Noraini grew up in Malaysia, where she completed a Bachelor of Science in Bio Industry at the University Putra Malaysia in 2001, followed by a Masters degree, specialising in soil microbiology and biofertilizers. Currently, she is sponsored by the Malaysian Government for her PhD studies at UWA. Her research aims to increase knowledge about the role of biochar in influencing soil microorganisms, especially arbuscular mycorrhizal fungi, as this role is not well understood.
Biochar use in agriculture, with an emphasis on soil biology

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Soil Biology Group UWA

WANTFA

GRDC biochar research group
Biochar – what is it?
Biochar – pyrolyzed biomass

- Terra Preta – ancient soils of the Amazon
- Pyrolyzed organic matter (today’s soil amendment)

Chicken manure + wood chip biochar

Wheat chaff biochar
Claimed benefits

Soil chemical and physical properties

- Increased stable carbon in soil
- Increased soil pH
- Improved retention of nutrients – reduced leaching
- Improved soil aggregation
- Improved plant growth
Claimed benefits

Soil biological properties

- Improved soil conditions for soil microbes
- Habitable spaces for soil microbes
- Survival and reproduction rate of soil microbes
- Nutrient supply
- Microbial biomass and mycorrhiza fungi (AMF)
Experimental Approaches

- Characterising biochars
- Soil amendment with biochars – soil biology
- Interactions between biochar and microbes

To determine the role of biochar as a habitat in soil and its effect on soil microorganisms, including mycorrhizal fungi
Hypotheses

Surface and pore structure of biochar will differ according to pyrolyzed carbon source

- surface structure
- pore size and connectivity

Soil amendment will increase microbial biomass and colonisation of roots by mycorrhizal fungi

- biochar type, particle size and rate of application
  - P fertiliser
  - organic matter
Pore structure of 3 biochars

Distribution of pores in biochars

Biochar A from Eucalyptus wood

Biochar B from Acacia saligna

Biochar C from Eucalyptus wood

Biochar A and B had almost similar distribution of finer pores (10 µm - 100 µm)
Biochar B had uniform and highest porosity
Biochar C has higher proportion of bigger pores (>100 µm)
Soil amendment with biochar

Soil treatments

- biochar type
- biochar particle size
- rate of application
- fertiliser (P)
- organic matter

4 experiments
Soil amendment with biochar

Microbial biomass C and P
% root length colonized by mycorrhizal fungi

AMF fungal Colonization in root
## Summary of experiments

<table>
<thead>
<tr>
<th>Soil treatments</th>
<th>Microbial Biomass</th>
<th>Mycorrhizal Fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>biochar type</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>biochar particle size</td>
<td>(+)</td>
<td>not determined</td>
</tr>
<tr>
<td>rate of application</td>
<td>+</td>
<td>++</td>
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</tbody>
</table>

Relatively minor effects of biochar
Mycorrhizal colonization in roots

AMF colonization (%)

without P fertiliser

with P fertiliser

Wheat chaff biochar

0  2.5  5  7.5 t/ha

0  2.5  5  7.5 t/ha
Biochar microbe interactions

Fungal hyphal network covering biochar surface
Biochars varied in surface and pore structures

- within source and among sources
- unknown: effects of clogging of pores
  habitable space within biochar
  pore connectivity

Biochar amendment to soil had little effect

- microbial biomass
- mycorrhizal fungi root colonization
- some transient effects were observed