Minnipa Farming Systems Competition - A Review of Soil Health after 10 years

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INFORMATION

Key messages

- **A comparison of 2001 and 2010 soil analysis suggests that organic carbon levels may have declined over the 9 year competition, irrespective of the rotation utilised and production achieved.**
- **However to suggest that there is a continuing long term decline in soil health in the face of improved "sustainable" farming techniques is premature.**
- **The competition ceased in its current form in 2010 with all paddocks sown to an oilseed (canola or juncea).**

Why do the trial?

The Farming Systems Competition was commenced in 2000 to compare the impact of four different management strategies on production, profitability and sustainability at the Minnipa Agricultural Centre.

The trial continued until 2009 comparing the production of four independent farming systems imposed by four management groups, these being; local farmers, farm consultants, research staff and the current district practice, each group being responsible for one paddock.

While comparative production and profitability were measured annually (EPFS Summary 2009, pg 120) soil health and sustainability have not been previously reported.

How was it done?

The field crop or pasture sown on each of the four 3 ha plots were determined annually based on rotation, market forces, seasonal forecasts, land condition and the personal preferences of the four management groups.

Each trial plot had a chemical fallow treatment imposed in 2000. Over the 9 year study the number of years of each crop type varied from 8 to 3 years of wheat and 3 to 1 years of pasture, each plot had 1 year of hay production. The annual pasture phases, dominated by annual *Medicago* sp., were grazed for short periods, based on available feed on offer and the maintenance of adequate groundcover to avoid wind erosion. Crop residues were also grazed, to remove spilled grain and weeds, but with consideration to maintaining adequate ground cover. Crop sowing rates varied based on the preferences of the individual management groups as did the disease and weed management strategies. Total units of phosphorus and nitrogen applied to each trial plot over the 9 year period are presented in Table 1.

Organic carbon (%) from the 0–0.1 and 0.1–0.6 m soil profiles taken at 4 random points from within each of the 4 trial plots were estimated at the commencement (2001) and at the completion (2010) of the trial. The comparative fertiliser inputs were recorded along with the total grain yields from the 3 ha plots. Annual and growing season rainfall was also recorded.

What happened?

The long term average growing season and annual rainfall at Minnipa is 240 and 330 mm respectively. The period 2001 to 2009 included 3 years of deciles 1, 2 or 3 (2006, 2007 and 2008), 5 years of deciles 4, 5 or 6 (2001 to 2005) and 1 year of decile 9 (2009).

The 4 farming systems imposed a range of crop types, rotational structures and fertiliser inputs over the course of the study. All systems included wheat, pasture and had a hay crop in the rotation. The total amount of grain removed from each system varied from 5.2 to 12.4 t/ha with the lower grain producing systems having pasture with grazing imposed or hay cut and removed in 2009 (decile 9 year).

Table 1 Nine year adaptive farming systems annual rotations and grain yield (t/ha) with total nitrogen and phosphorus inputs (kg/ha)

Year	Local farmers Annual crop - (t/ha)	Consultants Annual crop - (t/ha)	Researchers Annual crop - (t/ha)	District Practice Annual crop - (t/ha)
2001	Wheat - 2.7	Wheat - 2.8	Hay	Wheat - 2.8
2002	Wheat - 1.5	Wheat - 1.3	Barley - 1.4	Pasture
2003	Wheat - 1.2	Wheat - 1	Canola - 0.5	Wheat - 0.9
2004	Wheat - 1	Barley - 1.4	Wheat - 1.3	Wheat - 0.8
2005	Pasture	Peas - 1.6	Wheat - 2	Pasture
2006	Wheat - 0.7	Wheat - 0.8	Pasture	Wheat - 0.6
2007	Wheat - 0.9	Wheat - 1.2	Pasture	Wheat - 0.5
2008	Hay	Pasture	Wheat - 0.5	Hay
2009	Wheat - 4.4	Hay	Pasture	Wheat - 4.6
Total grain	12.4	8.5	5.2	10.4
Units of N	84	109	61	52
Units of P	53	72	48	8

Table 2 Soil organic carbon (%) in the 0-0.1 and 0.1-0.6 m soil profiles in April 2001 and 2010

Treatment	Year	Local farmers	Consultants	Researchers	District Practice
Organic carbon 0 - 0.1m	2001 2010	1.1 1	1.1 0.9	1.1 0.8	1.1 0.8
Organic carbon 0.1 - 0.6m	2001 2010	0.5 0.4	0.5 0.5	0.4 0.4	0.5 0.5

Soil organic carbon percentages were the same across all farming systems in 2010. However there was a soil organic carbon decline (LSD P=0.05) between the 2001 and the 2010 means of the 4 systems in the 0-0.1 m measured profile depth. This decline was not repeated in the 0.1-0.6 m soil profile.

What does this mean?

The study has suggested that current farming systems incorporating no-till/minimum till crop establishment, recommended crop nutrition inputs, sound weed and disease control and grazing management may have resulted in a decline in soil organic carbon over the 9 year course of the study. Irrespective of the rotation, from a conservative 3 year wheat-wheat-pasture to a 5 year wheat-wheat-wheat-wheat-pasture rotation, the decline trend was consistent.

Coventry et al (1998) reported that in a continuously cropped paddock (1984 -1995) at the Minnipa Agricultural Centre soil organic carbon increased (0.7 to 1%). Recent measurements from that same paddock (2005-2008) with ongoing continuous cropping indicate a further increase in soil organic carbon to 1.2% (A Cook pers. comm.). In a 2002 survey of 12 upper Eyre Peninsula commercial farm paddocks Cordon (2003) reported soil organic carbon levels less than 0.7% in response to continuous cropping and more than 1.4% following extended periods of annual pasture. However between the outliers there were a number of intensive cropping systems that had a measured soil organic carbon of more than 1%.

To accept the results of this study as opposed to the previous reports (Cordon, 2003; Coventry et al., 1998) may require consideration of the impact of 3 years of exceptionally low production (2006, 2007 and 2008) along with the period of near to average rainfall and production (2001-2005). To suggest that there is a continuing long term decline in soil health in the face of improved "sustainable" farming techniques is premature but there is a need to validate these outcomes on a broader regional scale.

References

Cordon N (2003) Sustainability on the far West Coast – results from a survey. Eyre Peninsula Farming Systems 2003 Summary. Minnipa Agricultural Research Centre, Plant Industries and Resources South Australia, ISBN 0 7590 1344 6

Coventry DR Holloway RE and Cummins JA (1998) Farming fragile environments: low rainfall and difficult soils in South Australia. Proceedings of the 9th Agronomy Conference Wagga Wagga 1998 pp.107-116.

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