two and tightly covered with a transparent polythene paper used as a humid germination chamber for small scale use. (Source: Justus M. Munywoki).

Figure 3: Improvised humid germination chamber accelerates germination by physically inducing necessary germination factors. (Source: Justus M. Munywoki).

High germination and emergence rate for lemon seeds is actualized through removal of barriers such as removing of the seed coat. After seed extraction, washing the pulp with plenty of water ensures there is no accumulation of residual material that increases fungal growth that kills the seed.

Light and well-draining medium such as coarse river sand also increases the rate of germination and emergence. Optimizing germination factors such as humidity and moisture for the lemon seed reduces the number of days the seed take to germinate and emerge.

DISCUSSION

The productivity of sweet oranges is highly depended on the quality of the rootstock on which it was budded. Besides citrus disease and pests, inadequate planting material is a main challenge facing citrus production. As the world fruit farming embraces precision in its production to counter climatic vagaries, precision in choosing the best rootstock for orange propagation is key. The qualities of a good rootstock are governed by its viability, free of diseases, purity and higher germination percentage. Germination percentage is optimized by choosing the best seed, while faster germination is achieved by optimizing temperature and humidity in a controlled germination environment.

CONCLUSION

While agriculture is the main economic activity for most developing countries, there is inadequate, often poor agriculture extension service linkages to the farmer. Decentralizing these services as well as subsiding their costs can work towards increasing farmer awareness on best agronomic citrus production. Other models such as Trainer of Trainers (ToT) can increase community outreach in extending best citrus agronomic practices in rural settings efficiently.

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