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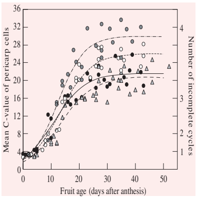
John Bryant takes a closer look at some of this month's Original Articles

Pegging-out on the bend

When cucurbitaceous seeds germinate in an orientation such that the radicle emerges pointing downwards, two small pegs grow out from opposite sides of the transition zone between the hypocotyls and the root. The pegs act as levers, enabling the cotyledons, with the plumule enfolded between them, to emerge from between the two halves of the seed coat. However, if the seeds germinate so that the radicle emerges horizontally, the transition zone responds to gravity by bending downwards. In this situation, a single peg forms on the concave side of the bend. The position of peg outgrowth relative to the gravitropic bend suggests that the two phenomena may be linked and this suggestion has been supported by research on cucumber (*Cucumis sativus*) seedlings reported by **Saito *et al.*, of Sendai, Japan (pp. 413–422)**. Auxin accumulates on the concave side of the bend in the classic gravitropic response. It is very likely that the auxin is also involved in the initiation of peg formation because if IAA is applied to the convex side of the bend, a peg also grows out from there. Following the establishment of the auxin gradient across the transition zone, there is an up-regulation of auxin-inducible genes. One of these genes, *CS-ACS1*, encodes ACC synthase, which catalyses the last step in ethylene formation. *CS-ACS1* mRNA accumulates preferentially on the concave side of the bend (as shown by very elegant quantitative RT–PCR and *in situ* hybridization experiments). This leads to preferential synthesis and accumulation of ethylene on the concave side of the bend. Finally, exposure to exogenous ethylene after peg initiation (whether natural or induced by IAA application) enhances peg growth, whereas early exposure to ethylene inhibits initiation of the peg. Here then is a beautiful example of the sequential action of two hormones, with the second, ethylene, being dependent on the first, auxin.



How large can a tomato grow? The answer lies in the cells

Plant growth is achieved by a combination of cell division and cell expansion. Cell expansion itself may be affected by DNA endo-reduplication, the replication of DNA, often several times, in the absence of cell division, which is usually correlated with large cell volumes. DNA endo-reduplication may thus be a way of achieving a large cell size. The relationships between these various processes may be complex, as illustrated by the work of **Bertin (Avignon, France, pp. 439–447)** on the growth of tomato fruit. In tomato, extensive DNA endo-reduplication occurs in the pericarp; some cells may undergo as many as seven rounds of DNA replication (starting in the diploid or 2C state) and thus contain 256C amounts of DNA. So, although division in the pericarp ceases relatively early, high biomass is achieved because of the large final size of the cells (which may be due in part to their high DNA content). The author has investigated the effects of a number of factors (of which we focus here on growth temperature), on cell division, cell expansion and DNA endo-reduplication in the growing fruit. Looking specifically at two of the growth temperature regimes (20/20 °C, day/night and 25/25 °C), it is clear that the relationship between division, expansion and endo-reduplication can be altered by temperature. Thus, at 20/20 °C, cell division in the pericarp continued for longer than at 25/25 °C, resulting in approx. 14 % more cells. However, because of a reduced period of cell expansion at 20/20 °C, final fruit volumes were not significantly different. Temperature also affected DNA endo-reduplication: plants at 25/25 °C reached a slightly higher mean DNA C-value than plants at 20/20 °C. Furthermore, the amount of DNA had a greater effect on cell volume at 25/25 °C than at 20/20 °C. This all reveals the complex interplay in the growth parameters that affect fruit size, a complexity well illustrated by the other data obtained in this very thorough investigation.

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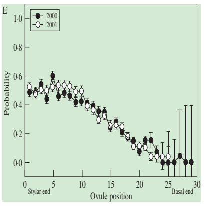
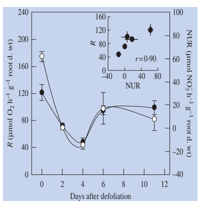


As alike as peas in a pod

The title of this piece is an English saying used to describe the similarity of, for example, identical twins. However, it does not stand up to scrutiny. Peas in a pod often differ from each other quite markedly, for example in size. Further, there are also variations in the likelihood of individual seeds in a pod surviving to maturity. This is clearly shown by **Mena-Alí and Rocha (San José, Costa Rica, pp. 449–455)** for a tropical member of the Fabaceae, the tree *Bauhinia ungulata*. They have investigated, over three seasons, the development process from ovule to viable seed. The first step, fertilization by the incoming pollen, was achieved successfully for between 70 and 95 % (the latter in two years out of three) of the ovules. However, a large proportion of the embryos were aborted in all three years so that only between 20 and 45 % of the original ovules developed into mature seeds. Further losses occurred because of damage by moth larvae and by beetles, giving final viable seed production of between approx. 10 % and approx. 38 %. The authors also demonstrated very clear position effects. Failure in fertilization was most likely for ovules that were in more basal positions in the pod, i.e. further from the style, with a greater distance for the pollen tube to travel. Similarly, early abortions (but not late abortions) were much more frequent at more basal positions. The authors suggest that this may be related to the vigour or quality of the pollen. Rapidly growing pollen will quickly encounter ovules at the stylar end of the pod, leaving the slower growing pollen to seek unfertilized ovules at a greater distance. It would be very interesting to know which features of an embryo lead to its abortion, but the overall effect is clear: ovules at the basal end of the pod very often do not develop into viable seeds.



Roots route nitrogen for new shoot nutrition

Mowing the lawn is a frustrating business: the grass just keeps growing again. In natural habitats, this feature is an adaptation to defoliation by grazing animals. There are thus interesting questions about how the plant supplies nutrition and energy to fuel the regrowth of its aerial parts after severe reduction of photosynthetic capacity. This has been the subject of research by **Monika Kavanoví and Vít Gloser (Brno, Czech Republic, pp. 457–463)**, working with the rhizomatous grass *Calamagrostis epigejos*. For this species, there is the added interest that it is invasive and is proving difficult to control, although the authors state that repeated mowing reduces its competitiveness. In the experiments reported here, the grass was defoliated very extensively and regrowth was studied in relation to respiration and to aspects of N-metabolism. Leaf area and shoot length started to recover almost immediately, but total plant dry weight did not start to rise for about 6 days (following a slight drop), presumably indicating that in this initial phase net photosynthesis was not great enough to exceed the loss of carbon by respiration and other processes. In roots, respiration rate and specific nitrate uptake rate declined markedly in the first 4 days, after which they both partially recovered. The relationship between the two suggests that uptake of nitrate by roots is dependent on root respiration. Supply of N to the growing shoot therefore did not come from external nitrate but from amino acids and soluble proteins originating in the roots, which lost 50 % or more of their content of these compounds in the first week after defoliation. The loss of proteins appeared to be partially selective, with certain proteins declining much more than others. However, there was no evidence for a specific storage protein. Interestingly, rhizomes did not play a part in the N nutrition of the new shoots, although they clearly have an important role in plant establishment.

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