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Foliar application of GA3 during terminal long-shoot bud development stimulates shoot apical meristem activity in *Pinus sylvestris* seedlings

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Summary - The effect of exogenous gibberellin (GA_3) on shoot apical meristem activity in conifer vegetative buds was investigated by spraying 0 or 0.1% GA_3 on the foliage of first-year Scots pine *(Pima sylvestris L.)* seedlings twice weekly for 9 weeks during development of the terminal long-shoot bud. Exogenous GA_3 promoted mitotic activity in the apical zone, thereby increasing both the rate and duration of cataphyll formation and giving rise to a higher and wider apical meristem. The increase in number of cataphyl Is increased the number of axi lary meristems, which developed as short-shoot buds.

Keywords: *axillary meristem , cataphyll cytohistological zonation, mitoses. organogenesis.*

Introduction

Cumulative evidence implicates the plant hormone gibberellin (GA) in the control of primordium initiation during the development of vegetative buds in conifers. In particular, the num - her of cataphylls (in *Pinta)* and needles (in *Picea)* formed in the terminal bud. and present on the shoot following elongation of the terminal bud, is stimulated by application of GA GA_3 and GA, in *Picea glauca (Wench)* Voss (Little and MacDonald 2003). $GA_{4/7}$ in *Pious contorta* Dougl. ex Loud. (Longman 1982). and GA_3, GA, and GA9 in *Pinus* sy/ves- *Iris* L. (Little and MacDonald 2003). However, the effect of exogenous GA on *Phuts* shoot apical meristem activity during vegetative bud development has yet to be documented.

In this study, we investigated the effect of foliar spraying of GA_3 during terminal long-shoot bud development on both mitotic activity and organogenic activity of the shoot apical meristem in first-year *Pima sylvestris* seedlings. In addition. we observed how this treatment affected the initiation and differentiation of axillary meristems within the developing terminal long-shoot bud.

Shoot apical meristem anatomy and function

The shoot apical meristem of *Phuts* constitutes a dome of tissue above the most recently initiated cataphylls. In the anatomical study of a bud, observations are made on the median longitudinal section of serial sections through the bud. The shoot apical meristem of such a section exhibits cytohistological zonation (sensu Foster 1938) that, in pine, comprises the apical initials, the central mother cell zone, the rib meristem and the peripheral zone (Sacher 1954, Curtis and Popham 1972, Riding and Gifford 1973). The apical initials, which are located at the summit of the shoot apical meristem, are larger and more lightly staining than the other surface layer cells, and have larger nuclei. The central mother cell zone extends from the apical initials to the center of the meristem and is composed of large, irregularly arranged lightly staining cells. Beneath the central mother cell zone is the rib meristem, which appears as a band of small, darkly staining cells. Bordering these three zones is the peripheral zone, composed of small, darkly staining cells. Each cytohistological zone performs a specific function. The apical initials provide cells to the central mother cell zone and the outer layer of the peripheral zone (Sacher 1954). Mitotic divisions in the central mother cell zone supply cells to the rib meristem and the inner layers of the peripheral zone (Sacher 1954). Mitoses in the rib meristem result in vertical files of cells that mature into the pith of the shoot (Sacher 1954. Esau 1977). Divisions in the peripheral zone give rise to primary needle (sensu Wareing 1950) primordia during shoot neolormat ion (sensu Halle et al. 1978) in first-year seedlings and cataphyll primordia during terminal long-shoot bud development (Sacher 1954, 1955, Esau 1977). The epidermis, cortex and vascular tissue of the shoot are also derived from the peripheral zone (Sacher 1954). In shoot growth, the shoot apical meristem is responsible for organogenesis, whereas the subapical meristematic region (sensu Sachs (1965)) of the shoot is responsible for clongation.