FURTHER STUDIES ON ROOTING OF SOME DECIDUOUS FRUIT TREES

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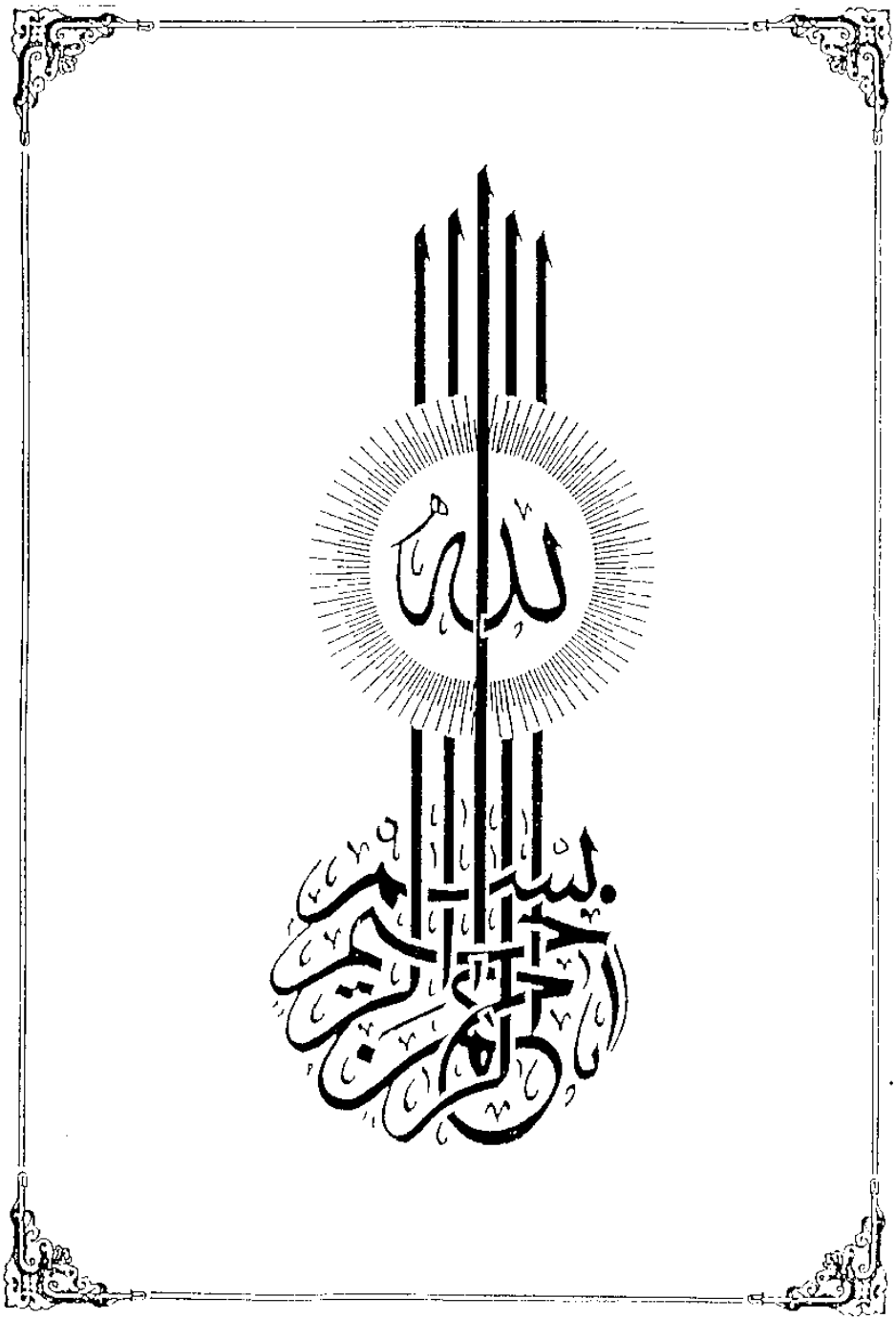

A C K N O W L E D G E M E N T

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I N T R O D U C T I O N

Although many of fruit trees can be propagated by cuttings easily, yet a great number of others do not initiate roots readily. In A.R.E., both apple and pear varieties are considered of this category.

In Egypt, Le conte pear (Pyrus communis x p. serotina) is the main cultivar and its acreage is around 3789 feddans (123). The Bartlett pear (Pyrus communis), however, grows in limited areas.

Pears are often propagated in Egypt by budding on different stocks, i.e. Baladi quince, Pyrus Calleryana, or into imported P. communis seedlings. The first combination fails within few years while those budded on P. calleryana meet some physiological disorders like chlorosis, which is very common in many pear orchards.

On the other hand, importation of "French pear" seedlings or seeds, every year is not the ideal answer for such a problem in Egypt.

Several trials have been carried out to propagate Le conte pear by hardwood cuttings (39, 58). Yet the

survival of the cuttings in the nursery rows remained a problem without answer.

Apples especially Baladi and Red Volus cultivars, are also grown in Egypt in some districts particularly at El Fayoum and Assioute Governorates. The total acreage of apples in Egypt is 1956 feddans (123).

Baladi apple is usually propagated by suckers, while Red Volus variety is propagated here by budding on Baladi apple or quince stocks.

The main objective of this investigation is to study the possibility of regenerating the previous two apple varieties by stem cuttings. In addition, further experiments were carried out in order to improve and hasten the rooting ability of cuttings of the two previous pear varieties. Moreover, a limited study was conducted on Baladi quince hardwood cuttings to find out the suitable time for propagation.

Some horticultural practices as well as various chemical compounds and growth active substances were tried with the aim of inducing, and subsequently improving the rooting potentiality of the tested cuttings.

In order to elucidate the biochemical changes occurring during rooting of the different cuttings under the different treatments of storage and auxin, it was decided to study the changes in both carbohydrate and nitrogen fractions.

Moreover, attempts were tried to clarify the actual causes dealt with the failure of apple cuttings to strike adventitious roots. Accordingly, endogenous growth active materials as well as the anatomical structure of stem cuttings, were also investigated.

It is hoped that the results of these studies provide a convenient method for propagating apple and pear varieties in A.R.E.

REVIEW OF LITERATURE

Stem cuttings proved to be a practical mean for propagating a large number of fruit species, i.e., grapes, fig, quince, pomegranates, sweet lime... etc. On the other hand, other species, e.g., apples pears, pecan, peach, mango... etc. seemed difficult to propagate by stem cuttings. This latter group seemed to be a virgin field to many investigators to encounter this problem in order to induce or hasten the root formation on such cuttings through using several methods of preparing the cuttings and by treating them with various chemical compounds.

Results obtained by these previous extensive studies revealed that successful rooting are greatly affected by several internal and external factors.
It should be mentioned out that ability of cuttings to strike adventitious roots could not be ascribed to one of these factors only, because the rooting response are governed by the interaction between many of these factors.

Before reviewing and discussing the effect of these factors on the rooting of stem cuttings, it is interested to shed some light on the morphology and histology of root emergence in stem cuttings.

Morphology and Histology of Root Initiation in Stem Cuttings

Plants differ greatly in their capacity to form adventitious roots on their cuttings. According to Hartmann and Kester (84), adventitious roots in cuttings of most plants originate endogenously from different tissues. In young stems, root initials arise near the outer side of the vascular system, but in older ones, they originate usually near the vascular cambium. On the other hand, in cuttings prepared from woody perennial plants, the roots often arise in the young secondary phloem tissue, moreover, various tissues e.g. vascular rays, parenchyma and pith may contribute to originate such roots. This previous report could be supported by results indicated by several investigators. Carlson (21) working on cuttings of some apple clones found that roots originated mostly at the base of the cuttings either at the side of callus tissue or from the cut surface. He added that roots apparently initiate from the pericycle in the vicinity of lenticels. In addition, Cummins (33) postulated that roots arise on stem cuttings of apple from parenchyma of secondary phloem and of leaf bud gap. He added that very few roots were observed to arise de novo within the basal

...llus of cutting.

In hardwood cuttings of pear, the roots originated at the level of the cut surface, either from the cambium or from the cells immediately outside it. The vascular tissue was intimately connected with the vascular cylinder of the cutting (Mittempergher 124). On the other hand, Fouad (58) with hardwood cuttings of Le conte pear, reported that adventitious roots appeared throughout the callus tissue developed at the basal and the additional wounds. He observed that roots were in attachment with the cambium zone just above the cut surface.

In determining the position of adventitious roots of vine 420A cuttings, Marro (118) found that 75 % of the total number of roots arose from below the buds, about 25% from below the tendrils and very few from the lateral portions of the nodes.

Adventitious roots of gooseberry cuttings aopeared at points opposite to the bud-gap and also just above the cuttings base (Rake 144). Moreover, roots of mulberry cuttings arose mainly from the secondary phloem, and also from pericycle and cambium tissues (Yadova et al 204).

In studying the root initiation in cuttings of some citrus species, Mes (121) observed that few roots were

formed at the extreme base of sour orange, while in citron the roots were noticed over the whole area of the cuttings covered by rooting media. Singh & Singh (166) postulated that roots of sweet lime, C. Karna and C. aurantifolia cuttings originated in tissues from pericycle to the ray parenchyma in the xylem. Moreover, Yadova et al. (203), found that roots of lemon cuttings seemed to originate from secondary phloem, pericycle, cambium and medullary rays.

In olive cuttings, all roots developed invariably from a node (Blommaert 18).

Preformed root initials :

Hartmann and Kester (84) mentioned that adventitious roots could be developed during the stem growth in some plants (before preparing the cuttings), these initials already present at the time the cuttings are made. He added that such pre-formed root primordia occur in a number of the easly rooting genera such as willow, poplar, jasmine and current.

On the contrary, Singh & Singh (166) did not observed such pre-formed root primordia in hardwood cuttings of some citrus varieties.

[illegible] and quince varieties, [illegible]
these pre-formed latent roots in the wood of old trees, causes swelling commenly called "burr knots" (84). These swellings can be used as a propagating material for certain apple clonal rootstocks (202).

Callus formation in relation to rooting of cuttings :

Callus is an irregular mass of parenchyma cells in various stages of lignification, developed as a layer at the basal end of the cuttings after it have been made and placed under favourable conditions for rooting. This callus tissue arises from cells in the region of the vascular cambium and adjacent phloem. Moreover, various cells of the cortex and pith may also contribute to its formation (Adriance & Brison 2, and Hartmann & Kester 84).

Studies carried out during 1953 and 1954 on Tyopsis dolobrata (150) and Pinus densiflora (134) cuttings indicated that adventitious roots developed from the callus tissue. Similarily, root initials of apple (33), pear (58), Hedera helix (66) and untreated Ilex opaca (22) cuttings appeared to arise throughout the callus tissue developed on the base of cuttings.

On the contrary, other investigators, (Vieitez (196) on

chestnut cuttings, and Wake (143) on gooseberry cuttings postulated that callus formation was not essential for root initiation, but it appeared to favour the rooting of these cuttings. In addition Stangler (171) reported that root primordia which was not noticed in the callus tissue developed on the base of rose cuttings.

Numerous investigators concluded that callus formation and adventitious root production are two independent processes with no actual connection (3, 5, 140, 143, 186 and 196).

Adriance & Brison (2) and Hartmann & Kester (84), reported that callus tissue is considered to be a protective layer against the decay organisms, so it has a great importance in cuttings which root slowly, but sometimes it may interfere with the absorption of water by cuttings. They added that callus formation and root production usually occur simultaneously because their development require the same internal and external factors.

Factors Involving in the Regeneration of Plant from Stem Cuttings

This part of review involved the effect of some internal factors on the rooting ability of stem cuttings, especially in species and varieties of fruit tree.

1. Naturally occurring growth substances

It is agreable among most of plant physiologists that the endogenous growth substances play a major rôle in the growth and development of higher plants. They actually affect and control the fundamental processes of cell division, cell enlargement, in addition to most, if not all, developmental aspects of plant growth (108, 113, 167). However, naturally occurring growth substances were also considered to be of great influence on controlling the root initiation in stem cuttings.

A. Endogenous Root promoting substances :

Auxins : Many investigators assumed a real relationship between the ability of cutting to form roots and the presence of auxins and their accumulation at the base of cutting. Vieitez and others (195) postulated that indolic substances were definitely present in the easily rooting quince