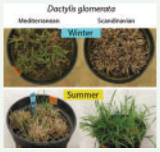
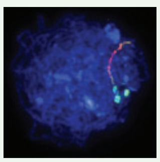


Winter and summer dormancy strengthen adaptive strategies for temperate herbaceous perennials (Review article)

Annals of Botany 119: pp. 311–323, 2017
doi: 10.1093/aob/mcw264

Summer and winter dormancy cycles for temperate herbaceous perennial species are sustained by environmental triggers initiating physiological processes of induction and release. This review article highlights research priorities such as the identification of seasonal factor thresholds and the analysis of biochemical compounds implicated in the dormancy modes of induction and release. **Gilliespie and Volaire** provide an overview of the growth-stress survival trade-offs inherent in summer and winter dormancy which reinforces the existing body of research on plant adaptations to extreme conditions under climate change.

Authors: L.M. Gillespie and F.A. Volaire



Microsporogenesis and the protective effects of Rye B chromosomes on pollen development

Annals of Botany 119: pp. 325–337, 2017
doi: 10.1093/aob/mcw206

Rye supernumerary (B) chromosomes possess an accumulation mechanism involving the subtelomeric domain enriched by B chromosome specific DNA sequence families, D1100 and E3900. **Pereira *et al.*** show that presence of rye B chromosomes may protect pollen mother cells at meiosis against heat stress induced damage. Heat resulted in equal up-regulation of heat shock protein Hsp101 transcripts in plants with zero or 2B chromosomes. A significant up-regulation of E3900 related transcripts occurred in 2B plants at meiotic prophase I, compared to in 0B plants that showed significantly greater heat induced nuclear anomalies. Bioinformatics revealed a high density of known heat responsive cis-regulatory elements within the E3900 sequence and a truncated variant, supporting stress induced response of transcription and a role for B chromosomes in the protection against heat stress induce damage.

Authors: H.S. Pereira, M. Delgado, W. Viegas, J.M. Rato, A. Barão and A.D. Caperta

Museomics reveal phylogeny of endangered Malagasy grasses

Annals of Botany 119: pp. 339–351, 2017
doi: 10.1093/aob/mcw208

Poaceae is one of the most diverse families in Madagascar, but some lineages have not yet been assessed within a phylogenetic framework. This study focused on the threatened taxa of *Chasechloa*, historically associated with the South American forest grasses of the genus *Echinolaena*. **Silva *et al.*** investigate the evolutionary relationships and origin of *Chasechloa* using molecular data produced by next-generation sequencing from museum specimens. *Chasechloa* was found to be only distantly related to *Echinolaena*. Miocene diversification of *Chasechloa* is temporally congruent with the origin of other angiosperms in dry forests of North Western Madagascar. Ants may have played a role in shaping the biology of Malagasy grasses as suggested by the presence of oil in the appendages of fertile florets.

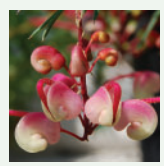
Authors: C. Silva, G. Besnard, A. Piot, J. Razanatsoa, R.P. Oliveira and M.S. Vorontsova

Saxophone stem ontogenesis and functions in *Acrocomia aculeata* (Arecaceae)

Annals of Botany 119: pp. 353–365, 2017
doi: 10.1093/aob/mcw215

The underground system known as the saxophone stem produced by seedlings of certain palm species exhibits unique growth patterns and distinctive morphologies. **Nascimento e Souza *et al.*** performed morpho-anatomical evaluations of seedlings during the development of the saxophone stem in *Acrocomia aculeata*, a neotropical oleaginous palm. The saxophone stem structure represents an important adaptation to dry environments by promoting the burial of both the shoot apex and storage reserves, which facilitates the continuous growth of aerial organs.

Authors: J. Nascimento e Souza, L.M. Ribeiro, M.O. Mercadante-Simões

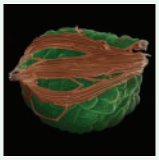


Bilateral flower symmetry developmental genetics in Proteaceae

Annals of Botany 119: pp. 367–378, 2017
doi: 10.1093/aob/mcw219

Bilateral symmetry has evolved as an adaptive trait linked to efficient pollination and successful outcrossing, occurring over 170 times in angiosperms and in many plant groups relying upon the asymmetric expression of key transcription factors from the CYC/TB1 gene family. **Citerne *et al.*** characterise the evolution of flower symmetry in Proteaceae, a basal eudicot lineage with high diversity in floral morphology, finding that bilateral symmetry is a very labile trait in Proteaceae. The asymmetric expression of CYC/TB1 homologues implicated in the development of bilaterally symmetrical flowers suggests that these genes may have been recruited and harnessed for the control of flower symmetry in this family.

Authors: H.L. Citerne, E. Reyes, M. Le Guilloux, E. Delannoy, F. Simonnet, H. Sauquet, P.H. Weston, S. Nadot and C. Damerval

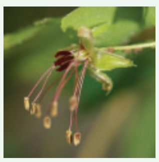


Ghost orchid symbiotic seed germination

Annals of Botany 119: pp. 379–393, 2017
doi: 10.1093/aob/mcw220

Successful orchid germination, embryo development and seedling establishment require the presence of mycorrhizal fungi. However, little is known about the orchid seed germination niche requirements *in situ*, especially regarding the role and host specificity of mycorrhizal fungi during germination and subsequent seedling development. **Hoang *et al.*** describe the array of effects of the co-culture of mycorrhizal fungal strains, isolated from the roots of the endangered leafless Ghost orchid (*Dendrophylax lindenii*), on *in vitro* seed germination, seedling anatomy and developmental morphology. The fungal strain Dlin-394 was confirmed as a possible Ghost orchid germination mycobiont, which significantly promoted seed germination and seedling development. The study highlights the implications of these results for developing efficient procedures for Ghost orchid production and outplanting.

Authors: N.H. Hoang, M.E. Kane, E.N. Radcliffe, L.W. Zettler and L. Richardson

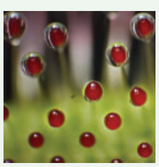


Geraniales flowers revisited: evolutionary trends in floral nectaries

Annals of Botany 119: pp. 395–408, 2017
doi: 10.1093/aob/mcw230

Investigating floral morphology in the order Geraniales, **Jeiter *et al.*** present data to demonstrate that even the most disparate floral morphologies are derived from a common origin, sharing a basic pentamerous and pentacyclic organisation with an obdiplostemonous androecium and receptacular nectaries associated with the antesepalous stamens. Floral morphology of the Geraniales shows a high degree of similarity, despite divergence in detail. The variations are predominantly lineage specific, with individual apomorphic characteristics such as zygomorphy or a reduced number of nectaries having arisen several times independently.

Authors: J. Jeiter, M. Weigend and H. Hilger

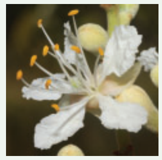


Holokinetic chromosomes, karyotype evolution and genome size in carnivorous Droseraceae

Annals of Botany 119: pp. 409–416, 2017
doi: 10.1093/aob/mcw229

Previous studies have suggested that carnivory and holokinetic chromosomes might be associated with genome downsizing in plants. **Veleba *et al.*** analysed genome evolution in sundews (Droseraceae), a widespread genus that uniquely combines chromosomal holokinetics with carnivory, and their relatives to show that this trend is not universally true. An analysis of genomic parameters and their relationship to climatic niches was undertaken for 71 Droseracae species using flow cytometry and phylogenetic methods to show that the evolution of genomic GC content is inextricably linked with genome size and with environmental conditions such as annual temperature fluctuations. The negative correlation between genome size and chromosome number suggests that karyotype evolution for Australian sundews may be propelled by holokinetic drive.

Authors: A. Veleba, P. Šmarda, F. Zedek, L. Horová, J. Šmerda and P. Bureš

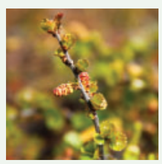


New insights into the evolution of the florally diverse Detarioid legumes

Annals of Botany 119: pp. 417–432, 2017
doi: 10.1093/aob/mcw223

The Brazilian tree *Goniorrhachis marginata* is the only species of its genus in the bean family (Leguminosae) with striking flowers consisting of a long floral tube and regular corolla redolent of the rose family. **Prenner and Cardoso** study floral development with a scanning electron microscope and analyse the results in a broad phylogenetic context. Key observations were that the 4-merous calyx has resulted from complete loss of one sepal and that formation of the regular corolla originates from a typical caesalpinioid pattern with the upper petal innermost (ascending aestivation) and the young style bending away from the inflorescence axis. The authors propose a new synapomorphy for the clade further to an extensive dataset analysis showing that abaxial bending styles characterise all major lineages of Detarioid legumes

Authors: G. Prenner and D. Cardoso



Snow depth and summer warming shape arctic leaf anatomy and gas exchange

Annals of Botany 119: pp. 433–445, 2017
doi: 10.1093/aob/mcw237

Climatic changes can result in modified leaf anatomy and gas exchange in arctic plants. In a one-year-old field experiment in Greenland, **Schollert *et al.*** investigate the effects of increased snow depth and warming on leaf anatomy, biogenic volatile organic compound (BVOC) emissions and CO_2 exchange for the common arctic shrubs *Betula nana* and *Empetrum nigrum* ssp. *hermaphroditum*. Additional snow depth affected the leaf anatomy by increasing the glandular trichome density in *B. nana* and modifying the mesophyll of *E. hermaphroditum.* Passive summer warming in open-top chambers thickened the epidermis of *B. nana,* while increasing the glandular trichome density and reducing the palisade:spongy mesophyll ratio in *E. hermaphroditum*. The modifications in leaf anatomy suggest a linkage between responses in leaf anatomy, BVOC emissions and CO_2 gas exchange, highlighting the ecological importance of monitoring changes in arctic winter precipitation.

Authors: M. Schollert, M. Kivimäenpää, A. Michelsen, D. Blok and R. Rinnan

Revising Corner's rule: how to best partition twig leaf area

Annals of Botany 119: pp. 447–456, 2017
doi: 10.1093/aob/mcw231

Corner's rule states that in woody plants, twigs (current-year shoots) with thicker stems support larger leaves. Larger leaf areas require thicker twigs for hydraulic and mechanical support, but a question remains as to why the pattern of thicker twigs resulting in larger leaves emerges, and also as to whether total leaf area should be partitioned into many small leaves or a few large leaves. Corner's rule implies that larger twig leaf areas should be partitioned into larger sized leaves. **Smith *et al.*** verified Corner's rule in six co-occurring and functionally similar species, finding that individual increases in leaf size correlate in a strikingly consistent manner with increases to twig leaf area. Supporting their hypothesis with computer simulations, the authors propose that the resulting pattern of leaf formation optimises whole twig photosynthesis, thereby offsetting the cost of the endeavour of producing larger leaves.

Authors: D.D. Smith, J.S. Sperry and F.R. Adler

From South America to Shenzhen, China; road trip of an invasive weed *Mikania micrantha*

Annals of Botany 119: pp. 457–464, 2017
doi: 10.1093/aob/mcw218

The South American weed *Mikania micrantha* has spread rapidly across Southern China since its introduction to the Shenzhen region in 1984. **Geng *et al.*** used SSR markers to investigate and map genetic diversification of this weed along highways. The results show a relatively low level of genetic differentiation, a lack of clear geographic genetic structure and strong gene flow between populations. The long-distance dispersal of seeds associated with vehicular transportation on highways may have provided corridors for the spread of *M. micrantha* in Southern China, thereby shaping genetic variation.

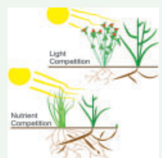
Authors: S.-L. Geng, Q. Chen, W.-L. Cai, A.-C. Cao and C.-B. Ou-Yang

Cherry fruit developmental analysis

Annals of Botany 119: pp. 465–475, 2017
doi: 10.1093/aob/mcw232

Evaluating genetic and environmental effects upon sweet cherry cultivars differing in seasonal duration and fruit size, **Gibeau *et al.*** employ photographic measurements to apply a framework of biological time indices demarcated by the degrees of growth of reproductive buds, ovarian volume and pits from dormancy to maturation. The initial growth phase is defined by the acceleration of ovary growth in the (minimum) two weeks preceding anthesis, coinciding with bud scale separation. Post-anthesis, unfertilised or otherwise unsuccessful individuals were eliminated statistically with discriminant function analysis prior to polynomial curve fitting and estimation of developmental time. Developmental differences across early, mid and late-maturing cultivars were not detected until the final growth period.

Authors: D.M. Gibeaut, M.D. Whiting and T. Einhorn



Light competition suppresses couch grass more efficiently than nutrient competition

Annals of Botany 119: pp. 477–485, 2017
doi: 10.1093/aob/mcw228

Competitive crops are important for sustainable cropping systems. For perennial weeds, below-ground organs, for instance rhizomes for couch grass, constitute the best measure of a crop's long term suppressive capabilities. **Ringselle *et al.*** found that the type of competition (primarily for light or nutrients) utilised by a crop influences both the suppression rate and the likelihood of whether the crop will successfully alter the weed's allocation pattern. By competing primarily for light, red clover suppressed the rhizome biomass of couch grass more than perennial ryegrass per gram of produced companion crop biomass. Perennial ryegrass impacted upon couch grass allocation with a higher proportion of rhizomes.

Authors: B. Ringselle, I. Prieto-Ruiz, L. Andersson, H. Aronsson and G. Bergkvist

Annals of Botany **119**: iv–vii, 2017
Available online at www.aob.oxfordjournals.org

News in Botany: Nigel Chaffey presents a round-up of plant-based items from the world's media

Tree rings stop cell division in plants

Well, I'm not sure what it means but it certainly sounds impressive – and another item to add to the list of tree ring properties[1,2]. Sadly, it's nothing to do with tree rings. It is, however, everything to do with my misreading of the true news headline, 'Three rings stop cell division in plants'[3]*. Whilst that headline is still intriguing, it's not as revealing as my version. Why? Because what we have there is a classic example of the problem of plant myopia, the condition where one's life is so influenced by plants and botanics that one sees plant-inspired items everywhere. Hence my seeing the word tree when it was in fact three.** Plant myopia is really the opposite of plant blindness, the condition wherein people don't see plants in the environment and/or don't recognise the importance of plants[4,5,6,7,8,9]. Plant blindness is one of the great malaises of the modern world (although it's been around a long time!) and must be tackled if we are to be a species that fully appreciates what marvels plants and the plant world (which includes eukaryotic algae[10,11], prokaryotic cyanobacteria [11,12], and the members of the Plant Kingdom[13,14]) are. Over the years attempts have been made to cure this chronic condition. Many times like-minded plant-aware individuals have banded together and organised themselves into Botanical Societies (or Bot-Socs). However, originally they were termed Phyte Clubs – phyte is an ancient term for plants [15]. A great opportunity to promote the work of these laudable organisations was missed when the movie industry misunderstood the name of these serious-purposed societies and produced the film Fight Club[16,17], which in turn perpetuated the 'error' in Chuck Palahniuk's novel of the same name[18,19]. And, most definitely unlike the book/Hollywood version, the 1st rule of Phyte Club is that you must talk about it[20,21]. You must tell people about phytes and why they are so special and important. The 2nd rule of Phyte Club is: YOU MUST TELL PEOPLE ABOUT THE IMPORTANCE OF PLANTS (i.e. the same as the 1st rule, only written in capital letters). All Phytophiles – as Phyte Club members are known – are true evangelists and their mission is to go forth and preach the phytological message and change the hearts and minds – but they're happy to begin just with attitudes – of the great 'unphytocognisant'. These true plant visionaries have a sacred duty to lead the plant-blind out into the light, the photosynthetic, life-giving light that nourisheth us all. Here endeth the 'lesson' – for now!

* The news item reports the work of Masakazu Nambo *et al.* who have used triarylmethanes to develop chemical tools to examine cell division in plants, by stopping the process[22]. As their name might suggest, triarylmethanes are organic compounds containing three aromatic rings in their structure[23,24]. The activity of the 'antiproliferative agents' that the team synthesized appear to be specific for plants, rapidly and apparently reversibly and without damage inhibiting cell division in tobacco BY-2 cells and Arabidopsis.

** For a great account of many of the known side effects of this blinkered plant vision phenomenon, do read Aurora Toennisson's blog on the phenomenon[25], and the comments thereupon.

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The lachrymatory tale of the barnacle and the bacterium

Ever intrigued by, and interested in sharing, stories which show how plants – or organisms with plant-like properties – help other less well-off forms of life, this is a tale that might well bring a tear to the eye. Investigating formations in sandstone blocks on the coast near the Lakes Entrance holiday resort [1] on the coast of Victoria (SE Australia), John Buckeridge and William Newman have uncovered what appears to be the first record of mutualistic symbiosis[2,3] between a 'higher invertebrate'[4] and cyanobacteria[5,6]. The rock features, which have the appearance of crying eyes and have been named the 'Tears of the Virgin', are apparently the work of cyanobacteria [bacteria that undergo photosynthesis similar to green plants[7,8] (and are therefore sufficiently plant-like for Mr Cuttings' purposes)] that dissolve away some of the rocky substrate to produce depressions and the elongated tear-like 'tails'. The depressions are occupied by the barnacle[9] *Chthamalus antennatus*[10,11], which is thereby better able to withstand the desiccating conditions when uncovered by the receding tide. The cyanobacteria – which have yet to be fully identified although may involve *Rivularia*[12,13] sp(p).– are presumed to benefit from access to the barnacle's nitrogenous waste products. An additional bonus for the barnacle is that these dehydration-defying depressions allow it to survive in areas higher on the shore than they could otherwise occupy so it is less likely to be prey to crabs and other predators[14]. Barnacles and blue-green algae in binary biological harmony? That's just bonzer[15]!

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Toxin-tainted submarine snow

Terrestrial ecology is reasonably straightforward [Ed. – Careful, Mr C, there'll be letters…]: plants do their productivity thing via photosynthesis and get bigger, etc. and are eaten by grazing animals (which, in their turn, are preyed upon by carnivores…)[1]. When plants – and other organisms – die their carbon-/energy-rich bodies and 'bits-and-pieces' provide sustenance for the decomposing community[2,3], whose inorganic outputs are then available to be taken up by plants to be incorporated anew into organic materials. Notwithstanding the fact that some trees can reach heights of 100 metres plus, all of that takes place a few metres above the ground, and to a few feet below the soil surface. Basically, terrestrial ecology takes place in one rather small space. Marine ecology is rather different (!) One major distinction is that photosynthesis takes place within a thin veneer of sunlit water at the top of the oceans yet biodiverse communities – many of which depend ultimately for their energy from the products of this near-surface photosynthesis – are found many thousands of metres below on the ocean floor, where photosynthesis is not possible[4,5]. How do such seafloor-occupying organisms survive? What is the connection between the photosynthetic/producing part of the oceans and those consumers in the abyss[6,7]? For many at depth it is a gift from above – not light itself, but organic material that is produced one way or another from the efforts of photosynthetic organisms – that gives them energy-rich organic inputs. This constant 'rain' – 'a shower of organic material'[8] – is termed marine snow[9,10] because it looks a little like that terrestrial precipitation. Now, if the only lifeline to support yourself and your community is provided from action far above, it would be nice to think that gift wasn't going to cause you harm. Well, that assumption might be unwarranted according to work by Astrid Schnetzera *et al.*[11]. Studying marine snow derived from the toxic diatom[12,13] *Pseudo-nitschia australis*[14,15], they show that a significant amount of domoic acid[16,17] survives the descent to the depths. Domoic acid is a potent neurotoxin, which causes Amnesic Shellfish Poisoning (ASP[18,19]) in humans who might unwittingly consume it via tainted shellfish that have in turn fed – and equally unknowingly – upon a diet rich in domoic acid-producing diatoms when present in large populations, so-called harmful algal blooms (HABs[20,21]). Although the impacts upon marine organisms that feed upon such domoic acid-enriched marine snow is not yet known, any potential 'interactions with aggregate-associated microbes and zooplankton consumers warrant further consideration.' If Miss Smila was a denizen of the deep, one wonders what her feeling for marine snow might be[22,23]. Might this tainted snow be considered a marine equivalent of acid rain[24,25] that so bedevils parts of the terrestrial environment …?

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Latin name or scientific name, where do you stand?

Recently, the gentlefolk who oversee the *Annals of Botany* blog site and Mr Cuttings have been engaged in good old-fashioned healthy debate about what to call scientific binomials[1], those two word official names that every described organism has. And that debate has revolved around whether they should be referred to as Latin names or as scientific names. I acknowledge that in formulating such binomials the words must follow the rules of Latin grammar (and are therefore *Latinised*)[2], which is emphasised by the words being given emphasis in italic script (as is also the case in UK and US English for unfamiliar Latin words and foreign phrases[3,4]). But, I also recognise that the words used in those names are often derived from languages other than Latin, such as Greek[5], Japanese (e.g. the genera *Tsuga*[6], and *Ginkgo*[7]), slang/conversational English (e.g. the genus *Hebejeebie*[8,9]), etc. For the latter reason in particular I think that binomials are best described as scientific names rather than Latin names (and which nicely contrasts with the term 'common names'[10,11] by which most plants are also known in everyday conversation). In support of my position, and as befits a scientific argument, I cite the following: '**scientific plant names** [P. Cuttings' emphasis] are only those names which have been formally published according to the International Code of Nomenclature[3]; they are also often known as botanical or Latin names' [2nd paragraph, 1st page of article][12]. Interestingly, this quote is from an Editorial article entitled 'Common mistakes when using plant names and how to avoid them'. As a second endorsement I offer: 'Writing the **scientific names** [P. Cuttings' emphasis] of species (sometimes also called by their Latin names), is not that complicated'[13], from the blog site curated by Lena Struwe and which is devoted to … botanical accuracy. But, let's extend the debate. What do you think we should call these 'scientific names'? Do you think it matters?* Do let me know.

* One way to avoid this – at least in botany – is to call the binomial the botanical name[14], which neatly sidesteps the issue.

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Super silk and mine-detectors

Two of the newest materials are carbon nanotubes[1,2] and graphene[3,4], both rather exotic forms of carbon. One of the oldest materials known to Man is silk[5,6], a complex material constructed primarily of carbon, hydrogen, oxygen, and nitrogen. What happens when the ancient meets the modern? And what does this item have to do with plants? Let's deal with the easy stuff first. Silk is a proteinaceous material[7] produced by the larvae of the silk moth (*Bombyx mori*[8,9]). Commonly termed silkworms, the larvae feed on leaves of the white mulberry tree (*Morus alba*[10,11]). Plant connection sorted. Traditionally, silk is used to make some of the most exotic fabrics and clothing items[12]. Strong though it is[13,14], even stronger silk is desirable – which I'm assuming would lead to longer-lasting, tougher-wearing clothing. The carbon nanotube and graphene connection comes from work by Qi Wang *et al*.*[15] who fed these materials to… silkworms. In contrast to 'regular' silk, the 'carbon-enhanced' silk produced under this unusual dietary regime was twice as tough and withstood 50% more stress before breaking. Furthermore, carbonising the silk by heating to 1050 °C gives it the ability to conduct electricity – unlike normal silk. This latter property opens up the possibility of producing biodegradable medical implants, and eco-friendly wearable electronics[16]. Slick work that silkworm's silk work. Even more explosive work was announced by Min Hao Wong *et al*. who have integrated single-walled carbon nanotubes (SWCNTs) into spinach (*Spinacia olerace*[17,18,19]). Although I have to confess that the details seem rather complicated for a humble botanist, what they've produced is plants that can 'serve as self-powered pre-concentrators and autosamplers of analytes in ambient groundwater and as infrared communication platforms that can send information to a smartphone'. In particular, the plants can detect nitroaromatics, chemicals associated with high explosives[20,21]. Such bioengineered plants can therefore be used to indicate presence of unexploded devices below soil level, and which may not readily be detected by visual inspection of an area. As potential 'bomb detectors' this work certainly caught the eye of the science news sites with headlines such as 'Carbon nanotubes turn spinach plants into a living bomb detector'[22]. But, if plants can be used in this way, it may be seen as a safer alternative than sending in humans with mine detectors. However, to detect these compounds they first have to be taken up by the plant and transported internally. So, maybe we all should handle spinach with extra care from now on (as if their oxalic acid[23,24] content wasn't already cause for some concern and reflection[25])!

[Ed. – In news related to the second item above, Long Zhang *et al*. report the transformation of grasses with bacterial genes that lead to a breakdown of wastes from explosives and munitions[26]. Hexahydro-1,3,5-triniitro-1,3,5-trizaine (RDX[27]) is released into the environment when many explosives are used, and is a concern as a contaminant of ground water [28]. Although plants can take-up RDX from the soil, they don't break it down. It therefore remains a potential threat to the environment. Transforming perennial switchgrass (*Panicum virgatum*) and creeping bentgrass (*Agrostis stolonifera*) with bacterial enzymes gave them the ability to degrade absorbed RDX to less harmful compounds which don't pose such an environmental threat. Arguably, this is a great step forward in dealing with such dangerous materials, and an intriguing example of phytoremediation [29].]

* Based appropriately enough at Tsinghua University in Beijing, China, given that China is regarded as the ancestral home of silk [30].

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