Targeted biochar use can reduce input costs

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Trial results point to way forward with biochar

Combining targeted moderate rates of biochar with DAP fertiliser can reduce fertiliser costs and improve profitability.

This is the key finding from 2013 field trials of biochar made from poultry litter (PL biochar) plus DAP on wheat at Paskeville, on upper Yorke Peninsula.

The highest yield in the replicated nine-treatment trial was achieved with a combination of 35kg/ha of biochar plus 100kg/ha of DAP (T6), with 100kg/ha of biochar plus 100kg/ha of DAP (T7) marginally, yet not significantly, less.

However, the highest gross margin was achieved with a combination of 35kg/ha of biochar plus 50kg/ha of DAP (T3), $18.42 ahead of T6.

Gross margin results will obviously vary with different biochar and fertiliser costs.

In the Paskeville trial the nil treatment (T1) received no fertiliser and no PL biochar and was the lowest yielding treatment.

Wheat that received 50kg/ha of DAP but no biochar (T2) yielded slightly more than the nil control but the small yield increase was not statistically significant; nor were the yield differences in the two plots that received only PL biochar at rates of 35kg/ha and 100kg/ha (T8 and T9). The 'biochar only' results reinforce the fact that, in the short term at least, biochar is not a fertiliser in its own right.

Banding 35kg of PL biochar plus 50kg of DAP (T3) produced a yield statistically better than only 50kg of DAP (T2) (see red arrow on Figure 2) and a yield similar to that achieved with 100kg of DAP but no biochar (T5) (see orange arrow on Figure 2). Adding 100kg of PL biochar with 50kg of DAP (T4) also resulted in a significantly better yield than applying only 50kg of DAP (T2).

However, there was no significant yield difference between T3 and T4 and the lower input cost of T3 resulted in a much better gross margin. These results clearly show that adding more biochar (100kg in T4 compared with 35kg in T3 in this instance) does not necessarily ensure a better outcome, and in this trial there was a slight, but not statistically significant, decrease in yield with the higher rate of biochar.

There was a similar pattern in the results from using 100kg of DAP (T5), 100kg of DAP plus 35kg of PL biochar (T6) and 100kg of DAP plus 100kg of PL biochar (T7). Using a a low rate of biochar (T6) in combination with 100kg/ha of DAP (T5) resulted in a yield increase that tailed off marginally when the biochar rate was increased to 100kg (T7).

The average yield results mirrored this trend almost exactly, as seen with the lower rate of DAP and PL biochar treatments (T2, T3 and T4 – the yellow shaded area on the graph) but the

KEY POINTS FROM 2013 BIOCHAR TRIALS

- Banding low rates of biochar can reduce cropping input costs and improve profitability.
- Biochar can improve the efficacy of fertiliser but should not be regarded as a fertiliser in its own right.
- More is not better. A rate of around 35kg/ha of biochar plus a modest rate of DAP produced the best economic outcome for all rates of DAP used in the trial (0, 50 and 100kg/ha).

Treatment (kg/ha)	DAP (kg/ha)	PL biochar
1	Nil	Nil
2	50	Nil
3	50	35
4	50	100
5	100	Nil
6	100	35
7	100	100
8	Nil	35
9	Nil	100

TABLE 1: NINE TREATMENTS CONSISTING OF VARIOUS COMBINATIONS OF DAP AND PL BIOCHAR WERE INCLUDED IN THE 2013 TRIAL AT PASKEVILLE.

Results

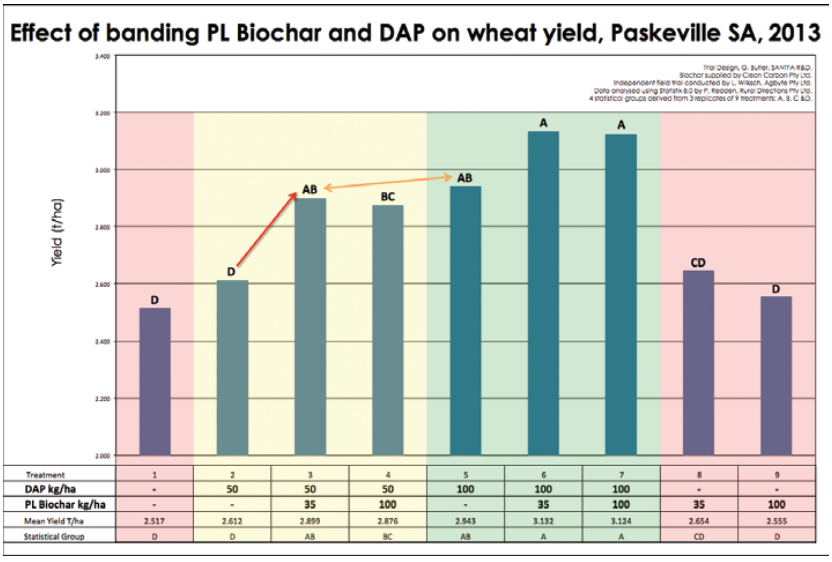


FIGURE 2: 2013 WHEAT YIELD RESPONSE TO DAP FERTILISER AND POULTRY LITTER (PL) BIOCHAR, PASKEVILLE, SA.

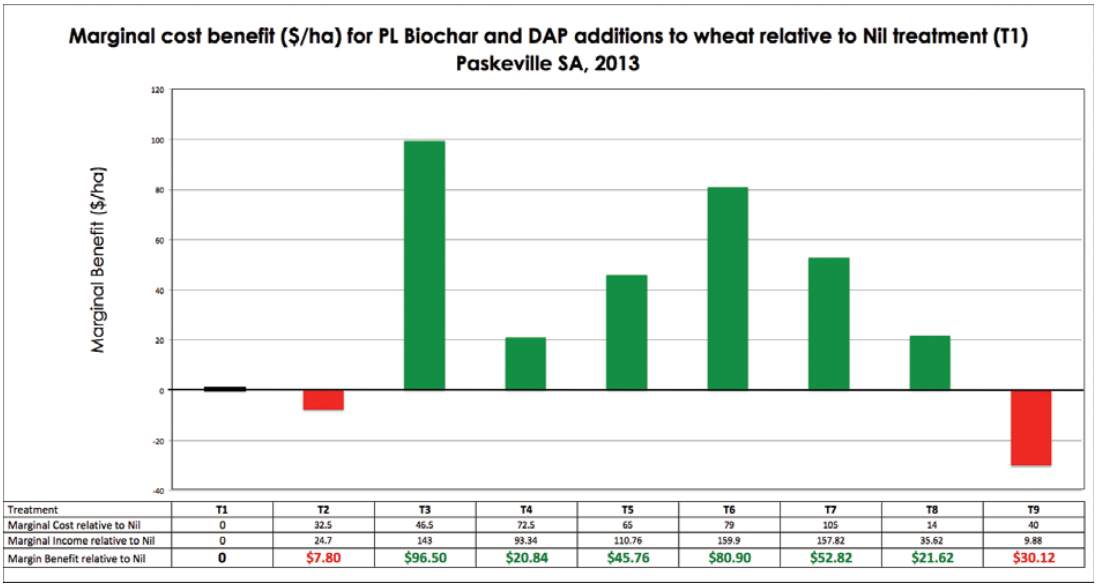
Marginal cost benefit analysis using the nil treatment as a baseline

A Application	B DAP cost [$/ha]	C Biochar cost [$/ha]	D Total cost [$/ha] B + C	E Yield [t/ha]	F Yield over nil [t/ha] F – F nil	G Income over nil [$/ha] F x $260	H Gross Margin over nil [$/ha] G – D
T1 Nil	0	0	0	2.517	–	–	–
T2 50 kg DAP	32.50	0	32.50	2.612	0.095	24.70	**- $7.80**
T3 50 kg DAP 35 kg biochar	32.50	14.00	46.50	2.899	0.382	143.00	**+ $99.32**
T4 50 kg DAP 100 kg biochar	32.50	40.00	72.50	2.876	0.359	93.34	**+ $20.84**
T5 100 kg DAP	65.00	0	65.00	2.943	0.426	110.76	**+ 45.76**
T6 100 kg DAP 35 kg biochar	65.00	14.00	79.00	3.132	0.615	159.90	**+ $80.90**
T7 100 kg DAP 100 kg biochar	65.00	40.00	105.00	3.124	0.607	157.82	**+ $52.82**
T8 35 kg biochar	0	14.00	14.00	2.654	0.137	35.62	**+ $21.62**
T9 100 kg biochar	0	40.00	40.00	2.555	0.038	9.88	**- $30.1**

TABLE 2: THE MARGINAL COST BENEFIT OF EACH TREATMENT RELATIVE TO THE NIL TREATMENT (T1) SHOWED SOUND FINANCIAL OUTCOMES AND REDUCED INPUT COST FOR SEVERAL COMBINATIONS OF DAP AND PL BIOCHAR.
ASSUMPTIONS: 1) DAP AT $650/T, SO 50 KG = $32.50 AND 100 KG = $65.00
2) BIOCHAR @ $400/T, SO 35 KG = $14.00, 100 KG = $40.00
3) GRAIN PRICE @ $260/T

A ONE-YEAR COST ANALYSIS DOES NOT CONSIDER ANY LONG-TERM, IF ANY, EFFECTS ON P AVAILABILITY IN THE SOIL NOR ANY LONG-TERM BENEFITS FROM BIOCHAR SUCH AS INCREASED MICROBIAL NUTRIENT CYCLING OR WATER-HOLDING CAPACITY.

FIGURE 3: A GRAPH SHOWING THE MARGINAL COST BENEFITS OF ALL TREATMENTS RELATIVE TO THE NIL TREATMENT (T1)



statistical analysis did not provide the same conclusive outcomes for the higher rate of DAP coupled with PL biochar (T5, T6 and T7 – the green shaded area on the graph).

Discussion

The marginal cost benefit figures show that PL biochar can provide a healthy production and financial benefit provided the right rate is applied relative to fertiliser application rate.

Adding a low rate of PL biochar provided a better marginal cost benefit across all application rates of DAP (0, 50 and 100 kg/ha) than the equivalent rate of DAP alone.

Importantly, the highest gross margin per hectare (T3) was a relatively low risk proposition due to the modest input cost of the low rate DAP (50kg/ha) and low rate biochar (35kg/ha).

This suggests there is potential to achieve a healthy gross margin by supplementing a reduced DAP fertiliser rate with a modest rate of banded biochar, which would also serve to simultaneously reduce input cost and production risk.

The high rate of DAP (100kg/ha) could be pushed to produce a higher gross margin with the addition of the high rate of biochar (100kg/ha) but this approach increases in-put cost and therefore heightens risk.

Conclusions

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

However, there is still very little commercial supply of biochar.

Several SA poultry producers are considering manufacturing PL biochar from their litter but investment in pyrolysis technology is unlikely to occur until there is greater certainty of demand for 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) currently under consideration by the federal government.

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BUILDING THE BIOCHAR KNOWLEDGE BASE

SANTFA has been working with biochar as a method of reducing fertiliser input cost for some time and the positive results from trials carried out in 2012 have been reinforced by results from further trial work in 2013.

Trial results published in last year's July journal showed that, in 2012 trials at Minlaton, banding a mixture of biochar made from poultry litter at 450oC (PL biochar) plus DAP fertiliser at sowing improved wheat yields.

Based on this positive outcome, a similar trial was sown in 2013 at Paskeville using a no-till knife-point and press-wheel system. As in 2012, the trial was designed with three replications for statistical integrity and harvested by an independent contractor.

Despite the different location and seasonal conditions, the results from the Paskeville trial were very consistent with the 2012 data from Minlaton.

There were nine treatments in the Paskeville trial, derived from combinations of three DAP fertiliser rates (nil, 50kg/ha and 100kg/ha) and three PL biochar rates (nil, 35kg/ha and 100kg/ha).