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ARCTIC TUNDRA

Leaf drop raises carbon gain

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Deciduous shrubs are becoming increasingly common in arctic tundra landscapes, typically dominated by evergreens, graminoids and cryptogams. This shift in community composition could fuel carbon uptake in these systems, according to a one-year study of Alaskan tundra phenology.

Shannan Sweet, at Columbia University, and colleagues compared the phenology and productivity of two types of tundra in Alaska — one dominated by evergreens and graminoids and the other by deciduous shrubs — using remotely sensed measurements of canopy reflectance and numerical models. Canopies dominated by deciduous shrubs greened up faster, and reached the period of peak greenness 13 days earlier, than canopies dominated by evergreens and graminoids. As a result, the peak season in the deciduous canopies lasted an average of 10 days longer. Leaf area was also greater in these ecosystems.

The deciduous canopies took up three times more carbon over the course of the growing season than the evergreen- and graminoid-dominated canopies, due to the longer peak season and increased leaf area; peak season extension accounted for over 70% of this response. As such, the researchers suggest that future increases in deciduous shrub abundance in these systems could enhance tundra carbon gain. *AA*

INSECT RESISTANCE

Triple whammy

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The brown planthopper (BPH) is a major pest for rice production, causing up to 60% loss of yield in affected crops. Multiple biotypes and continuous evolution of BPH rapidly circumvent conventional methods of pest control. Instead, Yuqiang Liu, at the Nanjing Agricultural University, and colleagues have employed genes within a previously reported resistance locus, *Bph3*, to induce a broad-spectrum and an enduring defence against BPH.

Rice varieties exhibiting insect resistance due to the *Bph3* locus have been used for more than 30 years. Liu *et al.* used populations derived from a cross between the resistant rice variety Rathu Heenati and the susceptible variety 02428 to map the *Bph3* locus to a 79 kb region on chromosome 4, where four genes (*OsLecRK1–4*) encoding lectin receptor kinases were found. BPH-resistant lines had an identical sequence for *OsLecRK1–3* but different sequences for *OsLecRK4*, indicating that the three-gene cluster (*OsLecRK1–3*) without *OsLecRK4* represents *Bph3*. Indeed, BPH infestation dramatically induced the expression of *OsLecRK1* and *OsLecRK3* in resistant plants but not in their susceptible cousins, suggesting *Bph3* increases the resistance by enhancing the inducible expression of lectin receptor kinases. This hypothesis was verified in transgenic rice lines over- or under-expressing the three *OsLecRK* genes.

Introducing *Bph3* into a susceptible *japonica* variety, Ningjing 3, through marker-assisted selection significantly enhanced the resistance to BPH and white back planthopper. The gene cluster thus provides a valuable tool for breeding rice with broad-spectrum and durable insect resistance. *JL*

INNATE IMMUNITY

Septic shock

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The innate immune system of higher organisms efficiently senses potentially dangerous microbes by detecting foreign, conserved molecular patterns such as flagellin — part of the flagellum present in many bacteria. In both plants and mammals this recognition is achieved by membrane pattern recognition receptors (PRRs). In another example of independent and convergent evolution, Stefanie Ranf and colleagues have identified the sensor for lipopolysaccharide (LPS) in *Arabidopsis,* which is one component of the outer membrane of Gram-negative bacteria.

LPS is also called an endotoxin because it induces a potent immune response in animals that can lead to septic shock and death. In mammals, it is sensed by the receptor TLR4 — a Nobel Prize winning discovery. The authors isolate a mutant, named *lore*, in which LPS-induced calcium influx is abolished. The corresponding gene encodes a member of the B-type lectin domain receptor-like kinase subfamily. It confers LPS responsiveness by inducing downstream immune responses, making plants more resistant to bacterial infection, and is responsible for LPS-triggered immunity.

LORE is restricted to the genomes of crucifers, including cabbages, oilseeds and cress. However, when expressed in tobacco it confers LPS sensitivity, confirming that interfamily transfer of PRRs can broaden the range of pathogen detection, like adding more antennas to an air defence radar station, making this strategy of potential interest in crop engineering. *GT*

MEASURING CHLOROPHYLL

Looking-glass logic

Lab Chip **15,** 1708–1716 (2015)

Wearable computing technology has begun to be used in medicine to aid both training and clinical practice, but fewer scientific uses have been found elsewhere. Bingen Cortazar and colleagues in the Department of Electrical Engineering at the University of California Los Angeles have employed Google Glass as a flexible spectrophotometer for measuring the chlorophyll content of leaves in the field.

The chlorophyll content of leaves is an indicator of many aspects of both plant health and the environment. Standard assays destroy the leaf through chemical extraction, need to be performed in a lab and take time to yield results. Portable devices exist to spectrophotometrically estimate chlorophyll, but these are relatively expensive and inflexible. With the UCLA team's system a leaf is put in a 3D-printed holder and illuminated by LEDs powered by three AAA batteries. Images of the leaf taken by Google Glass worn by the experimenter are wirelessly exported to a web-based application that returns a value for chlorophyll content in around ten seconds.

Cortazar *et al.* calibrated their system against five species in the UCLA Botanical Gardens and could immediately estimate chlorophyll content from ten randomly chosen and unrelated species. The Google Glass system is not quite as accurate as a specialist meter but its convenience, speed and cost-effectiveness should make it an attractive alternative, especially in remote locations. *CS*

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