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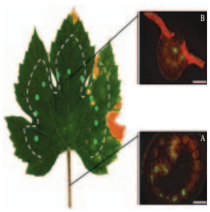
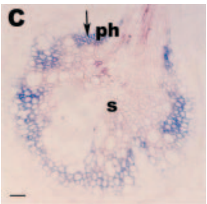
John Bryant takes a closer look at some of this month's Original Articles



Passive movement pierces plant defences—and demolishes dogma

For growers of grapevines, *Xylella fastidiosa* spells trouble; it is the causative agent of Pierce's disease, a condition that is almost inevitably lethal. **Chatelet *et al.* (Davis, California, USA, pp. 483–494)** describe *X. fastidiosa* as typifying those pathogenic bacteria that are limited within the host plant to the xylem, within which they move passively. Several of the symptoms of Pierce's disease relate to blockage of the xylem vessels, not just by the pathogen but also by substances produced by the host in response to infection. Other symptoms, including necrosis of leaf margins and loss of leaf laminae, imply that the bacterial cells can move out into the leaves. As the authors state, accepted dogma is that the bacteria can move between vessels by digestion of the membranes of pits that connect the vessels. However, this group has previously obtained evidence to counter this view. In particular, *lux*-expressing cells of bacteria that lack any ability to digest pit membranes were shown to move through the plant in a similar way to *X. fastidiosa*, indicating that there is an open route from the stem into the leaf with no discontinuities. In the present paper, the authors present an extensive range of results that confirm this idea. For example, the movement of air, latex paint particles and GFP-tagged *X. fastidiosa* cells from stem to leaf clearly indicates the presence of 'open conduits' out into the leaves. The stem–leaf connection does not occur in the youngest 12 nodes and, further, even when developed the 'conduit' does not reach the leaf margin: bacteria only reach approx. 50–60 % of the distance from the leaf base to the margin. Anatomical studies show that perforation plates are absent from tracheary elements beyond the basal 50–60 % of the leaf blade, thus preventing further outward movement of bacteria—but even at a distance they can cause necrosis at the leaf margins.

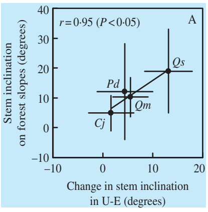


PR boost for compost claims

The current emphasis on more sustainable agriculture and horticulture has stimulated research on integrated management of pests and diseases. In such systems, the grower relies less on control by agrichemicals and more on biological control. Further, there is a growing literature to support the many claims that certain composts can provide protection against plant pathogens. Seedlings grown in such composts are much less prone to disease. The frequency of the diseases is very much lower and, if infection does occur, the severity of the symptoms is reduced. Much of the research has focused on the soil-borne pathogens themselves, but **Kavroulakis *et al.* (Kalamata and Athens, Greece, pp. 555–564)** have turned their attention to the plants grown in disease-suppressive composts. Using the known sequences of plant proteins that play a role in defence (a group of pathogenesis-related or PR proteins), they have designed primers to detect, by reverse transcription–polymerase chain reaction (RT–PCR), the expression of genes encoding these proteins. Their results clearly show that, even in the absence of any pathogens, growth of tomato (*Solanum lycopersicum*) in compost induced the expression of two *PR* genes: *PR1* and *PR5*. This did not happen in plants grown in a peat-based medium. A third *PR* gene (*PR69*, a member of the *PR7* gene family) was expressed in peat-grown plants, but expression was strongly up-regulated by growth in compost. They then carried out *in situ* hybridization to examine the spatial patterning of the expression of these genes: *PR1* was expressed in the root pericycle and *PR5* in the phloem of both roots and stems. The expression of *PR69* was less predictable, occurring sporadically in root parenchyma and vascular tissue. These results provide clear evidence that the compost can induce the synthesis of proteins involved in plant defences against pathogens: the plant is thus primed with its defence system ready to go, should an attack occur.

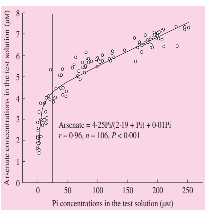
Continued overleaf

Seeing the light on the slippery slope



I was walking recently in the valley of the River Nidd in northern England and was interested to observe the different growth angles of trees on the steep wooded banks. Some were very nearly vertical while the growth direction of others was inclined in the direction of the downward slope. It is this topic that has interested **Matsuzaki *et al.* from the University of Tokyo (pp. 573–581)**. They have shown that, at a given angle of slope, the inclination of the stems of trees varies according to species. Of the four that they studied, *Cryptomeria japonica* showed the least inclination and *Quercus serrata* the greatest. To investigate the factors that regulate the angle of growth, seedlings were grown in individual pots that were either kept vertical or inclined at 45°. For both treatments, seedlings were illuminated either vertically from above or unilaterally (light source at 90° to vertical). This enabled the authors to evaluate the individual and the combined effects of gravi- and phototropism on the growth of the seedlings. The stems of all four species responded to both stimuli but, perhaps surprisingly, it was the magnitude of the phototropic response that was correlated with the angle away from vertical of trees growing on slopes. The authors conclude that even after the cessation of elongation, the inclination of woody stems can be controlled by phototropic responses. This work is important not only because it gives us information about plant growth in general but also because it is relevant to the amenity use of trees. The authors have obtained insights about what happens to the above-ground parts of plants growing on slopes. It will be very interesting now to link this with the work on the root systems of plants in similar situations, such as that described by Chiatante's group in their recent publications (e.g. *Annals of Botany* **97**: 857–866).

AsPi-ring to disallow arsenic access



Significant numbers of consumers in the more affluent nations now express concerns about pesticide and herbicide residues on or in their food plants. Some of that concern is justified in that specific safety limits have been laid down for certain compounds and the relevant food safety organizations are charged with ensuring that those limits are not exceeded. However, it is rare for concerns to be expressed about what is in plants 'naturally' and yet chemicals that are injurious to human health may well be synthesized or accumulated by plants, including some crop species. Arsenic is a case in point: phosphate and arsenate are taken up into plants by the same transport systems. Chemically, the two are very similar but, of course, one is an essential nutrient and the other is a poison. For the most part, this is not a problem and, anyway, the food safety regulators have also set limits for arsenic in food plants. However, in soils with high arsenic contents, arsenate accumulation is a problem. On a global scale, more marginal land, including land containing arsenic, is likely to come under cultivation. Accordingly, the work of **Zhu *et al.* (Beijing and Shanghai, China and Adelaide, Australia, pp. 631–636)** is particularly important. They have examined the uptake, from hydroponic solution, of arsenate and phosphate by two wheat cultivars and by doubled haploid lines derived from these cultivars. The kinetics of uptake were consistent with the well-known two-component transport model and gave a clear picture of the relative affinities for phosphate and arsenate. More significantly, one of the parental lines and three of the derived genotypes were shown to discriminate against arsenic. The molecular basis for this discrimination has yet to be determined but it will be extremely interesting to follow further progress as the inheritable molecular basis for this discrimination is uncovered.

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