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GAVIN PUBLISHERS

Archives of Applied Science Research

Veierskov B. Arch Appl Sci Res: AASR-101.

Short Communication

DOI:10.29011/AASR-101. 100001

Auxin: Cytokinine Ratio May Determine Plant Stem Elongation

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Citation: Veierskov B (2018) Auxin: Cytokinine Ratio May Determine Plant Stem Elongation. Arch Appl Sci Res: AASR-101. DOI:10.29011/AASR-101. 100001

Received Date: 06 September, 2018; **Accepted Date:** 12 October, 2018; **Published Date:** 19 October, 2018

Abstract

Endogenous levels of phytohormones seldom correlate to growth and development. However, in *Abies nordmanniana,* a IAA: cytokinin ratio below one corresponds to meristematic activity in the apical meristem, whereas a high ratio about 50 was observed in the elongating stem tissue.

Keywords: Auxin Cytokinin Ratio; Stem Elongation

Introduction

Although auxin has been known to influence cell elongation since the 1930'es, we are still lacking an understanding of how auxin participates in maintaining controlled stem elongation during a growing season. In a changing environment auxin initiates developmental adjustments of processes such as tropisms, apical dominance and cell proliferation [1], and auxin synthesis as well as transport are influenced by irradiance and temperature [2], all factors that may explain the weak correlations between hormone levels and plant development as well as unexplainable peaks [3-5]. Where auxin is able to stimulate cell elongation by itself, it is the interaction between auxin and cytokinin that is required to maintain cell division [6]. It is well documented that auxin and cytokinin regulates each other [7,8], and thereby developmental processes such as embryogenesis, meristem development and shoot branching [9]. However, auxin and cytokinin are today still being evaluated separately regarding stem elongation.

A model system where the development of the apical meristematic is separated from the process of stem elongation is idle to probe into the possible regulatory function of the auxin-cytokinin ratio in determining stem elongation. Such a model does exist in gymnosperms. In conifers such as spruce, pine and abies, a none elongating shoot initial is formed within the apical meristem each year, but the elongation thereof occurs first the flowering year. A cellular barrier exists between the two types of tissue. These plants are therefore unique by having separated the process of forming a shoot initial from the process of stem elongation. In these species of gymnosperms, top leader elongation is concealed to at short well-defined time period as bud burst occur in late May, and elongation of the preformed shoot initial occurs in June/July, with some variation between years [10].

We have made year round hormone determinations in several parts of *Abies nordmanniana* [11]. Although we observed a dramatic changes in the level of hormones during the growing season, as well as between different types of tissue, is was not possible to make firm conclusions to how the observed hormonal changes might regulate plant development. Furthermore, although weekly samples were taken in the period of growth, unexplainable variation in hormone levels was always determined (Figure 1).

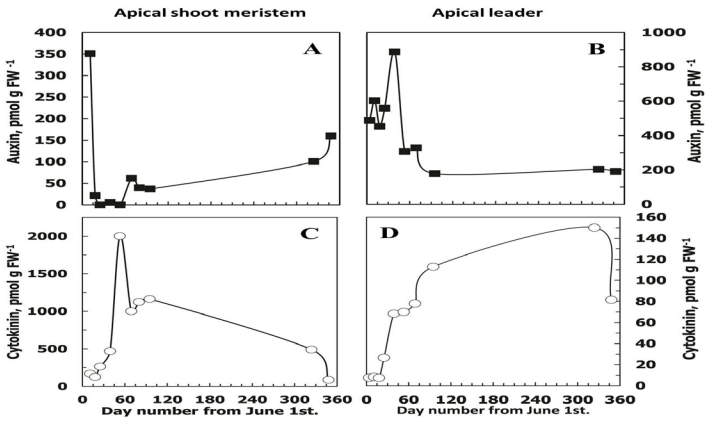

Figure 1: Year-round hormone levels in fluctuations *Abies nordmanniana.* The level of IAA (A and B) and cytokinins (C and D) in the apical shoot initial (A and C) and the middle of the elongating top leader (B and D. Cytokinin values are the sum of the major cytokinins identified (*t*-zeatin, *t*-zeatin riboside, *t*-zeatin riboside phosphate and *t*-dihydrozeatin). Original data are presented in [11].

During a reevaluating of the data obtained, it became apparent, that if the auxin-cytokinin ratio was used as a determinator of stem elongation, the unexplainable hormone fluctuationsdisappeared (Figure 1 vs Figure 2). The period of fast stem elongation corresponded to the period where the auxin-cytokinin ratio was very high, around 60, and as soon as theelongation process began to ceases, this ratio dropped to below 2. If the same ratio was determined within theapical bud, where the none-elongating shoot initial were formed, the ratio stayed below 1 throughout the entire developmental period, except at the very early phase of initiation, where a ratio of 2 was observed (Figure 2).

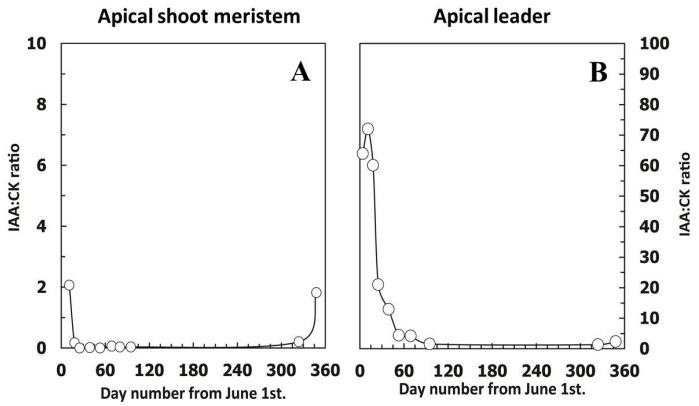

Figure 2: IAA: Cytokinin ratioin *Abies nordmanniana*. IAA:Cytokinin ratio in the apical shoot initial and the middle of the elongating top leader. Ratios based on data presented in (Figure 1).

The literature contains only very few data comparing the level of auxin to cytokinin. However, studies of hormonal levels in elongating buds in Lupinus [3] are in agreement with the hypothesis that it is the auxin:cytokinin ratio that determine elongation. A cytokinin: auxin ratio above 1 was observed in elongating bud tissue independent of the actual hormone levels, whereas a low ratio corresponded to a low elongation rate [3]. These authors concluded that although the data from each hormone may be suggestive they do not relate completely to observed growth pattern [3].

The ratio of auxin and cytokinin may thus control stem elongation independent of the actual level of each hormone. The threshold value seems to be around 1. Cell elongation occurs when the levels of auxin are above the level of cytokinin making the auxin: cytokinin ratio exceeding 1 whereas a lower ratio probably favors meristematic activity.

References

1. Vanneste S, Friml J (2009) Auxin: a trigger for change in plant development. Cell 136: 1005-1016.
2. Franklin KA, Lee SH, Patel D, Kumar SV, Spartz AK, et al (2011) Phytochrome-interacting factor 4 (PIF4) regulates auxin biosynthesis at high temperature. Proc Natl Acad Sci U S A 108: 20231-20235.
3. Emery RJN, Longnecker NE, Atkins CA (1998) Branch development in Lupinus angustifolius L. II. Relationship with endogenous ABA, IAA and cytokinins in axillary and main stem buds. J Exp Bot 49: 555-562.
4. Rasmussen (2009) J Pl Gr Reg 28:154-166.
5. Khaimov-Armoza A, Novak O, Strnad M, Mizrahi Y (2012) The role of endogenous cytokinins and environmental factors in flowering in the vine cactus Hylocereus undatus. I J Pl Sci 60: 371-383.
6. Perrot-Rechenmann C (2010) Cold Sp Har Per in Biol : 2.
7. Jones B, Gunnerås SA, Petersson SV, Tarkowski P, Graham N,et al. (2010) Cytokinin regulation of auxin synthesis in Arabidopsis involves a homeostatic feedback loop regulated via auxin and cytokinin signal transduction.Plant Cell 22: 2956-2969.
8. Tanaka M, Takei K, Kojima M, Sakakibara H, Mori H, et al. (2006) Auxin controls local cytokinin biosynthesis in the nodal stem in apical dominance.Plant Journal 45: 1028-1036.
9. Swarup R, Parry G, Graham N, Allen T, Bennett M (2002) Auxin cross-talk: integration of signalling pathways to control plant development. Pl Mol Biol 49: 411-426.
10. Swidrak I, Schuster R, Oberhuber W (2013) Comparing growth phenology of co-occurring deciduous and evergreen conifers exposed to drought. Flora 208: 609-617.
11. Rasmussen HN (2010) J Pl Gr Reg 29:268-279.