Targeted use key to biochar benefits

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SANTFA has a focus on finding sound ways to reduce input costs and biochar has been assessed for the past five years. In that time we have learnt a lot about rates, placement and the interactions between biochar, fertiliser and production outcomes.

In 2012, SANTFA's main biochar trial site was north of Minlaton on The Yorke Peninsula.

The key soil characteristics of the Minlaton site are listed below.

pH ($CaCl_2$)	7.40
Organic carbon (%)	3.85
CEC (meq/100g)	34.77
NO_3 (nitrate - mg/kg)	43.70
NH_4 (ammonium - mg/kg)	49.80
Phosphorus (DGT)	62.00

MINLATON SOIL CHEMISTRY

The trial design used in previous biochar trials on Eyre Peninsula was employed again in 2012, using wheat with different rates of biochar applied to the surface or banded into the seed bed in various combinations with di-ammonium phosphate (DAP). To ensure data integrity, each treatment was statically randomised and replicated four times, with an independent contractor sowing and harvesting the trial.

Results

There was a clear yield response to application of DAP at rates of 70 kg/ha and 140 kg/ha.

A combination of 70 kg/ha of biochar banded with the seed plus 5 t/ha biochar spread on the surface prior to being incorporated by sowing (Treatment 4 - T4) increased yield to about the same level as 140 kg/ha DAP (T3) with no biochar and more than 70 kg/ha of DAP with no biochar (T2).

However, a combination of 5 t/ha of spread biochar incorporated by sowing (IBS) and 140 kg/ha of banded DAP (T5) reduced yield to a level similar to that achieved with 70 kg banded DAP (T2).

Yield from 70 kg/ha DAP plus 35 kg/ha biochar banded with the fertiliser (T6) was marginally better than from 70 kg DAP alone (T2), but not as good as the yield achieved by banding 175 kg/ha of biochar with 70 kg DAP (T8).

The most impressive yield outcomes were achieved when DAP at 140 kg/ha (T3) was banded with biochar at 35 kg/ha (T7) or 175 kg/ha (T9), with the combination of 140 kg/ha DAP and 35 kg/ha of banded biochar the highest-yielding treatment in the trial.

Biochar banded at 35 kg/ha (T10) and 175 kg/ha (T11) without any DAP decreased yield, as has been recorded in previous years' trials. Spreading biochar at 5 t/ha without any addition of DAP (T12) produced a yield response similar to that from 70 kg/ha DAP (T2); a result that was not consistent with earlier years.

Discussion

Biochar can provide a healthy and economical production benefit provided the right rate and placement are used, with fertiliser application rate and soil condition critical considerations.

Use of the wrong rate or application method for the paddock conditions may result in short-term production limitations and less attractive financial outcomes.

Banding low rates of biochar into the seedbed with DAP can increase fertiliser use efficiency and yield, and in the 2012 trial this approach provided the greatest return on investment.

This suggests there is potential in high-rainfall situations to use biochar to improve crop production without increasing fertiliser application rates.

In low-rainfall situations, supplementing a reduced fertiliser rate with banded biochar may maintain crop production while reducing input cost and production risk.

At an application rate of 5 t/ha, the cost of biochar is likely to be greater than the benefit, at least in the short-term. However, the long-term benefit is unknown.

At this stage, the best short-term economic return on investment from biochar in cropping situations is likely to be achieved by banding biochar at low rates rather than spreading it at high rates. The high-rate spreading treatments have been included in the SANTFA trial design only because spreading high rates of 5 t, 10 t or 20 t/ha of biochar are common in the wider research community.

Conclusions

After five years of trials, the evidence suggests banding biochar to off-set fertiliser cost and production risks is a reasonable proposition.

A program to determine the appropriate ratios of banded biochar to fertiliser for different conditions would help growers interested in applying biochar make good judgements on the best rates of fertiliser and biochar for their specific circumstances.

Freight costs will make biochar uneconomical if it has to be carted long distances, so having local production capacity in regional SA is critical if biochar is to be cost-effective for SA growers.

KEY POINTS

- Biochar can improve the efficacy of fertiliser but should not be regarded as a fertiliser in its own right.
- The application method and application rate of biochar are very important if a cost benefit is to be achieved.
- Banding low rates of biochar will be more cost effective than spreading high rates.
- Banding biochar with fertiliser below the seed at a rate matched to soil type, environmental conditions and fertiliser rate, can provide production benefits and reduce risk.

Cost/benefit analysis

Assumptions:

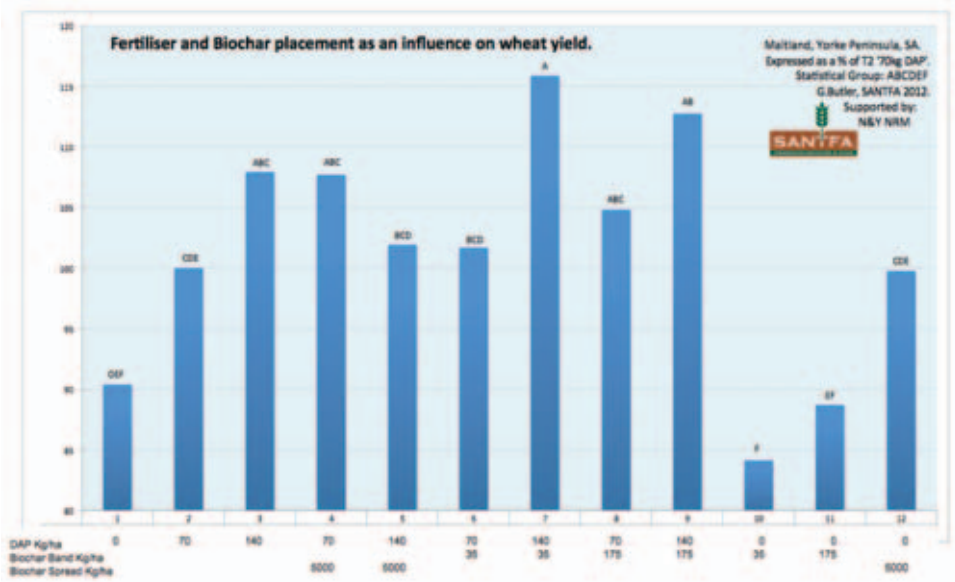
1) DAP at $650/t, so 70 kg = $45.50 and 140 kg = $91

2) Biochar @ $300/t, so 35 kg = $10.50, 175 kg = $52.50 & 5 t = $1,500

3) Grain price @ $260/t

	A Application	B Fertiliser cost $/ha	C Biochar cost $/ha	D Total cost $/ha (B+C)	E Yield t/ha	F Yield over nil t/ha	G Grain price $/t	H Yield benefit (FxG) $/ha	I Gross Margin over nil (H-D) $/ha
1	Nil	0	0	0	2.85	-	260	-	-
2	70 kg DAP	45.50	0	45.50	3.15	0.30	260	78	+ $32
3	140 kg DAP	91	0	91	3.40	0.55	260	143	+ $52
4	70 kg DAP 5 t biochar	45.50	1500	1515.50	3.39	0.54	260	140	- $1376*
5	140 kg DAP 5 t biochar	91	1500	1591	3.21	0.36	260	94	- $1497*
6	70 kg DAP 35 kg biochar	45.50	10.50	56	3.20	0.35	260	91	+ $35
7	140 kg DAP 35 kg biochar	91	10.50	101.50	3.65	0.80	260	208	+ $106
8	70 kg DAP 175 kg biochar	45.50	52.50	98	3.30	0.45	260	117	+ $19
9	140 kg DAP 175 kg biochar	91	52.50	143.50	3.55	0.70	260	182	+ $38
10	0 DAP 35 kg biochar	0	10.50	10.50	2.65	-0.20	260	-52	- $63
11	0 DAP 175 kg biochar	0	52.50	52.50	2.80	-0.05	260	-13	- $66
12	0 DAP 5 t biochar	0	1500	1500	3.14	0.29	260	75.4	- $1425*

* THE LONG-TERM BENEFIT OF HIGH RATES OF BIOCHAR SHOULD BE CALCULATED OVER MANY YEARS. A ONE-YEAR ROI IS NOT REALLY APPROPRIATE; FOR THE SAME REASONS THAT THE COST OF CLAYING A NON-WETTING SAND CANNOT BE RECOVERED IN ONE YEAR. HOWEVER, SPREADING BIOCHAR AT HIGH RATES DOES NOT APPEAR TO BE THE MOST COST-EFFECTIVE METHOD OF USE.



Biochar production is still in its infancy, with production currently limited to only a few research-scale production facilities such as the machine in Elmore, Victoria, which can produce 80 kg of biochar an hour from 200 kg of feedstock.

Nevertheless, there is capacity to supply biochar to SANTFA members for experimental and screening purposes, although the cost will be high until local production facilities come on line.

The anticipated price of the limited amount of biochar available from the Elmore plant in 2014 is $1,000/t (ex GST) plus freight. However,

production is projected to increase over the following 12 months, with commercial quantities of bulk biochar expected to be available in 2015 at an anticipated cost of less than $500/t (ex GST), subject to sufficient interest and indicative market demand to justify businesses investing in larger-scale facilities for local biochar production.

Those considering building larger-scale biochar production facilities in rural SA face a 'chicken and egg' situation, with demand needed to justify investment in the capital equipment but a plant required to provide the product needed to develop a market.

Several businesses with waste streams suitable for biochar production have expressed interest in moving forward with local production plants in SA should market demand be demonstrated.

Growers or companies can visit www.ccarbon.com.au to register interest in:

- a biochar production plant
- obtaining biochar for screening trials in 2014
- purchasing bulk biochar for the 2015 season.

THE ELMORE BIOCHAR PRODUCTION PLANT HAS A FEEDSTOCK CAPACITY OF 200 KG/HR AND CAN PRODUCE 80 KG/HR OF BIOCHAR.

Application of biochar to agricultural land is likely to attract carbon credit, with approval of biochar-related methodology that complies with the Carbon Farming Initiative (CFI) expected in late 2013 or during 2014.

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