Soils are Alive Newsletter

Volume 3 No. 4 2004

School of Earth and Geographical Sciences — The University of Western Australia

Welcome...

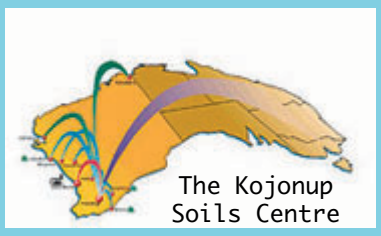
This newsletter discusses symbiosis research and touches on its importance in the soil ecosystem.

Lyn Abbott

The interrelation of plants and fungi,as well as the relationships established between many other organisms that make up the soil ecosystem, make symbiosis a key factor in soil health.

The Kojonup Soils Centre NEWS

The Kojonup Soils Centre has been established to promote knowledge of soil to the farming community and others interested in this important natural resource.



Acknowledgements

This Newsletter was established with support from the Ian Potter Foundation which is also supporting the development of a website on soil health that will be available soon.

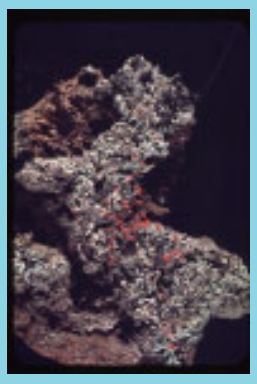
For further information, contact:
Professor Lyn Abbott
Faculty of Natural and Agricultural Sciences
The University of Western Australia
Crawley, WA 6009 Australia
email: labbott@cyllene.uwa.edu.au

Symbiosis and Soil

by Mathilde Anne Hungerford

The concept of symbiosis, an inter-dependent relationship existing between two organisms from which they both benefit, is not new. As early as 1869 Schwendener, a Swiss botanist, cited lichen as an example of two organisms, a fungus and an alga, living symbiotically.

His idea was not well received among his colleagues, and while some biologists pursued this possibility it was generally ignored. In 1885 a German forest pathologist coined the term 'mycorrhiza' in reference to the association between a plant root and a fungus. He later added the terms 'ectrotrophic' and 'endotrophic' to refer to fungus' living outside and inside the plant root (1). At this point people were finally beginning to take notice, although research was still slow and on a small scale, some of the most eminent British botanists were vehemently opposed to the idea.



Beatrix Potter, 12 years later, presented some of the first concrete evidence supporting Schwendener's theory in a series of highly detailed drawings showing the two organisms, and wrote a paper which was read at the British Linnaean Society where Darwin had, years before, presented his theory of evolution. Her paper was read by her uncle, since women were not permitted. Again, however, the audience paid little or no attention, since not only was the topic still out of fashion, but the paper was written by a woman. Beatrix Potter abandoned her biological aspirations and turned to illustrations, for which she is famous today. A hundred years after her paper was first presented the Linnaean Society issued an official apology (3,4).

Symbiosis finally 'came into fashion' in the mid-1900's. More and more evidence was mounting in support of the theory; specifically, radioactive tracers had been developed, allowing scientists to actually trace nutrient cycles in plants and their fungal associates. Interest increased as people took notice for the first time on a widespread scale. In 1963 the first international conference on symbiosis was held in London. By the

Infected root cells. Photograph courtesy of Mark Brundrett. Taken from http://www.ffp.csiro.au/research/mycorrhiza/.

1970's symbiosis research was established as a legitimate field of science(2).

Symbiosis is highly important to soil ecosystems because of integral roles played within the ecosystems by symbiotic organisms, such as mycorrhizal associations. Another important example is lichen involvement in soil crusts. In arid and semi-arid environments such as Western Australia, lichens and other organisms such as bacteria and mosses, form microbiotic crusts over large areas of soil with poor vegetative covering. These crusts are composed of soil aggregates held together by organic matter produced by the lichens and other organisms (5,6).

Hyphae of fungi holding soil together, creating soil aggregates.

Soil crusts increase soil stability, holding the aggregates together against opposing forces. Microaggregates formed by the binding of organic matter are very strong, not usually affected by common agricultural practices such as tillage. Crusts protect the soil from erosion to which it would otherwise be susceptible because of the lack of vegetation.

A crust can also increase the surface area of the soil, allowing more space for water absorption (5,6).

References

1. Koide, R.T., Mosse, B. (2004) A history of research on arbuscular mycorrhiza. *Mycorrhiza* 14, 145-163.

2. Smith, D.C. (2001) Symbiosis research at the end of the millennioum. *Hydrobiologia* 461 (1), 49-54.

3.http://www.chemheritage.org/EducationalServices/pharm/antibiot/readings/potter.htm

4. http://media.wiley.com/product_data/excerpt/28/04713997/0471399728.pdf

5. Coyne, M.S. (1999) Soil microbiology: an exploratory approach. Nelson ITP. South Melbourne: Victoria.

6.http://www.blm.gov/nstc/soil/crusts/

Anne is a visiting student from the USA. She attends Washington an Lee University in Virginia, and is halfway through neuroscience and environmental studies degrees. She spent eight weeks in the Soil Science department at UWA working with Lyn Abbott and Jen Slater on the Soils are Alive and the Australian Soil Club programs.

Anne Hungerford

CURRENT RELEVANT RESEARCH AT UWA

Djajadi, a PhD student at the University of Western Australia, is currently conductin research on the Biological contribution to cohesiveness of primary particles of sandy soil for different agricultural management practices.

SPECIFIC OBJECTIVES

The main objective of the research is to investigate soil biological properties that are likely to contribute to cohesiveness of primary soil particles and their effectiveness in increasing aggregate stability in sandy soil exposed to different soil management practices.

EXPERIMENTS:

1. Changes of physical and biological soil properties in relation to cohesiveness of particles of sandy soils with addition of clay and organic matter.

2. Effect of addition sub soil clay and organic matter on water stable aggregates, microbial biomass, soil strength and cation exchange capacity of sandy soil with different particles size.

3. Correlation between Bacterial Fungal Ratio and Aggregate Stability of Sandy Soils added with Clay

4. Effect of Mycorrhiza hyphae on water stable aggregates of sandy soils with different size and amendments