

Impact of Biochar on Crop Yield and Nitrogen

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Key Messages

- 4 t/ha of biochar applied in 2010 has not altered grain yield this season.
- Crop yield increased with increasing nitrogen.
- Research into biochar will continue until 2015.

Aim

- To determine the impacts of biochar on crop yield.
- To compare the effectiveness of different methods of applying biochar to the soil.

Background

Biochar is a carbon rich product created when organic matter is heated to temperatures greater than 250°C in low oxygen conditions (Antal and Grønli 2003). During the conversion of organic matter to biochar, volatile compounds are released. These compounds can be combusted to produce energy; hence it is can be considered a carbon negative method of producing energy. Biochar is also very stable in soils. It can remain in soils for many hundreds, or thousands of years, providing a method of carbon sequestration (Ascoug et al. 2009).

From an agronomic perspective it is suggested that biochar could improve soil health by improving nutrient retention, particularly in coarsely textured soils (Chan et al. 2008). As most biochar is alkaline, it may also provide a liming effect. From a biological perspective, biochar is also a potential habitat for microbes to avoid predation by nematodes and protozoa. Some biochars can also supply nutrients. The aim of this experiment is to examine the interaction between biochar (made from wheat chaff) and nitrogen. From this we hope to determine whether biochar changes nitrogen fertiliser use efficiency.

The Experiment

If biochar does prove to be a beneficial soil ameliorant, growers will need to consider how to apply the product. In this trial biochar was either banded or applied on the soil surface at a rate of 4 t/ha using the Department of Agriculture and Food's trial seeder. The biochar was applied in April 2010 and therefore this is the fourth cropping year after biochar application to the site. To investigate the claim that biochar increases fertiliser efficiency the trial compares 3 nitrogen rates (0, 20 or 40 units of N) applied as urea at seeding. No further nitrogen was applied.

Trial Details

Property	Long Term Research Site, west Buntine	
Plot size & replication	20m x 2m x 4 replications	
Soil type	Deep yellow sand	
Soil pH (CaCl₂)	0-10cm: 5.5	10-20cm: 4.6
EC (dS/m)	0.04	
Sowing date	15/05/13	
Seeding rate	60 kg/ha Hindmarsh	
Fertiliser	As per treatment (N), 40 kg/ha TSP	
Paddock rotation	2010: wheat, 2011: wheat, 2012: canola	
Herbicides	15/05/13: 2 L/ha SpraySeed, 1.5 L/ha Trifluralin	
Insecticide	15/05/13: 100 mL/ha Dominex, 200 mL/ha Talstar	
Growing Season Rainfall	208mm	

Results

The application of 4 t/ha of Biochar had no consistent impact on barley yield or grain protein in 2013. Increasing nitrogen rates increased grain yield from a base of 2.8 t/ha when no nitrogen was applied to 3.1

t/ha when 40 kg N/ha was applied. However, there was no interaction between application of biochar, nitrogen and yield.

Table 1: Barley yields and protein in response to different nitrogen rates at seeding on yellow sand at Buntine 2013.

Nitrogen units (kg N/ha)	Yield	Protein
0	2.8 ^a	9.1 ^a
20	2.9 ^b	9.8 ^b
40	3.1 ^c	10.4 ^c
LSD	0.1	0.3

Table 2: Average crop yield and grain protein after 4 t/ha of biochar was applied on surface or deep banded with three rates of nitrogen fertiliser (0, 20, 40 units of N) at Buntine in 2013.

Nitrogen kg N/ha	Biochar treatment	Yield t/ha	Protein %
40	Nil	3.1 ^d	10.5 ^d
40	Banded	3.1 ^d	10.5 ^{cd}
40	Spread	3.1 ^d	10.3 ^{cd}
20	Nil	2.8 ^{abc}	9.5 ^{ab}
20	Banded	3.0 ^d	9.9 ^{bc}
20	Spread	2.8 ^{bc}	9.9 ^{bc}
0	Nil	2.7 ^a	9.0 ^a
0	Banded	2.7 ^{ab}	9.3 ^a
0	Spread	2.9 ^c	9.1 ^a
LSD		0.15	0.63

Yields and proteins followed by the same letter do not significantly differ (P=0.05)

Comments

This year, barley yields were unaffected by biochar application with 40 kg N/ha. Spread biochar application increased barley yield without N applied and banded biochar application increased barley yield when N was applied at 20 kg/ha. The biochar has been in the soil for four years and trial results collected for three years (2010, 2011 and 2013) in each of these years biochar has no major impacts on grain yield. Biochar is considered a long term soil ameliorant and largely untested in broadacre agriculture, therefore the trial continues to be monitored into the future.

References

- Antal MJ, Grønli M (2003) The art, science and technology of charcoal production. *Ind Eng Chem Res* 42: 1619-1640
- Ascough PL, Bird MI, Brock F, Higham TFG, Meredith W, Snape CE, Vane CH (2009) Hydropyrolysis as a new tool for radiocarbon pre-treatment and the quantification of black carbon. *Quaternary Geochronol* 4: 140-147
- Chan KY, Van Zwieten L, Meszaros I, Downie A, Joseph S (2008) Using poultry litter biochars as soil amendments. *Aust J Soil Res* 46: 437-444

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