

Cost still an issue, but interest in biochar for soil health grows



The January issue of *Australian Farm Journal* reviewed the research into biochar being undertaken by CSIRO. This month Matthew da Silva talks with three Australian biochar suppliers, focusing especially on their target markets and the marketing strategies they employ.

Barry Batchelor of Australian biochar manufacturer and supplier Black Earth Products is aware of the results current Australian research into biochar is delivering.

"Not all biochars are going to work in all soil types," Batchelor says. "The direct application of a high-carbon wood-based biochar onto some soils will have a negative effect."

The company operates a continuous-flow pyrolysis plant at Bendigo, Victoria, using poultry litter – a mixture of manure and bedding material – as a feedstock, where it is pyrolysed at about 550°C, which is a very passive way of making biochar, says Batchelor.

"What that means is it retains a lot of the minerals and the nutrients from the manures and there's a very, very low ash yield. You can handle the biochar and you won't get sooty, black hands. It's quite a stable product. It has a good moisture content. It doesn't have any dust problems as such."

"We're trying to convert the product to a recalcitrant carbon – that's a fixed carbon – so that it resists rotting and breakdown. Depending on the bedding material, the carbon can last between 100 and 1000 years."

While there is potential for particular biochars to make a difference to soil health and plant productivity, especially on sandy soils, the reality is they are too expensive to use in anything but blends with composts and fertilisers.

The poultry litter is manure and bedding floor material taken from broiler chicken farms, which can vary from hardwood or softwood shavings to rice hulls. Biochars made from hardwoods have been reported to have the longest lifespan, says Batchelor, and rice hulls and softwoods may vary from decades to centuries. Batchelor's biochar is 61.2% recalcitrant carbon.

The company's system produces 100 kilograms of product an hour. Batchelor has been operating with business partner Michael Cowie for about 18 months and calls biochar a "boutique industry".

"The home garden market has been one of our starting points, and we've started to get more and more interest in broadacre, or in vineyards or high-value horticultural (and) agricultural enterprises."

Cost a factor

The reason for focusing on these markets is the cost of biochar. Batchelor charges \$1500 a tonne excluding GST, plus shipping and handling, and says the price scales down with larger orders. The continuous-flow pyrolysis system which produces Black Earth Products biochar is a lower-volume commercial prototype, he says, and a larger and more efficient system is in development which will produce higher volumes of biochar that will reduce the price per tonne.

Currently, though, cost is still a major factor deterring farmers from using biochar on their paddocks. If a farmer applies Batchelor's biochar at 1t/ha, he or she is in effect applying about 612kg carbon/ha or 2.2t

CO₂e/ha. (Carbon is converted to CO₂e by multiplying by 3.66.) Therefore, each tonne of CO₂e applied costs \$682. The Carbon Farming Initiative (CFI) price per tonne of CO₂e is \$23 as of July 1 this year so in CFI program terms the return for applying 2.2t CO₂e/ha is \$41.40 (\$23/t x 2.2t).

There are benefits to soil health of applying manure-based biochar and these will affect productivity, but the role of biochar on the positive list under CFI is nonexistent at this price.

"The CSIRO (and NSW Department of Primary Industries) are looking at about 5t/ha in the way of application," says Batchelor. "My thinking with that is not to apply it in a single, one-off hit (because) you have that high cost; you blend the product with fertilisers or minerals or composts."

"(Adding biochar to) compost is my preference. And you add it over a number of years, or a number of seasons; that way you spread the cost. But you also get the minerals you're applying the biochar with locked up with the biochar so then they exchange to plants a lot more efficiently. That's how I envisage going into the broadacre. We're developing the business to be able to do that at the moment."

Batchelor says his company is also developing an agricultural product that uses 20% biochar blended with a series of high-quality poultry, pig and wood-shaving composts.

"The blend we are developing will give an up-front fertiliser kick with medium- and long-term soil conditioning properties. The labile carbon offers a short- to medium-term improvement and biochar's recalcitrant carbon will offer longer-term improvements."

"Blending biochar is sometimes known as charging. By charging with composts, fertiliser or positive micro-organisms, you help fill the complex micro-fine porous structures in biochar, which creates a better overall product."

Blending biochar with mycorrhizae fungi has been undertaken in West Australian wheat trials and has produced some encouraging results (*Australian Farm Journal* September 2011).

China bamboo biochar

Ray O'Grady of O'Grady Rural at Lismore, NSW, is taking a similar route in biochar marketing. One element of his business is Moso BioChar, manufactured from bamboo pyrolysed at about 450°C. He sourced the product through the China National Bamboo Research Center in Hangzhou, the capital of Zhejiang province in eastern China.

Moso BioChar has 71.5% carbon, 2.2% silica, 4.1% ash (calcium, magnesium, phos-

phorus and potassium plus other trace elements) 0.24% nitrogen, 8.7% oxygen and 1.8% hydrogen.

O'Grady says the beneficial effects of Moso BioChar on soil fertility derive from that fact it helps hold nitrogen in the root zone by reducing leaching.

The abundance of micro-pores in the biochar provides a food store and protection for humus-building beneficial soil microbes.

"The carbon in biochar is very resistant to chemical and microbial breakdown," says O'Grady. "In the *terra preta* soils, for example, the char is more than 500 years old and some has been carbon-dated to 1500 years."

"(My) farming (business for biochar) is fairly restricted (due to) the cost structure of the product by the time we land it here and then, also (and) more importantly, the distribution costs within Australia," he says.

"We have applied it in agricultural situations but more as a banded, low-volume application in direct contact with the seed. We use it there as a carrier for microbes and to retain nutrients close to the seed as it's germinating. It is particularly useful in the case of leguminous crops that depend on rhizobium – nodulation. And also, when you have rhizobium and also mycorrhizae in association with the (biochar), the yield benefits of the leguminous crops are repeated over and over."

O'Grady says there are no biochars available under \$US250-\$US300/t anywhere in the world.

"Therefore, by the time you transport it to the farm and then apply it at the rates that research has been using at – a lot of the research has been broadcast application, and there've applied 5t/ha and 10t/ha – (that) just (puts) it right out of scope for general farmers."

"So you have to develop techniques of finding out ways to apply it much more efficiently, such as banding or, in the case of vegetables, in seed-raising mixtures. It's an excellent thing for seedling growth to put, say, 20% biochar into the potting mix so that when the seedling goes out it can be

inoculated and also nutrients retained by the char around the seedling."

O'Grady charges \$31 for a 14kg box or \$1315 for a 670kg pallet-load (\$1960/t) of biochar. Each tonne contains 710kg of carbon or 2.6t of CO₂e so the price per tonne of CO₂e is \$753. It's why his marketing currently focuses on urban horticulture, golf courses and tree restoration.

Like Batchelor, he recommends mixing biochar with compost to improve soil performance on farms.

"They've used 4-10% biochar in (pig manure compost mixes) and they've reduced the nitrogen losses by (up to) 74% compared with pig manure compost surface-applied, Table 1."

Batchelor says farmers should be trialling biochar in a compost mix on a part of their acreage to see how it performs.

"That comes down to research and also people trying the product and putting it on an acre or a couple of hectares in the corner of their property to see if they're actually going to get the benefits from it," he says. "It may take a few years to really see the long-term benefit of that."

O'Grady says it is desirable to see a response within the first 12 months and an ongoing response after that.

"There are many farmer observations where stumps have been burned out in cultivation paddocks that still show the benefits



Barry Batchelor is developing an agricultural product that contains 20% poultry manure biochar blended with poultry, pig and wood-shaving composts.

Table 1: Adding biochar to pig manure compost reduces nitrogen losses

Treatment	% reduction in nitrogen losses during composting
Control	0%
3% Moso biochar	28%
3% Moso biochar + 0.4% bamboo vinegar (PandA)	74%
6% Moso biochar	61%
9% Moso biochar	65%