Clarification of the Term Topophysis

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(Received 25th April 1966)

Summary

The term topophysis is commonly used to refer to vegetative propagules that maintain the branch-like growth habit they had as shoots on the ortet. A definition is presented that is believed to provide a preferred use of the term. According to this definition topophysis refers to states of differentiation of meristems on the ortet that vary according to the hierarchical order of the meristem within a branched system. This definition gives topophysis a developmental meaning comparable to that of cyclophyllis. Furthermore, it avoids confusion by more precisely defining the meaning of position.

Key words: topophysis, cyclophyllis, ortet, ramet, plagiotropic growth, branch order.

Zusammenfassung

Der Begriff „Topophysis“ wird allgemein in Bezug auf vegetativ vermehrte Pflanzen benutzt, die ihren astartigen Wuchs aufrechterhalten, den sie bereits als Triebe an „Ortet“ hatten.

Der Begriff wird so definiert, daß eine bessere Anwendung ermöglicht werden soll. Die Definition besteht sich auf den Zustand von Meristemendifferenzierungen am Muttermanschwerk, die in Übereinstimmung mit der hierarchischen

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Ordnung der Meristeme in einem Astsystem sind. Die Definition gibt dem Begriff „Topophysis“ eine entwicklungs-mäßige Bedeutung, vergleichbar mit dem der „Cyclophyllis“. Weiterhin werden Verwechslungen vermieden, wenn die Bedeutung der Position am Ortet präziser beschrieben werden soll.

The recent surge in interest on vegetative propagation of trees has brought with it the realization that considerable phenotypic variation may occur among vegetative propagules from the same ortet. Although awareness of the problem is increasing, documentation of these phenomena is not new. The so-called „retinopsydra“ forms of some members of the Cupressaceae have been attributed to juvenile characteristics in the ortet persisting throughout the life of the ramet (Bassett, 1930). In many species, basal regions of the ortet retain juvenile characteristics as the apical distal regions mature. Ramets derived from the basal tissue will proceed through a life cycle from juvenile to mature, whereas ramets from the distal tissue will miss juvenile stages of their life cycle. Also, persistent plagiotropic growth of rooted lateral branches exemplified by the classical studies of Voight (1904) on Araucaria excelsa, illustrate the variation in phenotypic expression that may arise in rooted cuttings from different branch orders of the same ortet. Terminology has been applied to these phenomena. Ševčíkova (1924) applied the term cyclophyllis to de-
scribe the effects of life cycle stage on meristematic potential. Molsch (1922) used the term topophysis to explain the differences observed by Vöchting when cuttings from terminal shoots were compared with those from first and second order laterals. A third term, periphysis, has been used to refer to the effects of the environment in pre-conditioning tissue (Haale et al., 1978).

Although each of these had specific meanings to the authors, over the years use of the terms has become confused. Olesen (1978) made a major contribution by drawing attention to the confusion that existed in the literature over the terms cyclophysis and topophysis. He proposed two definitions to clarify the distinction between these two terms: “Cyclophysis: the process of maturation of the apical meristems. Topophysis: the phenomenon that scions, budlings and cuttings for some time after grafting, budding or rooting maintain the branch-like growth habit they had as shoots on the ortet.”

We fully support the definition proposed by Olesen for cyclophysis, but we feel that his definition of topophysis requires restatement for the following reasons.

1. Topophysis should not be confined to phenomena in detached shoots as suggested by the definition. The developmental processes that give rise to topophytic effects take place in the intact plant, but are demonstrated by their persistence in detached parts.

2. Since the term topophysis refers to the nature of the plant in relation to position (Gr. topos: place; physia: nature), it should not necessarily be confined to growth habit characteristics. In conformity with the definition of cyclophysis, topophysis should refer to any morphological, anatomical and physiological differences that result from positional influences, and that are maintained in detached shoots.

3. Position requires precise definition. Reference to branch-like growth habit is too vague, and does not adequately separate cyclophytic and topophytic effects, since branch habit may be modified during maturation of the tree (see branch angle differences between trees of different maturation levels, Bostad and Libby (1982)). Since the study by Vöchting, which prompted introduction of the term topophysis by Molsch, was based upon cuttings from first

and second order laterals, it would appear to be appropriate to define position as being the rank order of shoots.

To overcome these objections, we propose that the following definition of topophysis should be used in the future.

Topophysis: a state resulting from differentiation in developmental and physiological potential of apical meristems among branch hierarchical orders, independent of the processes of maturation of terminal meristems.

Results of a study that support the concept of topophytic differences based upon branch hierarchical position are reported elsewhere (Power, Dodg and Libby, 1985). From these results, and from previous unpublished observations, the authors conclude that the development of shoots (whether it is rooting, stem form, or shoot growth) after detachment from the tree, varies according to the maturation level of the shoot, and also with the branch order position from which the cutting was taken. The results further indicate that within the ortet, the processes of cyclophysis and topophysis interact, such that with increasing maturation of the ortet the degree of differentiation among branch order positions becomes more pronounced.

Acknowledgements

We wish to thank Drs. W. J. Libby and H. Hopp and for reading this manuscript, and making useful suggestions.

References


C Effects and Second Generation Clone Performance in Picea sitchensis and Pinus contorta

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(Received 21st May 1986)

Summary

Clonal variation in 5-year heights was partitioned into genetic and C effects by two-generation cloning; where the first generation was grown in two contrasting environments.

Four clones of each of 5 provenances of Picea sitchensis and Pinus contorta were propagated from 14 to 15-year-old trees and grown for 5 years at an upland and a lowland site. Second-generation clones were then grown for 5 years at the lowland site. There was no evidence for C effects on 5-year heights in the second generation attributable to the upland and lowland environments of the first generation mother trees.

The second-generation clones grew equally as well as the first generation clones, suggesting that maturation was arrested by repagation.

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