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Phloem Mechanism in *Terminalia catappa* and *Cocos nucifera* and Their Implications in the Continuty of the Rain Forest

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Abstract: The mechanism and complexity of phloem function was investigated using two angiosperm taxa; *Terminalia catappa* and *Cocos nucifera.* The two terminalia plants (A and B) were differentiated by girdling and removing the basal twigs of A, girdling, defoliating and leaving the basal twigs in B. *Cocos nucifera (c)* was also girdled leaving D as control. After three months, specimen B produced new leaves at the stups. A wilted and withered while C was still flourishing with fruits. After the experimental period of six months, A withered, B whithered and C remained fresh and green. These findings are discussed in line with modern research findings.

Key words: Mechanisms % Phloem-Function % Rain Forest % *Terminalia* % *Cocos* % *complexity*

INTRODUCTION

The plant taxa studied are from two different Angiosperm classes. By classification system of Cronquist [1], *Terminalia catappa* belongs to the Magnoliopsida while *Cocos nucifera* is a member of Class Liliopsida. These two make up the Angiosperm plant [2, 3]. Raven and Johnson [4] also reported that the Magnoliopsida has 175,000 species while Liliopsida has 65,000 species as global record. These two taxa are also unique in their vascular system which ramify their entire body structure ensuring the distribution of water, mineral salts and organic materials [5, 6]. Primary plant growth (growth in length) results from elongation of cells produced by their terminal meristems. From this meristematic activities, epidermis, general matrix tissue (parenchyma) and primary xylem and phloem result [7]. In real herbaceous dicotyledons and monocotyledons, almost all tissues, especially the vascular tissues are produced by this meristematic activity. These terminal meristems are produced at the main stem apex and the apex of plant branches. In Liliopsida (*Cocos nucifera*), the stem, no matter the size is formed by collection of leaf bases deposited as the leaves died. These enlarge the girth of the stem. Because it is not a true stem enlargement these monocotyledon stems are called false stems [8]. On the other hand, Postlethwait and Hopson [9] reported that lateral growth results from activities of lateral or secondary cambium which is usually formed in the Magnoliopsida This lateral cambium is also called vascular cambium which cuts out phloem cells on the outside and xylem cells on the side. Laying down of these tissue cause the formation of wood. Phloems which get crushed against the bark of tree gets smaller while the xylem (which actually forms the wood) get larger. Cork cambium is also found after the phloem cells forming the various components of the cork [4]. Another difference in the two Angiosperm sub classes is in relation to the position of their vascular tissues. In monocotyledons, the vascular system made of separated bundles of phloem and xylem are scattered through out the stem. The scattered appearance is a reflection of the leaf bases scattered through the stem as they are deposited [10, 11]. The hebaceous vascular plant have vascular bundles arranged in rings near the periphery of the stem. In woody dicotyledonous plants, vascular bundles fuse with each other in stem to form a cylinder of conducting tissues with the vascular cambium in a vantaged position where it can produce both phloem and xylem to enlarge the plant girth [4, 12].

Postlethwait and Hopson [8] reported that the root of Angiosperm plants absorb water and mineral salt from the soil and through the xylem distribute this to other parts of the plants where it is needed for growth and other

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metabolic activities of the plants. They also reported another movement within the plant where organic molecules move from sources of synthesis to where they are most needed (sink). Onwugbuta-Enyi [13], opined that when such organic molecules are severed from reaching the root or other plant parts, such part is starved and killed. What then is the aim of the traditional herbalist who use tree bark in most of their practices? The aim of this research is to use every day situations like girdling (which is done by users of tree bark for medicinal purpose to demonstrate the mechanism and complexity of phloem function and to discourage herbalist from total girdling.

MATERIALS AND METHODS

The materials used for this study were all within the Niger Delta ecosystem (Table 1).

Method: Specimen B had a basal twig of 30 cm long below the girdle zone. It was also defoliated. The entire crown, leaves and twigs were removed. The girdling was 10 cm to the ground level. The bark and phloem were removed. Though girdling was done for A and C, defoliation was only for B. Experimental period was six months.

RESULTS AND DISCUSSION

Significant results were observed within the research period of six months. Specimen A started wilting after eight days. By three months, plant A has withered completely. The twigs were totally dried and crispy, Specimen B produced new foliage at the stubs. The basal twig was also flourishing. Specimen C was growing normally. D was also not disturbed. The fruits on C and D did not abort. New inflorescence were also produced. At the end of the experimental period, specimens A had completely withered. Specimen B suddenly withered, specimen C and D had normal growth. The physiological implication of these results were far reaching. Specimen B had a basal twig and was defoliated. The defoliation probably helped reduced the loss of water by transpiration. This reduction also reduced absorption stress on the root system [13]. The reduction of absorption stress helped the plant cope with the organic material synthesized by the basal twig for a period of three months. This is in line with the report of that phloem transport is determined by the relative locations of the areas of supply and utilization of the product of photosynthesis. The explained further that phloem transport does not necessarily occur upward or downward but from a source of production/supply to a point of need (sink) The basal twig provided a source for the root system but because of its size, was not able to cope with the task of sustaining the root to absorb water for the entire plant especially when the new foliage started photosynthesis. The reaction of specimen A was significant. After girdling, the leaves were still there transpiring and putting a lot of stresses on the root system whose source of food had been severed by girdling. Since there was no carbohydrate translocation to it, there was no respiration, no energy for absorption and other metabolic activities. The normal reaction was for the root system to stop absorption and set up a physiological drought within the entire plant. The ultimate result was to wilting and withering. This is in agreement with Miller and Levine [14], who reported that the phloem tissues carry photosynthate to root. When it is removed, the tree dies. Guttman and Hopskin [15] also gave their support for this finding. They opined that although many things are unclear about phloem transport, the most accepted is the pressure flow where sucrose and other organic matters load at source and actively unload at sink with energy expended at both ends. This energy is made up after respiration of the organic material. When these materials fail to get to the root, the root starves. This was the case with the experimental plant A. Specimen B later wilted and withered after six months, this could be due to the size of the twig (30cm long) which was not sufficient as a source for the entire root system. The strain of doing this tedious job eventually wilted the plant. Most anti-malaria herbs *(Alstonia sp, Mangifera sp, Allamblanckia sp)* were from the tree barks. Complete girdling should stop as a measure of conserving the taxa. Gill [16] supported this by warning against girdling. The result in specimen C did not follow

Table 1: Plant Taxa and Status At Onset Of Research

Common names	Taxa/specimen	Family	Status	Class
Umbrella tree	*Terminalia catappa A.*	Combretaceae	Girdled, not defoliated basal twig	Magnoliopsida
Umbrella tree	*T. catappa-B*	"	Girdled, defoliated With basal twig	"
Coconut	*Cocos nucifera C*	Arecaceae	Girdled	Liliopsida
Coconut	*C. nucifera D.*	"	Ungirdled	"

Table 2: Plants Reaction Within Experimental period

Specimens	After three months	Six months
A	Withered	Completely withered
B	Grew fresh leaves at stumps	Completely withered
C	No remarkable change	No remarkable change
D	No change	No change

the trend above. After experimental period of six months, the plant was still fruiting and bring out new fronds and inflorescence. Raven and Johnson [4] had something to say in line with this unusual result. They reported that the palms *(Cocos nucifera)* have parenchyma cells which continues to divide long after their production. As a result they grow considerably bigger than other monocotyledons. They went farther to explain that the vascular bundles (xylem and phloem) which distribute water, mineral salt/organic materials of photosynthesis are not arranged in concentric ring as in *terminalia* species but are scattered all through the stem. The implication is that even when the plant *(Cocos nucifera)* was "girdled" to the middle, there was still vascular bundle to transfer water and mineral salt/organic materials. This explains the survival of the taxa *Cocos nucifera* (specimen C). Specimen D was not girdled, its survival after the research period was in agreement with the report of Green [17] who presented the phloem as a passage for photosynthnate; usually from the source of where it is needed.

SUMMARY AND CONCLUSION

Plant taxa are affected by position of their vascular bundle when plant/water relation is considered. The monocotyledons whose vascular bundles are scattered through the entire stem are not affected by the removal of part (up to half) of the outer stem. The dicotyledons with concentric vascular bundle are severely affect by girdling. The removal of the bark called for the death of the plants. Herbalist should consider this especially in this period of green medicine where many use tree bark as potent medicine. While collecting the bark, total girdling should be avoided to ensure continuity of the species and the forest ecosystem.

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