Farnesene affects Arabidopsis root meristem altering auxin transport

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Abstract

Farnesene is a sesquiterpene with semiochemical activity commonly found in the essential oils of many plants and heavily involved in interspecies communication. This molecule, already known for its high phytotoxic potential and its effects on root morphology and anatomy, caused a loss in gravitropism, bold roots and a "left-handedness" phenotype. These clues suggested an alteration of auxin distribution, and for this reason, the aim of the present study was to evaluate its effects on: i) PINOID proteins (PIN) distribution, involved in polar auxin transport; ii) PIN genes expression iii) apical meristem anatomy of primary root (RAM), in *Arabidopsis thaliana* seedlings, treated with 250 μM farnesene, for 7 days. The following GFP constructs: *pSCR::SCR::GFP, pDR5::GFP, pPIN1::PIN1::GFP, pPIN2::PIN2::GFP, pPIN3::PIN3::GFP, pPIN4::PIN4::GFP* and *pPIN7::PIN7::GFP* were used to analyze auxin distribution. Farnesene caused a reduction in meristem zone size and an advancement in transition zone suggesting a premature exit of cells from the meristematic zone. Moreover, these effects were accompanied by a significant reduction in cell division. The auxin-responsive reporter *DR5::GFP* highlighted that auxin distribution was clearly impaired in farnesene-treated roots where auxin distribution appeared maximum in QC and columella initial cells, without extending to mature columella cells. This finding was further confirmed by the analysis on PIN transport proteins distribution, assessed on individual constructs, which showed an extreme alteration mainly dependent on the PIN7, involved in pattern specification during root development and auxin redistribution. Finally, farnesene treatment caused a down regulation of all the auxin transport genes studied. We propose that farnesene affected auxin transport and auxin distribution causing a severe alteration of root meristem, and consequently the left-handedness phenotype. *This research was supported by the Italian Ministry of Education, University and Research (MIUR), project SIR-2014 cod. RBSI14L9CE (MEDANAT).

Keywords: Farnesene, auxin transport, root meristem, PIN proteins

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