CROWN SHYNESS IN VARIOUS TREE SPECIES

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Abstract: **This paper presents review on Crown shyness. This paper reviews hypotheses related to crown shyness and it tells about a possible connection between camphor and crown shyness. This review paper also gives information about canopy gaps and crown shyness. A recent study related with crown shyness is also introduced.**

Keywords**: Camphor, Canopy gaps, Crown shyness, recent studies.**

I. INTRODUCTION

Crown shyness is a natural phenomenon observed in some tree species, in which the crowns of trees do not touch each other, which results in the formation of a canopy with channel like gaps called as 'Canopy gaps' [1]. This phenomenon is also known as canopy shyness [2] or, intercrown spacing [3]. Arborists and botanists have studied crown shyness for almost a century but the answers are elusive. These openings may also be important insofar as they restrict intercrown movements of arboreal animals and vines [4]. A similar sort of defense by mechanical abrasion of competitors and dislodgement of herbivores has been observed in wave-swept algae [5]. One view is that abrasion of buds on wind-blown branches results to open spaces between tree crowns [6], on the other hand, it was proposed that crown shyness in Malaysian dipterocarps ('*Dryobalanops aromatica*' and various species of 'Shorea') is caused by reduction in lateral growth due to mutual shading [7]. A possible connection between camphor and crown shyness is shown, which can help us to understand the real science behind crown shyness. So, it becomes a topic of research for all those scholars who are willing to understand crown shyness. Plus, many hypotheses which tried to explain canopy shyness are also discussed. A prominent hypothesis explains that crown shyness has a connection with a blue-green pigment called 'Phytochrome' [8] is shown. To get better understanding about crown shyness, Fig.1 shows pictorial representation of crown shyness in 'Avicennia germinans'.

Fig.1 Crown Shyness in *Avicennia germinans* [9]

II. LITERATURE REVIEW

A) THE RELATION OF THE BLUE-GREEN PIGMENT 'PHYTOCHROME' (HYPOTHESIS)

Phytochrome is photoreceptor in trees and plants which helps to detect light. They are sensitive to light in far-red and red region of visible spectrum and can be classified as type I (activated by far-red light), or type II (activated by red light) [10].

Neighbor detection is thought to be a function of several unique photoreceptors. Plants are able to sense the proximity of neighbors by sensing backscattered far-red (FR) light, a task largely thought to be accomplished by the activity of the phytochrome photoreceptors [11].

Phytochrome is responsible for running pivotal processes inside a tree or plant body such as flowering and expanding of lateral branches.

Trees growth increases when they absorb 'red light'. However, if crowns of trees touch each other then, it leads to decrease in absorption of red light for trees because, the touching of trees crowns leads to increase in shade. So, to avoid this tree may show crown shyness.

B) THE RELATION OF WIND AND ABRASION WITH CROWN SHYNESS (HYPOTHESIS)

Pruning is a process which consists of the selective removal of certain parts of trees and plants, such as branches, leaves and buds. Pruning affects the lateral growth of trees and studies suggest lateral branch growth is largely uninfluenced by neighbors until

disturbed by mechanical abrasion [12]. This process can be carried out artificially with the help of some cutting tools like a pair of scissors or, it can happen naturally due to winds.

Winds, forces the flexible branches of trees to move randomly and, if in this condition interaction with adjacent trees' crown occur then, it gives rise to unnecessary pruning. So, pruning with the help of winds may lead to damage trees important parts like foliage, which plays a vital role for performing photosynthesis and thus as a response trees may show crown shyness. But, it is already explained that if crowns are artificially prevented from colliding in the winds, they dramatically fills the canopy gaps gradually [13].

Australian forester M.R. Jacobs, who studied the crown shyness patterns in eucalyptus in 1955, believed that trees growing tips were sensitive to abrasion, resulting in canopy gaps [14].

This reflects that, for preventing unnecessary abrasion with neighboring trees, trees may show crown shyness.

C) THE CAMPHOR CONNECTION

Camphor is a solid compound which has a chemical formula $C_{10}H_{16}O$. Two most popular tree genres, which show crown shyness, are 'Eucalypt' and 'Dryobalanops'. The interesting fact is that both of these genres have 'Camphor connection'. A study was carried on the chemical constituents of the essential oil of the leaves of 'Eucalyptus globulus' was done and it was revealed that some amount of camphor is present in the leaves of the essential oil of eucalyptus globulus [17]. The presence of camphor crystals was also determined in some species of 'Dryobalanops' which are, Dryobalanops keithii, Dryobalanops lanceolata, Dryobalanops oblongifolia and Dryobalanops rappa [15]. Fig.2 shows camphor crystals inside the cells of axial parenchyma cells.

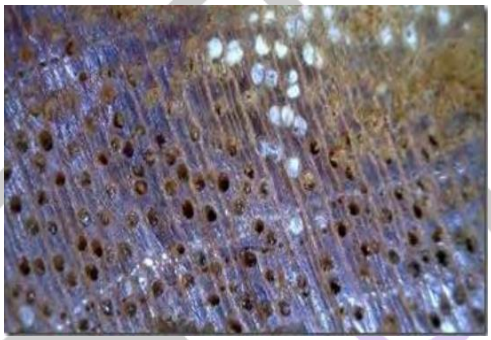

Fig.2. The presence of camphor crystals identified on cross section surface of *D. keithii, D. lanceolata, D. oblongifolia, D. Rappa tree stems, inside the cells of axial parenchyma* [15]

D) RECENT STUDIES ON CROWN SHYNESS

A recent study has suggested that *'Arabidopsis'* shows distinct leaf placement strategies when they are grown amongst kin and unrelated conspecifics, shading dissimilar avoiding kin. This response was shown to be contingent on the proper functioning of multiple photo sensory modalities [16]. However, a strong link between photoreceptors and a crown asymmetry is yet to be proven experimentally.

III. PROBLEM STATEMENT

Going through this review, author finds a relation between camphor and crown shyness. Thus the problem of this paper is to find that relation.

IV. ANALYSIS AND RESULT

It is revealed from the above study that camphor is present in '*Eucalyptus globulus*'. It is also seen that camphor is also present in other species such as *D. keithii, D. lanceolata, D. oblongifolia and D. rappa*. Therefore, it can be said that presence of camphor is found in various tree species which show crown shyness. Actually, when two trees grow side by side their foliage maintains a specific distance between the two. This is Crown shyness and this is possibly due to presence of camphor in the species.

CONCLUSION

The variety of hypotheses and experimental study results might suggest that in reality there are multiple causes for crown shyness and many hypotheses are connected with each other. However, to understand this phenomenon researchers have to perform various research studies with some new directions and connections. A possible connection between crown shyness and camphor is given, and some pivotal hypotheses are explained. This paper discusses all important hypotheses related to crown shyness, which makes it easy for researchers to study Crown Shyness.

MERITS OF THE PAPER

This review paper explains various hypotheses for crown shyness and it also depicts information about the connection between camphor and crown shyness.

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