Seasonal and inter-annual soil CO_2 efflux in savanna/wetland mosaic in the Okavango Delta, Botswana

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The evaluation of biospheric fluxes and stocks of carbon is of major importance in the context of increasing CO_2 concentration in the atmosphere and the related potential change in climate. We investigated the effects of seasonal changes in soil temperature and soil water content on soil respiration in three different ecosystems, rain-fed grassland, seasonal floodplain and permanent swamp, at the Okavango Delta, Botswana. We further analysed the spatial variation of soil respiration within each site and attempted to relate these variations to the stand structure and to local soil characteristics. The observed large seasonal amplitude of soil respiration rates at the rain-fed grassland and the seasonal floodplain clearly reflected reduced soil water content. By contrast, low soil respiration rates at the permanent swamp in June were caused by the presence of seasonal floodwaters. During the wet season, average soil respiration rates at the permanent swamp and the seasonal floodplain were similar, 9.4 ± 2.4 μmol m^{-2} s^{-1} and 7.7 ± 4.3 μmol m^{-2} s^{-1}, respectively, and were almost four-fold higher than that at the rain-fed grassland, 2.31 ± 1.13 μmol m^{-2} s^{-1}. Largest day-to-day changes in soil respiration rates as a result rainfall events, approximately 20%, were found at the rain-fed grassland. The Arrhenius type equation, describing the relationship between soil respiration and soil temperature for each site and each season, predicted the seasonal variations in soil respiration reasonably well, $r^2 \geq 0.6$, despite the confounding effects of soil temperature and soil water content since both factors co-vary across seasons.

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Vanadium, an element required by animals but not by plants

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Plants passively take up elements that are not essential to their growth and development. Some of these affect animals that feed on the plants, either favourably as nutrients, or unfavourably as toxins. There are a number of elements that are thought to be required by animals, but not by the plants on which they feed. These include Na, I, Co, Se, Cr, Sn, F and V. Since crops are not usually supplied with these elements, it is possible that through continual cropping they may become depleted in the soil and therefore not be available in sufficient concentrations to the animals that feed on these plants. This work tested the effects of Vanadium, a ubiquitous yet understudied element, on the growth and mineral nutrition of a root crop (turnip) and a leaf crop (spinach). The element was supplied in the form of ammonium vanadate (NH_4VO_3) in five concentrations on a logarithmic scale from 0 to 20 mg L^{-1}, chosen specifically to determine the concentrations at which effects are noticed, due to the fact that no definite mean or toxic level has been described in literature. Sand culture was used in a random block experiment including five replicates. Only at the highest level of 20 mg L^{-1} was growth significantly reduced, and the chemical composition significantly affected.

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An investigation on the biological activity of *Acacia robusta* subsp. *robusta*

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Acacia robusta subsp. *robusta* (Mimosaceae) is used in folk medicine to treat throat infections. Methanol and dichloromethane extracts of *A. robusta* subsp. *robusta* were screened for antimicrobial activity using disc diffusion method. In this study, root bark methanol extract exhibited activity against some Gram-positive bacteria and little activity against some Gram-negative bacteria. Dichloromethane extract had little activity against both Gram-positive and negative bacteria. The detection of some antibacterial activity in this plant seems to justify its use by the traditional medical practitioners for the treatment of ailments of infectious nature.

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The function and maintenance of distyly in *Pentanisia prunelloides* (Rubiaceae)

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The adaptive function and evolution of distyly has intrigued pollination biologists since Darwin's suggestion that reciprocal herkogamy evolved to promote intermorph cross-pollen transfer. The distylous, pollen colour dimorphic plant, *Pentanisia prunelloides*, was used as a model system to show how intermorph cross-pollen transfer is influenced by nectar (butterflies) and pollen (bees) collecting insects. The results show that individual bee visitation sequences, as well as pollen loads, are morph biased and result in low pollinator effectiveness when compared to butterflies. Darwin's cross-promotion hypothesis (reciprocal herkogamy promotes higher proficiency of intermorph cross-pollen transfer than intramorph cross-pollen transfer) and pollen fates (pollen removal failure, pollen transport loss, facilitated autogamy, autonomous autogamy, intramorph cross-pollen transfer and intermorph cross-pollen transfer) were investigated by combining emasculation and non-emasculation treatments, which revealed that the proficiency of intermorph cross-pollen transfer is 1.88 times higher than intramorph cross-pollen transfer, as well as about 1% of the pollen produced reaches the stigmas of the opposite morph. For both morphs, intramorph cross-pollen transfer was responsible for the largest contribution to illegitimate stigmatic pollen loads, while the geitonogamy and autonomous autogamy contributions were minimal. Negative frequency dependent selection has been hypothesized as an important selective force for the maintenance of distyly in natural populations. By manipulating the morph ratios and examining pollen import as well as export in experimental and field arrays, evidence for negative frequency dependent pollen transfer pattern was detected. Furthermore, it was shown that the theoretical conditions for the maintenance of sigma-height dimorphism as proposed by the Lloyd and Webb model were satisfied in this system.

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How savanna grasses decompose?

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Decomposition studies typically use litter bags placed on the soil. The fact that decomposition starts while plant litter is still standing in the field, experiencing breakdown by the sun, has seldom been considered. Here I report a comparative study of rates, and correlates, of decomposition of ten species of savanna grasses in the sun and on the soil. Rates of photodegradation of grass litter were significantly slower than microbial breakdown. The variables that best predicted decomposition in the sun were also different from those that determined decomposition on the soil. Initial photodegradation was predicted by polyphenolic content and tensile strength while initial microbial decomposition was governed by C/N ratio, polyphenolic content and tensile strength. These results have important implications for which grasses accumulate fuel, standing dead litter, in savannas.

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Photosynthesis and the regulatory role of sucrose and hexose in sugarcane leaves

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In crops other than sugarcane there is good evidence that the size and activity of carbon sinks influence source photosynthetic activity via regulation of photosynthesis-related enzymes, an effect that is partly mediated through coarse regulation of gene expression. The existence in sugarcane of a robust sugar-dependent relationship between leaf and sink tissues could represent a potentially fundamental limiting factor for sucrose accumulation in the stalk and consequently, play a major role in overall sucrose yield. Previous work in our laboratories has demonstrated that increased culm sink demand through partial shading resulted in increased photosynthetic rates that correlated with a reduction in hexose levels in the leaves. In an extension of that study, we have examined source regulation in cold-girdled and detached leaves (second and third fully-expanded) of pot grown *Saccharum* spp. hybrid *cv.* N19 (N19) with the aim of elucidating the mechanisms that determine carbon partitioning in sugarcane. Cold-girdled leaves (at 5 °C) showed increased sucrose and hexose levels and a decline in photosynthetic rates over the duration of the 5 day treatment. Excised leaves, preincubated in darkness for 3 h, had increased photosynthetic rates on transfer back to light, relative to control plants maintained in the light. Tissue sucrose accumulation was reduced by darkness, but accumulated again upon transfer to the light. However, after the dark period, hexose levels remained significantly lower for the remainder of the incubation time; possibly indicating that photosynthesis was up-regulated by lack of hexose accumulation. When the excised leaves were fed or pre-fed sucrose via the transpiration stream, dark-treated leaves exhibited reduced photosynthetic rates, which were associated with increased sucrose and hexose concentrations within the leaf tissue. The observed down-regulation of photosynthesis by sugar accumulation has provided a starting point for future identification of gene transcripts that have putative roles in mediating the source–sink relationship.

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