ASC Vol 2 No 3 2006

Australian Soil Club

Welcome

The main articles in this issue are:

- ***State of the Environment in WA Draft Report open for comment***
- ***Microbial response to urea application - a study from New Zealand***

FEATURED WEBSITES

(1) Department of Primary Industries Victoria.

http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soil-home

This is the webite of the Department of Primary Industries in Victoria. It has considerable information about the soil resources in Victoria, including information about the wide range of soil types that occur in Victoria

(2) Australian Government's Natural Resource Management Website

http://www.nrm.gov.au/monitoring/indicators/soil/index.html

This is the Australian Government's Natural Resource Management Website.
It has a section on soil monitoring - for soil acidity, soil organic carbon, soil erosion by water and soil erosion by wind.

An example on the information available on this wesbite for soil acidity is:

- why would we need to monitor soil acidity:?
- how will monitoring soil acidity help measure resource condition?
- monitoring and reporting products
- proposed responsibilities
- links to other indicators.

For further information, contact:
Professor Lyn Abbott
School of Earth and Geographical Sciences
The University fo Western Australia
Nedlands, WA 6009 Australia
Email: labbott@cyllene.uwa.edu.au

State of the Environment - Draft Report for Western Australia, 2006

Open for Public Comment (to Sept 06)

The Western Australian Government recently released a draft report on the State of the Environment (2006). All aspects of the environment have been assessed. Many experts collected the information and distilled it into a readable format. It paints a picture of how the environment is going and identifies priorities for immediate attention. Overall, it provides an impressive documentation of the environment of Western Australia.

In relation to the state of land in Western Australia, the report concluded that there was inadequate information about soil and the condition of land. There has been a significant decrease in the protective cover of the land, especially in the south-western area of Western Australia.

The information is available on the website **www.seo.wa.gov.au**

Reporting on the State of the Environment is also a national project with guidelines established by the Federal Department of the Environment and Heritage. The National-level report will be delivered to the Federal Minister before the end of 2006. The report for the whole of Australia (as in the WA Report mentioned above) includes commentary on the atmosphere, biodiversity, coasts and oceans, inland waters and land.

What is Environmental Biogeochemistry?

CSIRO has also addressed the importance of the environment through its research program on Environmental Biogeochemistry.

This program seeks to improve the state of the environment thorough greater understanding of how to contain contamination of land and water in both rural and urban environments. Scientists are developing advanced monitoring and analytical methods for tracking pollution from its source and predicting movement of contaminants in the environment.

See the CSIRO website for more information

http://clw.csiro.au/research/biogeochemistry

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Microbial Response to the Application of Urea

Research on this topic was conducted by F.M. Kelliher, R.J. Sedcole, R.F. Minchin, Y. Wan, L.M. Condron, T.J. Clough and R. Bol (2005) published in the Australian Journal of Soil Research: 43, 905-13.

Over the past decade, urea has become a very common form of fertilizer – providing not only an economic source of nitrogen, but also readily available organic matter and increased soil microbial activity (Rutgers NJ Agricultural Experiment Station 2006).

The currently wide ranging use of urea as a fertilizer has raised many questions regarding its influence on soil biology and plant growth (Overdahl et al. 1991). In particular, there is still a degree of uncertainty regarding microbial response to urea.

When urea is added to soil in combination with water (either through the urine of animals or as a fertilizer) it breaks down to produce ammonia and carbon dioxide. This reaction can happen very quickly, especially in soils with a high pH. Ammonia hydrolyzes during the process of dissolution in water – producing ammonium (NH_4^+) that can be used by plants and hydroxide ions (OH^-) that increase the pH of soil and the solubility of organic matter. Soil microbial activity increases due to the increased availability of organic matter (Overdahl et al. 1991).

It has previously been observed (De Nobili et al. 2001 in Kelliher et al. 2005) that microbial communities develop a 'priming effect' after repeated exposure to urea. During this previous study it was noted that microbial communities exposed to urea demonstrate more activity in response to repeated application. A recent paper published in the *Australian Journal of Soil Research* (Kelliher et al. 2005) has investigated this 'priming effect' in three soils with varying histories of exposure to urea from the urine of grazing animals.

In their study, Kelliher et al. postulated that microbial communities in soils adapted to frequent exposure to urine from grazing animals would be most responsive to the application of urea in the laboratory. The authors investigated the response of microbial communities to application of urea in soil samples from three sites with different grazing histories near Lincoln in New Zealand: a dairy farm, a former dairy-farm taken out of production 20 years ago, and site that had never been grazed.

A pair of samples was taken from each of the sites and incubated in the laboratory before urea was applied to one sample of each pair. As an indicator of microbial activity, Kelliher et al. calculated carbon dioxide produced by soil microbial respiration. In order to investigate the relationship between microbial activity, pH and the availability of soil organic matter, the authors also measured soil pH and water soluble carbon after the application of urea to the samples.

As predicted, the pH of samples from all three sites increased after the addition of urea. At a distance of between 0 to 20mm beneath the surface, the pH of all the samples increased by approximately four units. The samples reached their maximum pH of approximately 9 by day 1 or 2, after which the pH of samples from all three sites gradually declined. At a similar depth from the surface, carbon availability also increased dramatically one day after the application of urea. For example, water soluble carbon in the sample taken from the dairy farm increased 10-fold from 0.26 to 2.6 grams per kilogram after application of urea, while water soluble carbon in the sample taken from the un-grazed site increased 21-fold from 0.17 to 3.5 grams per kilogram. After this peak, the proportion of water soluble carbon gradually decreased over the period of the investigation.

Before the addition of urea, all of the samples had similar soil carbon dioxide production rates (FCO_2), measured in micrograms of carbon dioxide produced per kilogram of soil over one second. One day after the application of urea, FCO_2 for the sample taken from the dairy farm was five times greater than the control sample, while FCO_2 for the sample taken from the un-grazed site was seven times greater than the control. Five days after application of urea, FCO_2 had declined to pre-application levels for all the samples.

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Visit the Soil Health website at www.soilhealth.com

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Addition of urea to soil produces carbon dioxide not only through increased microbial respiration, but also through hydrolization of urea itself. By subtracting the carbon dioxide produced through hydrolization from the total carbon dioxide produced after the application of urea, the authors calculated that the three samples produced 1.39 g CO_2 / kg soil (dairy farm), 1.67 g CO_2 / kg soil (set-aside) and 1.85 g C02 / kg soil (un-grazed) solely from microbial respiration. Expressed as carbon per unit of soil, microbial respiration increased 0.13 (dairy farm), 0.15 (set aside) and 0.2 (un-grazed) after application of urea. After statistical analysis, the authors found no significant difference between the responses to urea for the samples from the three sites – contradicting their hypothesis that the microbial communities in the sample from the dairy farm would respond more vigorously.

The authors applied a second round of urea to the samples in order to test the affect of repeated application. After the second application, the pH of samples from the three sites all increased to a similar level observed at the previous application, before gradually decreasing. In the same way, after the second application of urea, water soluble carbon was replenished in the dairy farm sample to almost the same level observed after the first application. In the un-grazed site sample, water soluble carbon levels were replenished to a level exceeding that observed after the first application.

The carbon dioxide efflux rates for the samples after the second application of urea reflected the increased availability of carbon for microbial respiration. Again, all the samples registered a significant response to the second application of urea, but no significant variance was recorded between the three samples. The amount of carbon dioxide produced solely by bacterial respiration over a period of nine days after the second application of urea was calculated as 1.58 g CO_2 /kg (dairy farm), 2.26 g CO_2 /kg (set aside), and 1.43 g CO_2 /kg (un-grazed). Expressed as a carbon per unit of soil basis, microbial respiration was found to have increased 0.26 (dairy farm), 0.41 (set-aside) and 0.2 (un-grazed) after the second application.

As expected, soil pH, availability of carbon, and soil microbial activity all increased after the application of urea. Results from this study indicate that soil microbial response was not directly proportional to the amount of water soluble carbon available in the soil.

Conclusion:

In contradiction to the authors' hypothesis, regular exposure to urea in the form of urine from grazing animals did not encourage a more vigorous microbial response in the soil sample from the dairy farm compared to samples from the other sites. Interestingly, however, the microbial communities in the samples taken from the set-aside farmland and from the dairy farm responded more vigorously to the second application than they did to the first application of urea. Further illumination regarding this 'priming effect', however, will have to wait for future investigation.

References:

Kelliher, F.M., Sedcole, J.R, Minchin, R.F., Wan, Y., Condron, L.M., Clough, T.J., Bol, R. (2005) Soil Microbial Respiration Responses to Repeated Urea Application in Three Grasslands. *Australian Journal of Soil Research* 43, 905-13.

Overdahl, C.J., Rehm, G.W. and Meredith, H.L. (1991), website: HYPERLINK "http://www.extension.umn.edu/distribution/cropsystems/DC0636.html"

Rutgers NJ Agricultural Experiment Station (2006), website: HYPERLINK "http://www.rce.rutgers.edu/horsepastures/soil_fertility.htm" http://www.rce.rutgers.edu/horsepastures/soil_fertility.htm

VIDEOS OF SOIL ORGANISMS

If you have good internet access, you might like to check the following website which has short videos of various soil organisms.

http://www.agron.iastate.edu/%7Eloynachan/mov/

FERTCARE

Fertcare is a national training initiative for people involved in the fertiliser industry. It seeks to improve the resource base from which information is given concerning the use of fertilisers in Australia.

This initiative of the peak body for the fertiliser industry in Australia (Fertilizer Industry Federation of Australian Inc) has produced a handbook that is available on their website:

http://www.fifa.asn.au

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AJSR special issue on soil biology in Australian farming systems

The *Australian Journal of Soil Research* has published a special edition on soil biology in Australian farming systems. The papers look at how soil biology can contribute to farming productivity and maintain environmental integrity. Topics include rhizosphere biology and crop productivity, impact of crop residue amendments and agricultural inputs, suppression of Rhizoctonia, nitrogen fixation, stubble retention vs burning, and earthworm dynamics. You can find the special edition (Volume 44, No 4 2006) at http://www.publish.csiro.au/?nid=84.

Soil health card: A monitoring tool for farmers developed by farmers

In 2002 a group of northern NSW farmers expressed a need for a soil health monitoring tool. They developed a soil health card using a series of workshops to identify and describe meaningful measures of their soil health. The group aimed for measures that were simple to use and easy to interpret. The process whereby farmers develop the measures is as important as the measures themselves. You can find their soil health card at http://www.tuckombillandcare.org.au/shc.htm. Abigail Jenkins' paper about the process of developing the card is at http://www.regional.org.au/au/apen/2006/refereed/1/3157_jenkinsa.htm.

Soil Biology Basics

Soil biology basics is a series of leaflets produced by NSW DPI covering soil biology in agriculture. The leaflets outline the basic processes involved, and also provide information on how to test biological products onfarm. So far there are 11 leaflets in the series. They are on the NSW DPI website at http://www.dpi.nsw.gov.au/aboutus/resources/factsheets/soil-biology-basics

The ASC website is www.soil.org.au

SoilCare

SoilCare is an association of primary producers and others on the North Coast of NSW with special interests in soil processes. It holds regular seminars and field days to help members access and share current information on sustainable soil management practices from around the world.
Find out more about its activities at http://www.soilcare.org.au/index.htm.

Murrumbidgee Soil Benchmarking

NSW's Murrumbidgee Catchment Management Authority is benchmarking the state of its soils through an innovative project delivered by NSW Dept of Primary Industries. Landholders participate in a series of soils workshops and their soil test results are recorded in the CMA's soils database. The project helps landholders interpret soil tests, match farming activity with soil and land capability, and recognise and deal with soil health problems. The training covers acidity, sodicity, salinity, fertility decline, dispersion and soil structural problems, and low organic matter content.
Find out more at http://www.murrumbidgee.cma.nsw.gov.au/index.php?id=203

ENVIRONMENTAL INDICATORS FOR THE STATE OF LAND IN AUSTRALIA:
see the Australian Government, State of the Environment Website. http://www.deh.gov.au/soe/land/index.html

A document is available which explains a set of 29 key environmental indicators which include:

Erosion: 9 indicators
Hydrology: 2 indicators
Nutrient & salt cycling: 5 indicators
Soil & land pollution: 6 indicators

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