Rothamsted Research
Harpenden, Herts, AL5 2JQ

Telephone: +44 (0)1582 763133
Web: http://www.rothamsted.ac.uk/

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For advertising and inserts contact:
Marketing Department
Biochemical Society
Charles Darwin House
12 Roger Street
London WC1N 2JU
tel.: +44 (0) 20 7685 2411; fax: +44 (0) 20 7685 2469
email: marketing@biochemistry.org

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Charles Darwin House
12 Roger Street
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tel.: 020 7685 2410; fax: 020 7685 2469
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The (Christmas) Tree of Knowledge

by Freddie Theodoulou, Science Editor

Picture the scene: the lights are low, mulled wine is bubbling on the stove and the distant sound of carols can be heard from rosy-faced singers in the streets. As you put the finishing touches to the Christmas tree, what are you thinking? Are you imagining the joyful responses as your friends and family open their gifts? Or wondering if fairy lights are wired in series or in parallel and whether the turkey will defrost in time? Now, I know you're supposed to be on holiday but if you're in a scientific frame of mind, spare a thought for your Christmas tree, which is not, as you imagined, the ultimate statement in festive domestic decoration but in fact a concise lesson in botanical biochemistry!

Let's start with the choice of tree. If you live in Europe, you've probably purchased a Norway Spruce (*Picea abies*) or you may have splashed out on a Noble Fir (*Abies procera*), because you don't want to spend the 12 days of Christmas hoovering up needles. Which brings me to the first lesson: evergreen plants and the control of leaf abscission. Although decorated Christmas trees as we think of them were reportedly introduced in the 16th century by Martin Luther (not a character one would normally associate with extravagant interior décor), the use of evergreens to symbolise everlasting life during winter dates back to antiquity. Unlike broad-leaved trees which put on such a fabulous show of chlorophyll degradation in the Autumn, conifers have highly reduced leaves (needles), an adaptation to survive winter hardship and photosynthesise all year round. But as we know, needles do drop off. Abscission in gymnosperms such as conifers is poorly understood, although ethylene is one of the usual hormonal suspects. Importantly, needle longevity is positively related to cold acclimation which brings us neatly to genotype x environment interactions. By bringing a tree into your cosy, centrally-heated home, you've probably inadvertently broken its winter dormancy, messing with a delicate balance of hormone signalling (principally gibberellic acid and abscisic acid), so don't be too surprised if not only do you have to get the hoover out, but also that your beloved Weihnachtsbaum fails to survive your guilt-ridden attempts to plant it out in your garden after Twelfth Night.

More positively, that Noble Fir also has an attractive open habit, provoking interesting questions about the gravitropic set point branch angle, which is all about auxin signalling and seriously important for light interception. Strong branches – good for displaying lots of heavy ornaments – draw attention to the deposition of lignin, a complex aromatic polymer derived from the shikimate pathway. Plus, there's the delicious Christmassy scent. Here you have terpene synthesis to thank, just one page in the gloriously diverse catalogue of plant secondary chemistry. And finally, the lights: never mind electric bulbs, how about a self-lighting tree? Glow-in-the-dark plants have been on the cards ever since plant biologists started tinkering with transgenics expressing green florescent protein and luciferase, but don't be too hasty: although a number of woody species can be genetically transformed, it's by no means easy and a myriad of technical problems remain to be overcome.

As you'll hear on page 30, attempts to generate ornamental luminescent plants are gathering momentum but for now, you'll have to stick with those little strings of electric lamps for your tree. Whatever your festive traditions, be they religious or secular, Happy Holidays! ■