The proprioceptive control of posture in land plants

Bruno Moulia

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Land plants have to control their posture while growing in a mechanically challenging environment. In particular they may recover from non-lethal tilting or lodging though active and coordinated growth movements. Such mouvements are known as gravitropism. Shoot gravitropism is triggered when statocysts sense the local angle of the growing organ relative to the gravitational field. Lateral transport of the hormone auxin to the lower side is then enhanced, resulting in differential gene expression and cell elongation,or shrinkage in woody parts of the plants, causing the organ to bend. However, little was know about the dynamics, regulation, and diversity of the entire bending and straightening process.

Recently, using vital kinematic imaging of the gravitropic movement of different organs from 11 angiosperms sampling the phylogenic tree of land angiosperms, we found that gravitropic straightening shares common traits across species, organs types and sizes. Surprisingly, the minimal dynamic model accounting for these traits is not the widely cited gravisensing law but one that also takes into account the sensing of the local curvature, i.e. a proprioception. A minimal dynamical model of the movement of the plant during gravitropism and posture control, called the AC model has been designed, that can explain most of the diversity observed in experiments. Moreover the entire dynamics of the bending/straightening response is described by a single dimensionless "bending number" B that reflects the ratio between graviceptive and proprioceptive sensitivities, and defines both the final shape of the organ at equilibrium and the timing of curving and straightening. Proprioceptive sensing is thus as important as gravisensing in dynamical gravitropic control. The mechanobiological mechanisms underlying this proprioceptive control will be discussed in the light of the models developed for the sensing and growth control after controlled bending, and the general issue of motion control in plants (and its relation with motion actuation) will be discussed

R.BASTIEN, T. BOHR, B. MOULIA.† *, S.DOUADY.† , 2013 . A unifying model of shoot gravitropism reveals proprioception as a central feature of posture control in plant. PNAS 110 (2): 755–760 († co-PI last authors, * corresponding author)

J DUMAIS 2013 Beyond the sine law of plant gravitropism (commentary of the paper by Bastien et al 2013) PNAS 110 (2) 391–392

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The schedule of your Oral presentation is as follows:

Day: **Monday, 9th December 2013**

Time: **09:20 –0 9:40**

Room: **Tramuntana 1 & 2**

Duration: **20 minutes** (including questions)

Prathibha Mehta

Conference Content Executive

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