

Scientific knowledge on the effects of biochar in perennial horticulture systems is limited. As part of the PIPS (Productivity, Irrigation, Pests & Soils) national apple program, we are investigating the effects of soil amendment with biochar over a 4-year period on *tree growth, water and nutrient relations* and *fruit yield and quality* of young 'Fuji' apple trees. To date, some positive results have been observed, particularly when biochar was combined with compost. An important observation is that there have been no negative effects following the application of biochar.

BIOCHAR TEAM

TIA: Sally Bound, Marcus Hardie, Alieta Eyles, Dugald Close, Steve Paterson, Garth Oliver, Justin Direen

PFR, NZ: Brent Clothier, Steve Green, Marcus Deurer, Roberta Gentile

Orchardists: Adrian & Scott Stevenson



Biochar produced from *Acacia* green waste (sourced from Pacific Pyrolysis, NSW)



Sally Bound preparing soil with biochar treatment (5 kg/tree) in Nov 2009 at an orchard site located in Mountain River



Installing flux meters in 2009 (from L to R): Adrian Stevenson, Scott Stevenson, Justin Direen, Markus Deurer and Marcus Hardie

Questions	Outputs	Effect
Fruit yield and quality: What are the effects of biochar on fruit yield and quality?	<ul style="list-style-type: none"> ➤ Crop load ➤ Fruit weight & size (year 1) ➤ Fruit firmness ➤ Total soluble solids ➤ Yield efficiency 	nil increased nil nil nil
Soil properties: How does biochar affect soil properties that influence water retention and leaching?	<ul style="list-style-type: none"> ➤ Leachate (NO₃, dissolved P, K) ➤ Hydraulic conductivity ➤ Soil water content ➤ Total soil porosity ➤ Aggregate stability ➤ Soil density 	nil increased increased increased nil reduced
Plant physiology: What are the physiological mechanisms underpinning the observed crop gains? Does biochar affect whole-plant water use and carbon uptake?	<ul style="list-style-type: none"> ➤ Tree growth (trunk girth) ➤ Total leaf area ➤ Photosynthetic rate ➤ Stomatal conductance ➤ Sap flow rate ➤ Leaf water potential 	increased nil nil nil nil nil

Key Messages

- The positive effect of biochar was greater when combined with compost
- Biochar can significantly improve fruit size and tree growth, even in a high input orchard
- Biochar reduced soil density, this helps in reducing soil compaction
- Biochar can increase total soil porosity and soil water content
- Results observed were in a high-input orchard. Positive effects are likely to be greater in orchards with lower soil fertility and in regions with limited water availability

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Garth Oliver measuring leaf water potential with a pressure chamber



Steve Paterson collecting leachate from flux meters buried in the soil