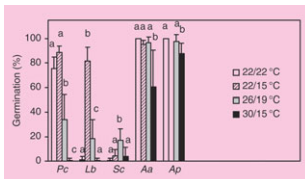


Life is sweet – but short

In an era in which our science is apparently dominated by studies at the molecular level, it is easy to assume that investigations of plant structure can teach us relatively little. However, such an assumption would be wrong. The renaissance in microscopy and the interfaces between microscopy, ultra-microscopy, computing and modelling (and indeed, with molecular studies) are providing exciting new information about plant anatomy, morphology and development. Aspects of this are beautifully illustrated in the paper by **Gaffal *et al.* (Erlangen and Freudenberg, Germany, pp. 593–607)**. They have investigated the relationship between the phloem and the floral nectaries in *Digitalis purpurea*. In this species, the nectaries are temporary organs and so not only is there the question of how they receive sucrose during their active phase but what happens to them

when they cease to function. It is not possible in this short commentary to do justice to the authors' elegant and very thorough work but the key findings were as follows. In the secreting nectary, the nectiferous layer is located below the epidermis. However, it is not in direct contact with the phloem sieve elements that deliver the sucrose. Instead, the latter are abutted by intercellular spaces or ducts, suggesting that transfer from phloem to nectiferous cells is via an apoplastic route, a suggestion supported by calculations on the required rates of sucrose delivery. However, the direction of the traffic changes as the nectary becomes exhausted. Even during the nectar-secretion phase, the nectary exhibits early signs of senescence, and after it is exhausted the cells show the typical progression of developmentally regulated programmed cell death, including increased vacuolation, loss of internal structural integrity, degradation of plastids, breakdown and eventual disappearance of chromatin, finally culminating in complete lysis of the cell contents. The still-intact phloem is thus able to take up the soluble lysis products and redistribute them within the plant.



Seeds seek signs from shaded soil

In the Biblical parable of *The Sower*, some of the seeds fell on stony ground. They germinated successfully but the seedlings did not survive because they withered in the heat of the sun. Germination in the wrong place clearly has disastrous consequences. For some species, mechanisms have evolved to ensure that this does not happen, as described by **Kos and Poschlod (Regensburg, Germany, pp. 667–675)** in respect of plants occupying a particular niche in the xeric Kalahari savannah. Plants that grow

under the canopy of *Acacia erioloba* trees form a well-defined subset of the local flora in this ecosystem. Many of them are dispersed by birds, which shed the seeds from their perches in the trees. Seeds germinate in the shade of these 'nurse' trees but do not do so in the open ground around the trees. Soil temperatures at a depth of 10 mm were measured every 2 h for 3 months under the canopy and in the open ground (matrix). Two features were very clear. First, the minimum soil temperatures of the two habitats were very similar; second, the maximum soil temperature was several degrees higher in the matrix than under the canopy, which meant that the daily temperature fluctuation (DTF) was much greater in the matrix. Seeds of canopy and matrix species were then set to germinate under various soil temperature regimes. Here we focus on regimes that mimicked the two habitats. Again the results were clear. Matrix perennials and annuals germinated equally well under both 'habitat-regimes'. Presumably there are other factors that prevent the growth of these species under the canopy. By contrast, for all the canopy perennials and some of the annuals, the matrix soil temperature regime was inhibitory to germination, in some species very strongly so. These species thus avoid unfavourable growth conditions by not germinating in the wrong place – unlike the seeds in the parable!



Model leaves – and shoots

Thinking about the dependence of human nutrition on fruit, seeds and their products leads to a realization of the importance of the regulation of flowering. Rightly then, the transition from the vegetative to the flowering state continues to attract attention. However, the floral transition is not just about forming flowers, as is illustrated by the work of **Cookson *et al.* (Montpellier, France, pp. 703–711)**. Their subject of study was the favourite ‘model’ long-day plant, *Arabidopsis thaliana*. Plants were grown under five different day-length regimes; in all other respects treatments were identical.

We concentrate here mainly on comparing the effects of 20-h and 10-h days on the ‘Landsberg’ *erecta* ecotype. Under short days, more rosette leaves were formed than under long days because the length of the leaf initiation phase was lengthened. However, when comparing leaves at the same position, the leaves on the long-day plants had a greater leaf area than those on the short-day plants. This resulted from greater absolute and relative leaf expansion rates. The number of epidermal cells was also significantly greater under long days but the effect of this was partly negated by the smaller area of the epidermal cells. Thus, the conditions that induce or inhibit flowering also affect leaf development but are the two developmental processes connected? Transferring plants from 10-h to 20-h days induced flowering and inhibited initiation of rosette leaves, consistent with the earlier experiments. To study the effects of flowering delay, the authors grew plants under 14-h days (in which flowering does occur) but then removed the flower buds. The results presented are confined to epidermal cell dynamics: predictably, the epidermal cell area was increased by this treatment but, perhaps unexpectedly, epidermal cell numbers were also increased. Nevertheless, the overall picture is clear: there are whole-plant mechanisms associated with flowering that contribute to the control of leaf development.



Turning on the gas for greater growth

Although many of the plant species we use as crops are, as a result of selection, very different from their nearest wild relatives, there are some for which this is not so. Thus, cultivated rice and red or weedy rice are regarded as conspecific. They are capable of interbreeding (although their flowering times tend to be different) and gene flow from one to the other certainly occurs [I have commented elsewhere on the problems that may be caused by gene flow from genetically modified cultivated rice to red rice: Bryant (2007). Rice, risk and regulations. *Biological Sciences Review*, in press]. Control of red rice amongst rice crops is a problem, one particular feature of which is the occurrence of banks of dormant seeds in the paddy fields. With this in mind, a joint Dutch–Italian team (**Gianinetti *et al.*, pp. 735–745**) have investigated the physiology of dormancy and germination, focusing especially on the role of ethylene. From their very thorough paper we focus here on some of the key results. Treatment of after-ripened (non-dormant) caryopses with inhibitors of ethylene synthesis or action, or with promoters of ethylene synthesis and release, had no effect at all on germination (as indicated by splitting of the pericarp). Further, exposure to these agents or to ethylene itself had no effect on dormant seeds; neither was there any residual effect on seeds whose dormancy was subsequently broken by after-ripening. However, ethylene inhibitors did retard seedling growth after germination; this effect was negated if the ethylene precursor ACC was added at the same time. With very sensitive laser-based ethylene detectors (capable of detecting emission rates as low as 5 fmol per seed h^{-1}), the authors demonstrated that germinating seedlings began to produce ethylene at about the time of pericarp splitting but the latter was not dependent on ethylene production. Thus ethylene is involved not in germination *per se* but in seedling growth (and especially growth of the radicle). Further, the kinetics of ethylene emission in the presence of the inhibitors AVG and STS, and of the precursor ACC, suggest that the synthesis of ACC must be activated before ethylene emission can start.

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