ANATOMICAL STUDIES CONCERNING SOME TYPES OF REGENERATIVE ACTIVITIES IN HIGHER PLANTS

By

SAMI ABDEL KAWI HABIB

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Approved by :

Prof. Dr.

Prof. Dr.

Prof. Dr.

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بسم الله الرحمن الرحيم

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

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INTRODUCTION

Growth processes are the visible aspects of differentiation. Every living organism has an intrinsic power to restore or replace parts that have been removed or injured by insects, fungal or mechanical injuries, aiming generally to produce a complete new individual. Hence, regeneration is generally applied to such process. In plants, regeneration is limited mainly to rapidly growing regions specially where cells remain alive and are potentially meristematic. Such cells have really an internal power to direct the processes of regeneration and developmental activity. Generally speaking, at least theoretically each cell is capable of producing an entire individual.

In higher plants, the process of regeneration is a complex one. This may be due to the higher degree of differentiation. In this case, three different types of regenerative activities are found namely : reconstitution, restoration and reproductive regeneration. The sites of these activities differ with different circumstances. In agriculture, such regenerative activities occur at a large scale in the fields of vegetative reproduction. It has an economical importance in the production of many horticultural and [illegible] crops.

A botanical study of some "vegetative seeds", from the anatomical point of view, seems to be promising in the elucidation of the internal regenerative activities. Such investigation lays the foundation for further fruitful studies concerning vegetative reproduction in agriculture.

REVIEW OF LITERATURE

[illegible] of *Peperomia* :

[illegible]e capacity of shoot and root regeneration from leaf [illegible] is very widespread throughout the plant kingdom. [illegible] excellent and somewhat diverse reports had appeared [illegible] with the anatomical and physiological changes invol[illegible] [illegible] the wound and propagation responses.

Swingle (1940) reviewed the comprehensive work on [illegible] studied plants achieved by Hagemann(1931) indic[illegible] that the tendency to form roots on leaves was [illegible] much [illegible] pronounced than the tendency to form shoots. He reviewed [illegible] of a total of 1204 spp. tested with detached leaves , 5[illegible] spp. had been found to yield roots alone, 25 [illegible] . shoots alone, and 289 spp. gave both roots and shoots. He added [illegible] if both roots and shoots were initiated on a leaf, buds [illegible] appear some time after the roots, and never before.

Harris and Hart (1964) found that in the leaves of *Pepromia sandersii*, the normal sequence in regeneration was root initiation followed by bud initiation, for either intact leaves or segments of leaves.

... atomy of the leaf :

As far as the writer is aware, little work had been ... on the anatomy of Peperomia plant.

Skottsberg (1947), observed five vascular bundles i... half-moon shaped transverse section of petiole of ... ...oana. Metcalfe and Chalk (1950) cited observations ... ...son (1914) indicating that three vascular bundles were present in the petiole of P. hispidula, A. Dietr. ... was recorded in P. langsdorfi, Miq.

The anatomy of the stem :

Metcalfe and Chalk (1950) reported that the outer part of the primary cortex includes a continuous ring or isolated patches of collenchyma in Peperomia and Piper. ... collenchyma ranging from 2 to 23 cells wide in the different Hawaiian species of Peperomia. In such species no definite endodermal layer was noted by Yunker and Gray (1934). Metcalfe and Chalk added that the vascular system consists of scattered bundles embedded in the parenchymatous ground tissue, or in some species, the bundles are organized into more or less distinct circles. In the stem of Hawaiian species of Peperomia there is an outer irregular ring of vascular bundles surrounding a central group of scattered bundles. No evidence of formation of secondary xylem and phloem was observed.

Regenerative ontogeny .

With the exception of the information of ... and ... (1964), no other work in hand had been published dealing with the regeneration from the leaves of Peperomia. ... leaf squares of P. sandersii, they observed that roots emerged endogenously from the parenchymatous cells adjacent to the xylem and phloem near the proximal end of the main vein. They emerged at both sides of the vascular bundle. The differentiation of a mass of short tracheids which connected the root and the main vein was firstly shown adjacent to the vascular tissue of the main vein near the base of the root primordium and lastly they extended into this base. They found also a slight protuberance situated at or very close to the proximal end of the main vein, and from this protuberance several buds often develop closely together. As the buds elongated, adventitious roots often developed from their stems.

In regard to P. tithymaloides, the writer had not found any literature dealing either with its anatomy or with the regeneration from its parts.

II. Cuttings of Ipomoea batatas, Lam.

Ipomoea batatas , Lam. is an economic plant widely cultivated in Egypt. In spite of its economic importance not in Egypt only but in many of tropical countries, little

...rmation is available concerning the anatomical and mor...
...ive standpoints. As far as the writer is aware, *Ipomoea batatas* has received scant attention.

... the anatomy of organs :

... Root :

McCormick (1916) studied the anatomy of the young tuberous root of *I. batatas*. She laid stress upon the development and activity of the primary and secondary cambia. She ... to the sites of emergence of the lateral roots. She did not record anything about the origin of the periderm. ... the other hand, she revealed in four figures the occurrence of the endodermis beneath the periderm.

Artschwager (1924) described in detail the stages of the secondary growth and the structure of the fleshy root of sweet potato. In her report she reviewed that the periderm was gradually laid down in the superficial cell layers of root and the original cortex and the endodermis became practically extinct.

Contrary to McCormick and Artschwager reports, Hayward (1938) reviewed that a periderm of pericyclic origin occurred on the periphery of *Ipomoea* tubers. Metcalfe and Chalk (1950) in their review stated that cork was initiated superficially but later arising more deeply in the cortex

. :

... the exception of the review of Metcalfe ... re was not any literature dealing with ... Ipomoea stem. They stated that the cortex ... collenchyma and assimilatory tissues. A discontinuous ... thin-walled fibers was noted in species of Ipomoea. ... phloem was devoid of sclerenchyma. Xylem occurred ... form of a cylinder traversed only by narrow rays. ... of intraxylary phloem occurred in all investigated members of the family except Cuscuta. Pith was unlignified. ... stated no information on the nodal regions, thence they mentioned nothing concerning the preformed root primordia.

c) Leaf :

With the exception of the report of Hayward (193) on the seedling anatomy of Ipomoea batatas no available literatures dealt with the anatomy of vegetative organs of this plant. Hayward reported that in the base of the foliage leaf there were five principal veins which proceeded for some distance down the petiole without anastomosing. The three median ones were bicollateral, while the two laterally placed were half-amphicribral or collateral in character. At the base of the petiole the two laterally placed bundles anastomose with the right and left median bundles, so that the leaf trace was consisted of two large lateral bundles and a small medium one.

Regeneration :

Buds :

Generally, the development of adventitious buds on roots of different plants was observed by early investigators. The studies were achieved by Dore (1955) on horseradish, Gorshkova-Mel'vil' (1957) on some herbaceous dicotyledons, Warmke (1957) on alfalfa, Torrey (1958) on Convolvulus, Bakshi and Coupland (1960) on Linaria vulgaris, and Bonnett and Torrey (1966) on Convolvulus arvensis. The only point on which they agreed that the adventitious buds arise on the roots near lateral rootlets. From the same point Dore (1955) reviewed that the newly formed roots also have their development.

Wittrock (1884)had classified the "root-shoots" in accordance with the conditions under which they may occur and their importance to the vegetative reproduction into three categories. The first was the "reparative" which developed only in cases where the root became injured or torn off from the mother-plant. The second was the"additional" which developed spontaneously upon roots of uninjured specimens. Finally, the "necessary" one which constituted a part of the normal morphological development of the plant. Wittrock listed the plants followed each category. In 1925 Holm added Ipomoea batatas to the "additional" group and pointed the reparative and the additional shoots may occur on the same plant. He did not determine if the roots of Ipomoea were the tuberous or the non-storage ones.

Beals (1923) removed one end of an enlarged sweet potato root by a transverse cut and found that a shoot regenerated out of the cambium at the cut surface.

Hartmann and Kester (1972) reviewed its reproductive capacity. They emphasized that tubers produced buds at the crown or proximal end, and fibrous roots toward the opposite or distal end. They did not indicate if these buds were produced from dormant primordia or they have their initiation at the time of planting. Also, they offered no information about the origin of such buds.

No other published papers had dealt with the regeneration of <u>Ipomoea</u> roots from the anatomical standpoint.

b) <u>Stem</u> :

As far as the writer was aware, there was not any literature dealing with the preformed root initials of <u>Ipomoea</u> stem.

The extensive work of Lemaire (1886), cited by Carlson (1929), was concerned with the origin of naturally occurring endogenous adventitious roots in the hypocotyls, stolons, and rhizomes of many herbaceous dicotyledons. He