Grains Research
UPDATE
Research Information for Farm Advisers from the
Grains Research and Development Corporation (GRDC)
Northern Region

GRDC
Grains Research & Development Corporation

AUTUMN 2008

Carbon trading and the science behind it

"Profiting from soil carbon sequestration in Australian farming systems is difficult due to the inability of the farming system to accumulate carbon in our climate and the expense of verification" says Professor Peter Grace of Queensland University of Technology. Carbon sequestration is the natural process of storing carbon molecules in our soils, and preventing carbon loss to the atmosphere that would add to global warming.

Global warming is due to increased atmospheric levels of several greenhouse gasses that include; carbon dioxide, methane and nitrous oxide - which are all agricultural by-products. A scale to measure 'global warming potential', uses CO_2 as a base (i.e. CO_2 = 1). Methane (CH_4) is equal to 23 units of CO_2, and nitrous oxide (N_2O) is equal to 310 units of CO_2. Thereby simply reducing the release of methane or nitrous oxide has a comparably huge impact on global warming compared to a unit of CO_2. According to Professor Grace; "focusing on methane and nitrous oxide emissions is possibly Australia's best approach, particularly as Australia's climate makes carbon sequestration in agricultural soils quite difficult to achieve".

Carbon sequestration is possible by returning land back to bushland, or to a lesser extent via improved management of current systems. The aim is to accumulate carbon molecules by:

1. decreasing tillage
2. increasing soil residues (particularly in cereals and pasture), and/or
3. using plants that store large amounts of carbon

Australia's generally high temperatures and variable rainfall, limit the amount of biomass produced and lead to rapid degradation of what is produced. Increasing soil organic carbon through zero or reduced tillage is inconsistent. Long fallows do not produce biomass, a single tillage operation releases much of the carbon previously stored, and verification and transaction costs for soil carbon are high. Sown and improved pasture management offer some benefit, but the usefulness also depends on market opportunities and their location. Excess soil water may slow the rate of decomposition of organic matter, but increase gaseous losses of N_2O thereby reducing the effectiveness and amount of carbon sequestration.

Australia's most efficient and cheapest option maybe in reducing N_2O release due to its high 'global warming potential' (310 times that of CO_2). Decreasing nitrogen fertiliser application in situations where large amounts are lost due to de-nitrification, i.e. water logging and volatilisation of nitrogen fertilisers would reduce Australia's impact on global warming.

Professor Grace believes carbon would have to be worth in excess of $50/tonne to Australian farmers before they would be able to absorb capital and transaction costs. "Until carbon is worth this amount it is unlikely to provide enough economic incentive to stimulate farmers into significantly altering practices for carbon trading alone", says Professor Grace. Based on figures from temperate SE Australia, where up to 200 kg carbon/ha/yr could be sequestered, this equates to $10/ha/yr. The current price of carbon on the Australian Climate Exchange is less than $3/tonne. Farmers must remember though that the increased carbon levels have to be permanent and maintained for long periods of time (70-100 years in most cases) to have any financial benefit in carbon accounting systems developed under the Kyoto Protocol.

Australia is already trying to reduce its carbon footprint by reducing the standard amount of N_2O lost to the environment in cotton systems to a standard of 0.5% from the international standard of 1.25%. Professor Grace admits "most of the carbon sequestration information in Australia originates from the US market, as they are moving to financially reward farmers for carbon sequestration" and the sequestration potential in those (cooler and wetter) environments is higher. For example farmers can register a field for carbon sequestration which is then monitored over time to ensure there is no cultivation. An amount is then paid to the farmer for this carbon sequestration.

The increased use of remote sensing and improved soil sampling techniques to reduce uncertainty is critical in developing precise estimates of carbon sequestration. These are all additional, but necessary expenses in the monitoring and verification processes and have major impacts on the final financial return. "The uncertainty associated with soil carbon sequestration in Australia is a major financial risk at this point in time, however the overall benefits of increasing soil carbon on sustainable agricultural production and soil conservation is the real winner"

For more information and the option to measure your own carbon footprint go to: www.isr.qut.edu.au

RESEARCH INFORMATION FOR FARM ADVISERS - ISSUE 42 Print Post Approved PP 255003/03570

Further information:

Professor Peter Grace Queensland University of Technology 07 3138 9283 pr.grace@qut.edu.au

Carbon emissions and storage – what is the effect of farming system?

A 33 year study of carbon cycling, storage and emissions in a southern Queensland winter cereal system, confirmed that nitrogen use and emissions were the main contributors to greenhouse gas emissions. Researchers Weijin Wang and Ram Dalal from Queensland Natural Resources & Water said "With applied nitrogen critical for maintaining yield and profit, emphasis should be placed on optimising nitrogen use efficiency through fine tuning rates to meet crop need, and delivering nitrogen when it is needed by the crop – possibly using split applications and coated fertilisers with slower nutrient release profiles. Sourcing nitrogen from pulse crop and pasture sources, was seen as a good way to obtain the in-crop benefits of good N levels, while avoiding the high off-farm energy costs associated with the manufacture of N fertilisers."

The study was conducted at the Hermitage Research Station at Warwick on a vertosol soil and included stubble burnt (SB), stubble retained (SR), conventional tillage (CT), no tillage (NT), nitrogen fertiliser added (NF) and no nitrogen fertiliser added (N0).

"The study looked both at the impacts in the crop and soil, including carbon sequestration in soil and crop residue, as well as off farm emissions involved in the manufacture and transport of farm machinery and variable inputs like fertiliser and herbicide. This enabled the carbon balance sheet of different systems to be compared," said Ram Dalal.

"On average the no-till, stubble retained and + N fertiliser treatments increased soil organic carbon in the top 20 cm of soil by 0.35, 0.03 and 1.6 t C/ha in comparison to the conventionally tilled, stubble burnt and no N fertiliser treatments, respectively. This effect was most pronounced where all three (no-till, stubble retained and N fertiliser) were combined. On this heavy clay black earth, we found very little difference in organic C between stubble burnt and stubble retained treatments over 33 years. In the stubble burnt treatment, most of the stubble C is lost immediately during burning. While in the stubble retained treatment, most of the stubble C is lost from microbial decomposition over time.

"The trial site had been farmed for several decades before the trial was started and it is believed that soil organic carbon had already been depleted to an equilibrium point, with little change in the conventionally tilled, stubble burnt, no N treatment since then. Based on this estimation, the no-till, stubble retained + N treatment significantly increased soil carbon by 2.3 t/ha over the 33 years of the trial. This relatively modest gain in soil carbon was felt due to low plant productivity in a continuous cereal rotation, the long fallow period and rapid mineralisation of soil organic matter in the sub-tropical climate.

"The amount of carbon stored in crop residues showed a slightly different picture, with less stubble retained (and thus less carbon) in the no-till + N treatment, than comparable treatments like no-till with no N, or either of the conventional tillage treatments. The rate of stubble decomposition was slowed by both the lack of tillage and the high C/N ratios where no N was added.

"Total on-farm emissions varied greatly from 5.7 to 28.6 t CO_2 equivalent /ha. N fertilisers (where used) were the single largest contributor to greenhouse gases in the farming system. This was due to the CO_2 generated in the breakdown of urea to ammonium, nitrous oxide emitted from N fertiliser applied and the high energy cost to make urea off farm.

Table 1: Greenhouse gas emissions over 33 years in a cereal cropping system in SE Queensland as affected by tillage, N fertiliser and stubble management.

	On farm emissions (t CO_2 equivalent / ha)							Off farm emissions (t CO_2 equivalent / ha)					
Treatment	Diesel	Urea	CH_4 (Stubble burning)	N_2O (Stubble burning)	N_2O (Stubble retained)	N_2O (Soil - from urea)	Sub total	Diesel (Production & transport)	Machinery (Manufacture & repair)	Urea (Manufacture & transport)	Herbicide	Sub total	Total (t CO_2 equiv. / ha)
CT N0 SB	4.0		6.6	2.1	0.4		13.1	0.4	1.5			1.9	15.0
CT N0 SR	4.0				3.9		7.9	0.4	1.5			1.9	9.8
CT NF SB	4.0	3.0	7.1	2.8	0.6	11.1	28.6	0.4	1.5	8.6		10.5	39.1
CT NF SR	4.0	3.0			5.7	11.1	23.8	0.4	1.5	8.6		10.5	34.3
NT N0 SB	1.0		6.8	2.1	0.4		11.1	0.2	0.6		2.0	2.8	13.9
NT N0 SR	1.0				3.9		5.7	0.2	0.6		2.0	2.8	8.5
NT NF SB	1.0	3.0	7.3	2.9	0.6	11.1	26.7	0.2	0.6	8.6	2.0	11.4	38.1
NT NF SR	1.0	3.0			6.0	11.1	21.9	0.2	0-6	8.6	2.0	11.4	33.3

CT: conventional tillage; NT: no-till; SB: stubble burnt; SR: stubble retained; N0: no N fertiliser; NF: N fertiliser applied

Fig. 1. Organic carbon contents (t/ha) in the top 20 cm soil under different farming scenarios (NT: no-till; CT: conventional till; SB: stubble burnt; SR: stubble retained; N0: no fertiliser N application; NF: N fertiliser applied).

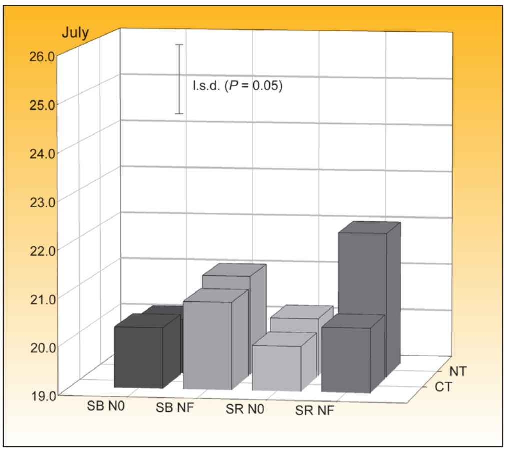

Fig. 2. Stubble carbon (t/ha) at the beginning and end of a fallow period under different farming scenarios (NT: no-till; CT: conventional till; SB: stubble burnt; SR: stubble retained; N0: no fertiliser N application; NF: N fertiliser applied).

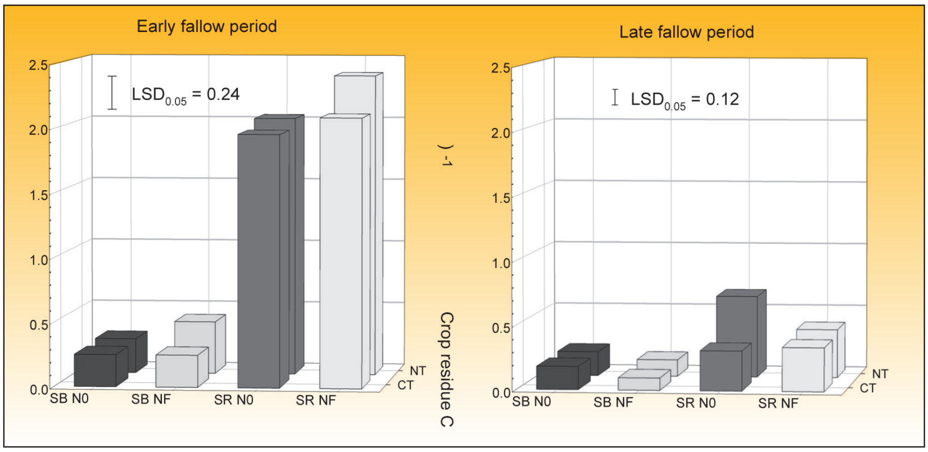

Table 2. Summary of carbon changes and greenhouse gas emissions over the 33 years of the trial

Treatment	Mean grain yield (t/ha)	Change in soil organic carbon (t CO_2 equiv. / ha)	Retained organic carbon (t CO_2 equiv. / ha)	On-farm emissions (t CO_2 equiv. / ha)	Off-farm emissions (t CO_2 equiv. / ha)	Net emissions (t CO_2 equiv. / ha)
CT N0 SB	2.55	0	0	13.1	1.9	15.0
CT N0 SR	2.43	-1.2	0.5	7.9	1.9	10.5
CT NF SB	2.75	3.9	-0.3	28.6	10.5	35.5
CT NF SR	2.77	0.4	0.6	23.8	10.5	33.3
NT N0 SB	2.63	-2.9	0.05	11.1	2.8	16.8
NT N0 SR	2.44	-1.8	1.7	5.7	2.8	8.6
NT NF SB	2.81	4.5	-0.2	26.7	11.4	33.8
NT NF SR	2.92	8.5	0.7	21.9	11.4	24.1

Further information:

Ram Dalal, 07 3896 9895 Ram.Dalal@nrw.qld.gov.au

Changes to herbicide classification

CropLife Australia and the APVMA introduced changes to mode of action (MOA) groupings for herbicide products in February 2008. The changes will improve the accuracy and completeness of the system and align the Australian herbicide grouping system more closely with the international system. The addition of six new herbicide groups sees the old groups E, F and K receive the most changes. Most of the other groups remain unchanged.

The six new groups H, O, P, Q, R and Z allow more accurate grouping of herbicides. 26 herbicide products (22 active ingredients) are affected by the new mode of action groupings. Herbicide product registrants have three years from February 2008 to update labels to reflect the new mode of action groupings.

Key changes are:

Active constituent	Chemical family	Old MOA group	New MOA group
Triallate	Thiocarbamates	Group E	Group J
Isoxaflutole	Isoxazoles	Group F	Group H
flamprop	Arylaminopropionic acids	Group K	Group Z

For all group changes see: www.croplifeaustralia.org.au

Labelling products with their mode of action, allows the user to more easily identify herbicides that work by similar means (ie. those within a particular mode of action group share the same letter code on the product label).

Australia was the first country to introduce compulsory mode of action labelling. Generally speaking, the mode of action codes reflect the relative risk of resistance evolving in each group, with Group B posing the greatest risk, followed by group A, with risk thereafter generally decreasing alphabetically down the groups.

The widespread over reliance on herbicides for weed management in Australia and particularly during the last 20 years, predisposes many weed populations to herbicide resistance. Selection of resistant strains can occur in as little as 3-4 years if no attention is paid to resistance management. Integrated Weed Management

(IWM) strategies have been developed to help farmers manage the increasing problems of herbicide resistance. CropLife Australia regularly updates Herbicide Resistance Management Strategies on its website after consultation with researchers, agronomists and farmers, and with reference to international developments.

Further information:

www.croplifeaustralia.org.au

Alpha line on disease resistance

Australia is to have a standard alpha – as distinct from numeric – labelling system for cereal and pulse varieties' resistance or susceptibility to disease.

A decision has been undertaken by GRDC to dispense with the various numeric labelling systems – and standardise on a more descriptive alpha labeling system that will rate varieties as S, MS, MR, R and similar.

These ratings are linked to relevant management strategies.

Current NVT ranking

NVT	Rating Abbrev.
Resistant	R
Resistant - Moderately Resistant	R/MR
Moderately Resistant	MR
Moderately Resistant - Moderately Susceptible	MR/MS
Moderately Susceptible	MS
Moderately Susceptible - Susceptible	MS/S
Susceptible	S
Susceptible - Very Susceptible	S/VS
Very Susceptible	VS

IPM Blog – "The Beat Sheet"

Entomologists from Queensland's DPI&F have turned to the web to help get the latest research information on insect pests of grain crops out to farmers and advisers. Their IPM blogsite, is named The Beat Sheet and it regularly features technical articles on issues of current importance to northern grains advisers and growers. Have a look at it at http://www.thebeatsheet-ipmnews.blogspot.com/

According to DPI&F's Dr Melina Miles; "Whenever we do a new posting, we send out a notice to all our subscribers to The Beat Sheet Newsletter with a direct link to the new article".

Further information:

Go to the Web Blog at http://www.thebeatsheet-ipmnews.blogspot.com/ Melina Miles 07 4688 1369 melina.miles@dpi.qld.gov.au

GRDC Code: DAQ00074

IWM workshop for advisers

For advisers wishing to hone their skills in this important area, a 2-day workshop on herbicide resistance and Integrated Weed Management in grain production systems is available. Specifically designed to suit the needs of agronomists and specialist grains weed advisers, this 2-day nationally recognised workshop has been delivered to over 400 agronomists and chemical company representatives. The workshop was developed by Independent Consultants Australia Network P/L in association with the CRC for Australian Weed Management and with the support of growers through the GRDC.

This workshop won the prestigious Business and Higher Education Round Table Award for training collaboration between a CRC and industry and more importantly, has won the acclaim of even the more senior advisers who have participated, - most of whom rated the workshop with top marks as being directly relevant to their information needs.

Further information:

John Cameron 02 9482 4930 icanjohn@tpg.com.au

Editor: John Cameron Ph: (02) 9482 4930,
PO Box 718, HORNSBY NSW 1630

Research writers: Stirling Tavener, John Cameron

Layout and design: Lightning Designs Ph: (08) 8274 1648