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



The cup that cheers — a new approach to vintage problem

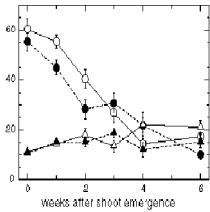
As I write this in August 2003, many European vine growers are suggesting that the very fine summer will lead to an excellent year for wine — in their terms, one of the best vintages ever. Nevertheless there are concerns in some regions that water deficiency may yet have deleterious effects on final yield and quality. It is thus interesting that **Zhen-Ping Wang and colleagues (Montpellier, France and Ningxia, China, pp. 523–528)** have devised a very neat experimental system to study *in vivo* phloem unloading into ripening grapes under well-watered and water-deficient conditions. The basis of the technique is the 'berry cup', a perspex cup in which an individual grape, still attached to the vine, may be immersed in buffer solution. Prior to immersion, the grape is carefully peeled without damage to the vascular tissue or to the pulp, thus exposing the dorsal vascular bundles. The buffer solution in the cup is sampled at intervals and its sugar content (mainly sucrose and fructose) is determined. It takes about 60 min to purge the sugars already present in the apoplast, after which the kinetics of the unloading process itself may be studied. Initial unloading from the phloem is into the apoplast from where the sugar solution is normally taken up into the vacuoles. The effects of inhibitors suggest that unloading is dependent on respiratory energy and on sugar transporters. Throughout the day, the unloading rate is also related to the rate of photosynthesis. And what about the effects of water deficit? In vines growing under water-stress (-0.5 MPa) phloem unloading rates are certainly slower than in control vines (-0.2 MPa). This is mostly attributable to a reduction in rates of photosynthesis, but in the later hours of daylight there is some evidence for a more direct effect. Perhaps those vine growers should be just a little concerned.



Succulent shock: old and young compete for water

It is a well-established idea that during water shortage, plants export water from old leaves to young leaves. The old leaves then senesce, die and drop off. But, suppose the sequence of events is the other way round: perhaps water shortage induces programmed cell death in older leaves (they are, in developmental terms, nearer to senescence than are young leaves). In programmed cell death the plant makes use of the resources (including water) from the dying cells, transporting them to the younger regions, and thus the older leaves wither and fall off. What then would happen if water stress does *not* induce programmed cell death: do the older leaves export water, but nevertheless survive, or do they retain it? It is this that has exercised **Rabas and Martin (University of Kansas, pp. 529–536)**. They used three succulents, *Kalanchoe tubiflora* (a CAM plant), *Carpobrotus edulis* (regarded as an inducible CAM plant but behaved as a C3 species in these experiments) and *Sedum spectabile* (inducible CAM plant) in which they examined the effects of water deficit on water relations, CO₂ fixation and nocturnal acid accumulation. They obtained no evidence for transfer of water from old to young leaves in any species even under water-stress conditions. Removal of old leaves led to increases in young leaf water content, especially in *C. edulis* and *K. tubiflora*, suggesting that there is normally competition for water between young and old leaves, rather than a preferential movement from old leaves. This is supported further by the finding that rates of CO₂ fixation (whether C3 or CAM) increased in young leaves after removal of old leaves, especially in conditions of water deficit. These results thus contradict the view that plants move water from old to young leaves during water deficit. It will be interesting to do a similarly rigorous analysis with non-succulent plants.

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Tapping into reserves: the route to survival?

When seeds (acorns) of *Quercus* species germinate, the emerging radicle grows quickly to form a well-developed and well-anchored tap root. Shoot emergence follows a few days after radicle emergence; elongation of the shoot brings the hypogeal cotyledons, the seed's major storage organs, above ground. Leaves begin to open within 2–3 weeks of shoot emergence and start to photosynthesize: the seedling is on its way to becoming a mighty oak. An interesting feature of these early developmental stages is the accumulation of carbohydrate reserves in the tap root.

Kabeya and Sakai (Tohoku University, Sendai, pp. 537–545) have investigated the role of this stored carbohydrate in the carbon economy of *Q. crispula* seedlings. They established seedlings at light intensities of 40 % full daylight, mimicking a typical open patch on the woodland floor, and at 3 % full daylight. We focus here on the former. They first noted that the tap root carbohydrates accumulate before photosynthesis starts and thus cannot come from newly fixed carbon. The cotyledons export storage reserves relatively rapidly over the first 4 weeks, first to the tap root and then to the shoot, but thereafter more slowly as photosynthesis is initiated. The authors then mimicked herbivory by clipping the shoots. This leads to re-sprouting of shoots from dormant buds either in the axils of scaly leaves on the epicotyl, or from the below-ground root collar. Obviously photosynthesis is now not available as a carbon source, so what fuels re-sprouting? It is not the carbohydrates in the root. Once again the cotyledons supply the need. The authors surmise that the root reserves are set aside for major emergencies such as when the cotyledons are eaten by birds or mammals. In such a situation the seedling would still have carbohydrates to fuel shoot emergence. It is thus abundantly clear what experiments the authors should do next!



Bryophytes suffer co-lateral damage in bracken battle

How selective are selective herbicides? Is it possible to control a nuisance species without damaging other plants? In relation to the control of bracken (*Pteridium aquilinum*) the answer appears to be 'No', as described by **Rowtree et al. (Manchester University and Natural History Museum, London, pp. 547–556)**. Bracken is a very invasive fern and in many parts of the world it is controlled with methyl (4-aminophenyl sulfonyl) carbamate. The soluble, commercially available version of this is known as Asulox, solutions of which are sprayed from the air or from the ground. Although bracken is

the target species, other pteridophytes are also sensitive. The authors of this paper have now looked at the effects of Asulox on another important group of plants, the bryophytes. As a group they are very widespread and are key players in many ecosystems; several species occur with bracken. Eighteen species of mosses, across the taxonomic range, from UK habitats ranging from aquatic to relatively dry were used in this study. Moss shoots were exposed to various concentrations of Asulox by immersion for 24 h and then grown for a further 3 weeks in the absence of herbicide. All species showed some sensitivity, as measured by effects on elongation growth, although the EC_{50} values (the concentration at which a 50 % inhibition of elongation occurred) were over a 70-fold range. The most tolerant species was an aquatic moss *Warnstofia fluitans* (indeed, its growth was actually stimulated at low Asulox concentrations), whilst damp-loving *Sphagnum* species were among the most sensitive. Obviously, total immersion is not the same as exposure by drift or drip but we note that the EC_{50} values observed here were all very much lower than the concentrations used to control bracken in the field. Thus the authors suggest 'that mosses are potentially sensitive to Asulox exposure under field conditions'.

Professor J. A. Bryant
University of Exeter, UK
E-mail j.a.bryant@exeter.ac.uk