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Abstract of spoken paper

Mathematically Modelling Mushroom Morphogenesis

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There is no reason why the "rules" which govern morphogenesis should not be established. From the rules and a few dimensions, times and rate values a mathematical expression to describe the entire morphogenetic process could emerge. Nice idea! But where do you start? Start simple. Making a stem bend in response to a tropic stimulus is a suitably simple ***experimental*** approach. The experimenter can choose when to apply the stimulus, it is easily replicated and reaction and response times can be measured readily. Also, the response itself can be ***measured*** so the quantitative demands of mathematical modelling can be satisfied. We have used the gravitropic reactions of mushroom fruit bodies to study control of morphogenesis because being the right way up is crucial to a mushroom. Changing orientation is a ***non-invasive*** stimulus. We've coupled video observation and image analysis to get detailed descriptions of the kinetics, and made and used clinostats to vary exposure to gravity, all combined with a variety of microscopic observation techniques to make quantitative observations (Moore *et al.*, 1996, *Mycological Research* **100**: 257-273; Stočkus & Moore, 1996, *Plant, Cell & Environment* **19**: 787-800). The model we have now describes the shapes assumed by real stems of *Coprinus cinereus* (Meškauskas *et al.*, 1998, *New Phytologist* **140**: 111-123; 1999, *New Phytologist* **143**: 387-399). Bending rate is determined by the balance between signals from gravity (a function of the ***angle*** of the stem) and curvature compensation (a function of the local amount of ***curvature***) detectors. This model is ***predictive*** and successfully describes the gravitropic reaction of stems treated with metabolic inhibitors, confirming the credibility of the model and indicating possible links between the functions of the equations and actual physiological processes. To take the model into three spatial dimensions we are developing the use of laser confocal microscopy to establish an accurate data set describing the geometrical arrangement of the hyphal components of fungal tissues. This cannot be done using conventional microscopy because z-axis (vertical) dimensions and internal branch angles cannot be measured. The confocal images are readily converted to red/green anaglyphs (using Confocal Assistant) which provide an easily realised three-dimensional visual sensation. However, the intention is to produce three-dimensional visualisations (using AVS/Express). These are fairly primitive at the moment (though they can be rotated for viewing from various angles), but they hold the promise of development to full 3-D visualisations which can be inspected 'from within' and used to extract geometrical measurements.