Are there Strigolactones in your garden?

Advances in science often result from the advent of new techniques and the convergence of diverse lines of research. One such example that has developed in the last decade involves a new class of plant hormones called **Strigolactones** and their relationship with mycorrhiza.

Mycorrhiza are fungal associations with plant roots whereby a fungus invades the roots of a plant and in a mutually beneficial relationship between them (symbiosis) the plant is able to augment its supply of nutrients via the fungal hyphae while the fungus augments its energy supply via compounds derived from the plant. It is a win/win situation in modern sociology jargon.

More than 80% of plants have mycorrhizal associations and they are particularly important in soils that are low in phosphorus and nitrates. Given that many Australian soils are deficient in phosphorus and/or nitrogen, mycorrhiza are particularly important for our native plants. Fossil evidence suggests the mycorrhizal associations began to evolve at least 460 million years ago (MYA) when plants first invaded the land, and long before the evolution of flowering plants (135 MYA). It is suggested that mycorrhizal associations contribute to plant diversity, ecosystem variability and productivity.

Strigolactones are quite complex molecules released by the plant roots in minute quantities. They have a very short half-life. They stimulate the fungal hyphae to branch and thereby increase the probability that the fungus will contact the plant root and form a functional mycorrhiza. The quantity of strigolactone released is increased when phosphorus levels are lower (increases of up to 100 000 fold in experiments). Not only has the strigolactone now been isolated and identified but its structure has been elucidated and its biochemistry worked out. Various analogues have also been synthesised. Current research is trying to identify the receptor/sensor molecules and the associated genes.

[There is some speculation that the fungus also secretes a signalling molecule to either stimulate the root to release strigolactone or to branch towards it]. It is perhaps not unreasonable to think in terms of these organisms communicating with each other.

The name strigolactone comes from a curious piece of serendipity. The genus *Striga* is one of a number of parasitic weeds of agricultural significance. One species, *Striga lutea* (Red Witchweed) has recently been identified in Mackay. These parasitic weeds invade the roots of the host plant and deprive it of water and nutrients with a consequent drop in productivity. The relationship is obligatory for the parasite and the very small seeds must locate the roots of the host for the parasite to complete its life cycle. These parasitic weeds are often found in soils that are low in phosphorus. A number of strigolactone compounds have been found that stimulate the germination of seeds of these parasitic weeds (and therefore initiate invasion of the roots of the host). It would appear that these parasitic weeds are exploiting a signalling pathway that evolved a long time ago for quite a different purpose.

Another fascinating connection is that we have known for some time that smoke stimulates germination in some plants (particularly Australian natives). The active compounds have now been identified as karrikins. The structure of these molecules is similar to the active site of strigolactones. Again perhaps evolution has built upon an ancient signalling pathway through natural selection.

Strigolactones according to recent research appear more generally important in working in conjunction with other plant hormones (auxins/cytokinins) in determining plant development and resource partitioning (…..but that's another story).

Contributed by Bob Newby. [I have not included references here but have a folder of papers if anyone is interested to read more. I thank Carolyn Osterhaus for alerting me to this fascinating story and Judith Wake for alerting me to the existence of witchweed in Mackay].