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

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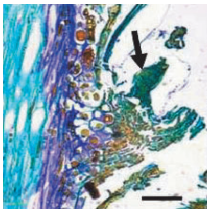
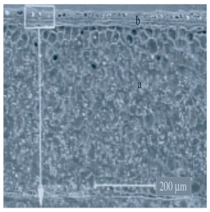


Fans of the flames—following the fire

The role of fire as an ecological factor was brought home to me when I was walking on a late summer day in the 'high country' of Yosemite National Park in California when I could see plumes of smoke rising in several different places, some of them very remote. Adaptation to fire has been investigated by **Dolors Verdaguer and Fernando Ojeda of Girona and Cadiz, Spain (pp. 593–599)**, in the very diverse genus *Erica* in a fire-prone heathland ecosystem in South Africa. The genus exhibits two main methods of regeneration after fire. Some species are 'resprouters', regrowing from buds on a lignotuber, a woody swelling at the stem base. Starch deposits in the roots are an energy source for the sprouting buds. Others species are seeders, repopulating fire-cleared zones by germination of previously dormant seeds. Seeders do not lay down extensive starch stores in their roots. The contrast is therefore between bud banks and seed banks. Interestingly, there are species that exhibit both strategies, exemplified by *E. calycina* and *E. coccinea*. The seeder and resprouter lifestyles occur in separate lineages and are inherited from one generation to the next. The authors had previously shown that starch deposition in roots is confined to the resprouter lineages. In the present work they show that there are clear differences in axillary bud formation and activity in the cotyledonary region and in the first two nodes. Resprouters have active buds from which the lignotuber is thought to grow; seeder lineages possess only rudimentary and/or atrophied buds in this region. The authors argue that the possession of atrophied buds is an indication that functional buds (i.e. the resprouter lifestyle) represent the ancestral state. They carry on to suggest that the seeder lifestyle is an adaptation that allows the exploitation of more diverse habitats and the evolution of many endemic species.



Put another nickel in

Flowering plants as a group are amazingly adaptable, as exemplified by species that grow in serpentine soils containing large amounts of nickel and low amounts of essential nutrients. In terms of nutrition these plants face two key problems. The first is obtaining enough essential macronutrients such as K and N. The second is avoiding the toxicity of Ni, concentrations of which far exceed the plant's requirement for this micronutrient. It is this latter aspect that has been studied by **Léon *et al.* (New Caledonia and Marseilles, pp. 609–618)** focusing on *Grevillea exul* var. *rubiginosa*, which grows on the serpentine soils of New Caledonia. Seeds were germinated in the presence of Ni, supplied as three different salts: Ni chloride, sulphate and acetate. At concentrations of Ni up to 50 mg L^{-1}, there was relatively little effect on germination but at higher concentrations inhibition of germination became very severe, although less so with Ni sulphate than with the acetate or chloride, the latter being especially toxic. However, seedling root growth in those seeds that did germinate was inhibited significantly at concentrations of 10 mg L^{-1} and above. Nevertheless, these data reveal a high degree of Ni tolerance. SEM and mineral microanalysis of seeds showed that Ni was nearly all confined to the seed coat except that seeds exposed to Ni chloride, the most toxic of the three salts, exhibited some Ni in the endosperm. In respect of seeds, therefore, *G. exul* is mainly a Ni excluder. However, the presence of Ni in the seed coat did have some effect on the distribution of certain other nutrients in the endosperm: the homogeneous distribution in controls was replaced by a patchy distribution, the most intriguing feature of which was the accumulation of Mg, P, K and Mn in the region of the endosperm nearest the embryo axis. The mechanism for this effect of Ni remains to be elucidated.

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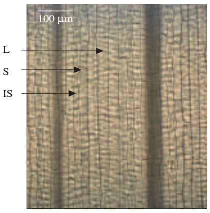
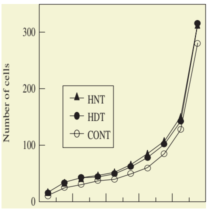


Bred dwarf

Dwarf varieties of cereals are extensively used all round the world and have been one of the factors contributing to significant improvements in yield. In wheat, the dwarfing genes used in plant breeding programmes include *Rht1* and *Rht2*, whose primary effect is to confer gibberellin insensitivity on the plant, as discussed by **Botwright *et al.* (Wembley and Canberra, Australia, pp. 631–639)**. This results in reductions in internode and coleoptile lengths, which have been attributed to smaller epidermal cells, although, as the authors point out, previous studies have been mainly confined to one type of cell. In addition to height reduction, leaf area of seedlings is also markedly reduced and this affects seedling vigour. The latter term includes, amongst other things, the ability of seedlings to become established, especially under non-ideal conditions. Thus, the reduction in vigour in these dwarf lines provides a good reason to investigate other dwarfing genes, such as *Rht8*. In lines carrying this gene, the dwarfing may be overcome by supplying gibberellin and thus *Rht8* is known as a gibberellin-sensitive dwarfing gene. The authors have carried out an extensive analysis (a) of two parental lines (a semi-dwarf line carrying *Rht8* and a tall and very vigorous line carrying *rht8*) and (b) of doubled-haploid lines (DHLs) carrying either *Rht8* (and therefore semi-dwarf) or *rht8* (and therefore tall). The study included measurement of the size and number of four epidermal cell types, the contribution of the cell types to leaf area, and estimates of seedling vigour. From this complex analysis, it is clear that in *Rht8* dwarf lines, cell size and other cell characteristics (and hence leaf area) and seedling vigour segregate independently of the dwarfing trait, in contrast to the gibberellin-insensitive *Rht1* and *Rht2* lines. So, as the authors conclude, there is now the opportunity to select dwarf wheat lines without sacrificing leaf area or seedling vigour.



In the heat of the night

Unravelling the complex network of factors that contribute to yield in crop plants has provided an ongoing challenge for physiologists and breeders. This is nicely illustrated by the work of **Morita *et al.* (Chikugo, Morioko and Kukuyama, Japan, pp. 695–701)**. These authors have studied the effects of temperature on grain size in rice. Temperature regimes, applied from the heading phase onwards, were control (22 °C during day and night), high day temperature (HDT, 34 °C/22 °C) and high night temperature (HNT, 22 °C/34 °C). Grain growth rates were initially highest in the HDT treatment, intermediate in the HNT treatment and lowest in the controls, but growth stopped 5 days earlier in the experimental treatments than in controls. So an increased mean daily temperature leads to increased grain growth rate, more so when the higher temperature was applied in the day, but decreased growth duration. Further, final grain dry weight was approx. 10 % lower in the HNT treatments than in the HDT and control treatments. The earlier cessation of growth has been ascribed to earlier senescence of the sink organs, but we also need to ask about what is happening at the cellular level in the endosperm, which provides the bulk of grain weight. Measurements of endosperm cell numbers and size again indicated the complexity of the situation. Cell numbers in both HDT and HNT treatments were greater than in controls but similar to each other. The equality of grain size between the control and HDT treatments was achieved by a greater cell area in the controls, while the lower grain weight in the HNT treatment was a result of the cells themselves being smaller. Thus, the relationship between cell division and cell size was different in the three treatments. Further, the effects of temperature vary according to the timing of the high temperature exposure in relation to photosynthetic function.

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