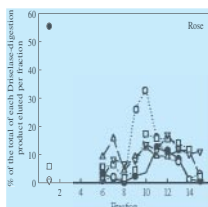


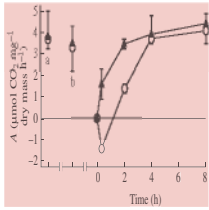
Losing the thread

The evidence for global climate change is now incontrovertible. Global temperatures have increased, and are continuing to do so. This is, of course, a matter of serious concern at several levels. In agriculture and horticulture the concerns include the possibility that conditions may become more difficult for crop growth. Within any one species, different aspects of growth and physiology are differently affected by high temperature and thus the most vulnerable process will be different in different species. In cotton, for example, boll formation, retention and yield are affected by high temperature, as described by a US research team, **Kakani *et al.* (pp. 59–67)**. The authors have identified pollen germination and growth as being especially sensitive to temperature. Typically, pollen is released in the morning before the temperature reaches its maximum. However, pollen tube growth is relatively slow and is in progress during the heat of the day with fertilization occurring between 12 and 24 hours after pollen germination. The authors have worked with 12 cotton cultivars, exhibiting a range of tolerances to stresses such as drought and high temperature. They collected ripe pollen from these cultivars and observed pollen germination and growth *in vitro* on artificial media at a range of different temperatures. Minimum, optimum and maximum temperatures for germination and tube growth varied between cultivars and, in general, the temperature optima for tube growth were lower than for germination. For both processes, the breadth of the range of 'permissive' temperatures varied. Further, at their optimum temperatures, the cultivars showed a good deal of variation in tube growth rates. Based on principal component analysis, the cultivars could be grouped according to their temperature tolerance, with the most high-temperature-tolerant group having optima for pollen germination above 32 °C. Interestingly, there was no correlation between temperature tolerance of pollen and membrane thermostability, emphasizing again that different processes are differently vulnerable.



In the frame of the rose

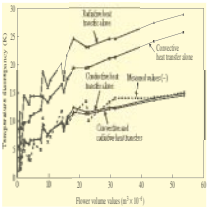
Technical innovation and advances in knowledge are tightly linked. The desire for knowledge drives the development of techniques; better techniques then give us more detailed knowledge. A particularly good example of this is analytical biochemistry, covering the whole gamut of compounds and complexes synthesized by living organisms. Research on the angiosperm cell wall illustrates this very well. Knowledge of the polymers involved in the wall and of their interlinkages has expanded enormously since the early 1970s and continues to do so. One of the features of the general model for angiosperm cell walls proposed by Albersheim's group in 1973 was the existence of covalent linkages between the hemicellulose and the acidic pectin components of the wall. Over the succeeding years, the existence and nature of those linkages has been gradually clarified. This is clearly seen in the work of **Stephen Fry's group at Edinburgh, UK**, exemplified here in this paper with **Zoë Popper (pp. 91–99)**. The group had previously obtained evidence for the existence in *Rosa* suspension cultures of a covalently linked complex of xyloglucan and pectin. In the work presented in this paper, they labelled xyloglucans by feeding the cells with [³H]arabinose and then subjected the cell walls to a range of fractionation and analytical techniques. The results are very clear: in *Rosa*, 60 % of the labelled xyloglucan is found in covalent linkage with the acidic pectin fraction made up of rhamnogalacturonan. Further, this type of linkage is not confined to rose. In a range of angiosperms, including two monocots, between 44 and 70 % of the xyloglucan is linked with acidic pectin. In *Arabidopsis* further evidence for such linkages was obtained by the demonstration that 20 % of the [¹⁴C]galacturonate-labelled pectins (obtained by feeding cells with [¹⁴C]glucuronic acid) are linked with xyloglucan. The authors conclude that such evolutionarily conserved linkages are likely to be essential for cell wall structure and function.



Hormone therapy may protect partnership from problems

Lichens have a remarkable ability to tolerate hostile conditions. Many can withstand extended periods of severe water deficit and then resume normal metabolic activity. However, we actually know relatively little about desiccation tolerance in these fascinating ‘dual organisms’. It has been proposed that lichens that are normally exposed to long periods of desiccation may exhibit constitutive adaptation mechanisms whereas those that grow in mainly moist conditions, subject to briefer periods of drying, may possess inducible tolerance mechanisms. It was one of the latter group,

Peltigera polydactylon, that was investigated by **Beckett *et al.*, Scotsville, South Africa and Kazan, Russia (pp. 109–115)**. *Peltigera polydactylon*, a lichen in which the photobiont partner is a cyanobacterium, lives in South African forests, which, although mostly moist, are exposed to regular winter droughts. The authors suggest that in this habitat lichens may experience partial dehydration before the onset of the full drought. They gave *P. polydactylon* a 3-day partial dehydration followed by 1 day of re-hydration before exposing them to full scale drought for 15 or 30 days. This pre-treatment led to a more rapid recovery of net photosynthesis after 15 days drought (but not after 30 days) compared with control plants. The partial drought pre-treatment could be completely replaced by application of 100 µM ABA under hydrated conditions. This is consistent with ABA in the cyanobacterial photobiont partner being involved in responding to/adaptation to water deficit, as in green plants. However, ABA treatment did not appear to protect chlorophyll fluorescence or photosystem II activity from drought, so the more rapid recovery of net photosynthesis after ABA pre-treatment clearly merits further investigation. The final point to make is that the effects of the partial dehydration or ABA pre-treatments were not shared with the fungal partner: its respiration and heat output were similar in control and in pre-treated samples.



Spadix size is certainly significant

One of my abiding memories of the late Tom ap Rees was his arrival at the lab on spring mornings in Cambridge carrying inflorescences of *Arum maculatum* that he had picked on his way to work. Tom was interested in the regulation of metabolism associated with thermogenesis in the spadices. He went on to show that enzyme activities and fluxes through glycolysis and non-ATP-yielding respiratory pathways increase very dramatically. But just how hot can the spadices get? Some of the constraints on temperature will be metabolic and some will be physiological, but are there also

physical limitations? This question has been addressed by **Gibernau *et al.*, Toulouse, France and Montreal, Canada (pp. 117–125)** for 18 different tropical aroids in which the male zone is in the upper part of the inflorescence. The maximum difference between the temperature of the spadix and ambient temperature was 15 °C; the magnitude of the temperature difference was directly correlated with the volume of the thermogenic zone in the spadix – size does matter! In order to discern the physical, as opposed to biochemical and physiological, factors that limit the temperature difference, they applied models describing different modes of heat transfer to their data. Three modes of heat transfer from a solid cylinder are possible: conduction (if the air around the inflorescence is still), convection (if the air is moving) and radiation. The analysis in fact shows that both a conduction model and a mixed convection–radiation model provide good fits to the data. The authors suggest that it is entirely feasible that different modes of heat transfer occur separately, but they mainly focus on the conduction model. So, in addition to the biochemical ability of the inflorescence to generate heat via thermogenic metabolism, the temperature differential is limited by heat loss consistent with conduction from a solid insulated cylinder with an internal heat source.

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