

Does biochar improve tree growth in a newly established apple orchard?



Farmer-Researchers

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Project Timeline:
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In A Nutshell

Val and Brent were curious to know if biochar will help regenerate soil in their young apple orchard and “*help to set in motion biological activity and nutrient retention*”.

Researchers have documented benefits from biochar in arid and tropical soils, which vary by soil fertility status and biochar quality. Much less is known about biochar’s effect in temperate regions, but there is anecdotal support for biochar use from some farmers in Ontario.

Key Findings

- In the first year of application, Val and Brent detected no effect of the biochar amendment on soil microbial activity, as a proxy for soil health.
- They also detected no changes in tree health in the first year of application.
- Val and Brent will continue to monitor soil and tree health in future years.

METHODS

Design

The study site included 5 rows, each with ~30 newly planted cider apple trees. Within each row, Val and Brent alternated two semi-dwarf root stocks, Geneva 202 and Geneva 935. They grafted different scion varieties to each row according to quantity available (**Figure 1**). In this way, the design is a paired design with 5 replicates.

After planting, Val and Brent randomly assigned either

- **Nutrient amendment + biochar (treatment)** or
- **Nutrient amendment only (control)**

Nutrient amendent: Evergreen Liquid Plant Food 5-20-5 + boron, manganese, zinc, copper, and magnesium, based on soil tests.

Biochar: from Whole Village in Alton; charged, or inoculated, with urine and/or cow manure.

Figure 1. Val’s experimental design for biochar application in her orchard. Each row has around 30 trees each.

| Row | Section | Treatment | Scion variety |
|-----|---------|-----------|---------------|
| 1 | West | Control | Goldrush |
| 1 | East | Biochar | Jonagold |
| 2 | West | Biochar | Jonagold |
| 2 | East | Control | Jonagold |
| 3 | West | Control | No graft* |
| 3 | East | Biochar | No graft* |
| 4 | West | Biochar | No graft* |
| 4 | East | Control | No graft* |
| 5 | West | Control | Cortland |
| 5 | East | Biochar | Cortland |

*Graft didn’t take. Unfortunately, Val’s grafting success was relatively low compared to other years, which is likely because she tried a new method for grafting.

Root feeding

Val and Brent tested the rate and method of amendment - root feeding - offered by Owen Goltz of Riverdale Farm and Forest. Owen is a farmer-friend who has experience and success with biochar amendments.

- All trees in the orchard were root-fed at 8-10 inches below surface level.
- They root-fed control trees at 0.17 L/sec and treatment trees at 0.24 L/sec, for an overall rate of 25 lb/acre.

Tree health

Val used a tree assessment tool developed by Lorne Jamieson. This tool assesses the following 3 factors:

Relative Vitality: 0-4 for trees with a graft that didn’t take; 5-9 for trees with a successful graft.

Relative Insect Pressure: A for no pressure; B some pressure; and C for a lot

Leaf Colour: G for green; Y for yellow

Soil health

Previous research on field crops suggests that biochar may increase soil health as a result of changes to the microbial community (Reference 1).

To measure changes in microbial community activity, Val used the Solvita® Field CO2 Test, which estimates microbial respiration from soil.

For each row, she found trees in the treatment and control sections with similar size, leaf colour and root stock. She sampled approximately 90 grams of soil from 6” depth, incubated with a CO2 gel probe in airtight jars at room temperature for 24 hours, and read the probe using the Solvita® handheld field meter.

RESULTS

Soil respiration

- CO2 flux was relatively high in all samples.
- There was no difference in CO2 flux between soil amended with and without biochar (P=0.28).

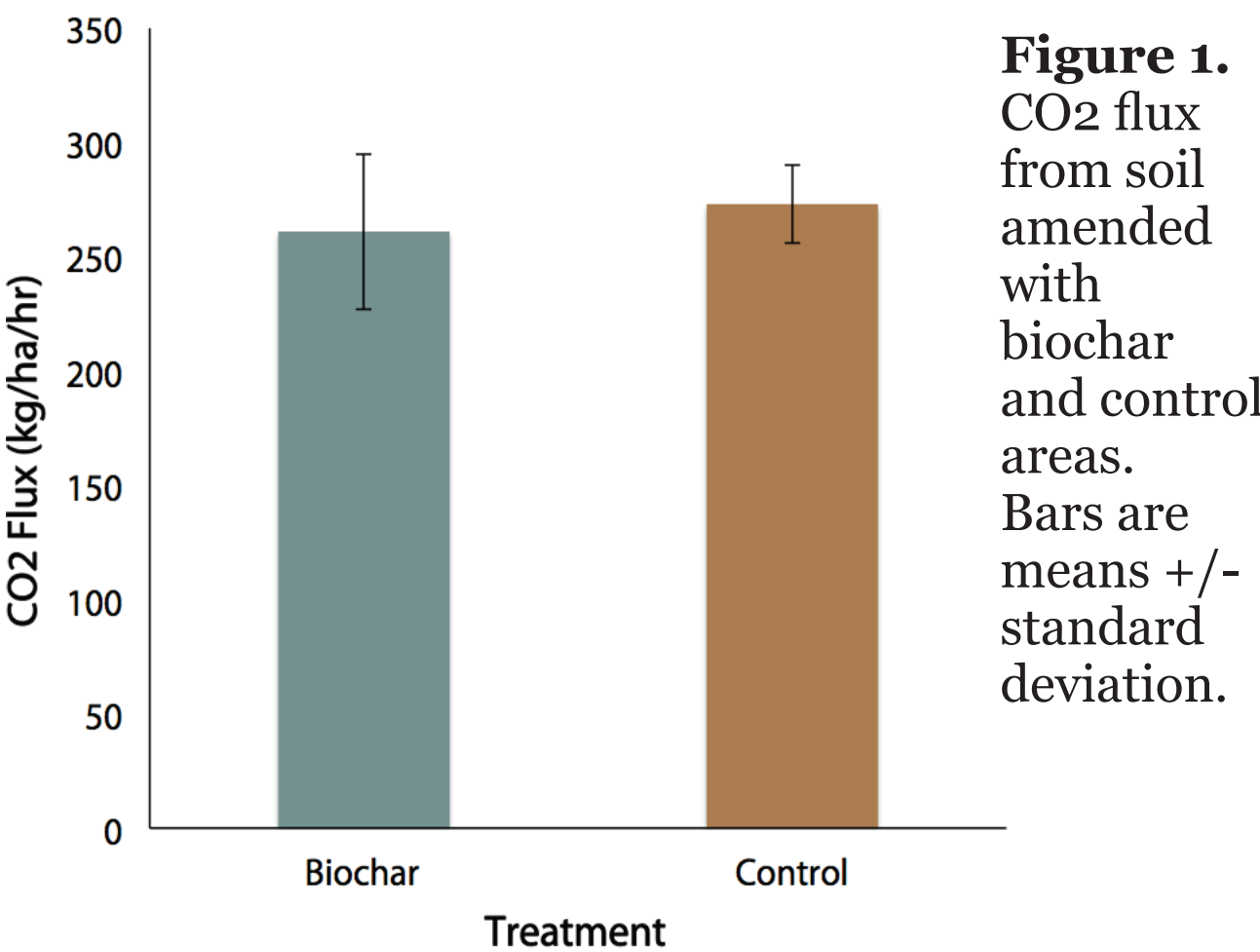


Figure 1. CO2 flux from soil amended with biochar and control areas. Bars are means +/- standard deviation.

Tree health

Val analyzed tree health, by ignoring graft success, as a cumulative score of all three assessment factors:

0-4 for vitality (weighted to a scale of 4 for grafted trees) + (A=6, B=3, C=0) + (G=6, Y=0)

Using this calculation, there was **no difference in tree health this year** (P=0.22).



Left: Root feeding cider apple trees.

Right: Solvita® jars with soil for soil respiration

TAKE HOME MESSAGE

Val did not detect differences in soil respiration or tree health as a result of the biochar application.

Val will continue to track any effects of biochar with tree health and soil health measurements. Depending on how effectively the biochar was inoculated before application, positive effects from biochar may take time. Conversely, it might be difficult to detect effects of biochar if they spread belowground from treatment to control areas.

Farmer-led research provided Val with multiple layers of learning, from the structure and accountability for collecting data, to a platform for her to collaborate and foster relationships with other farmers.

Thank you to **Lorne Jamieson** for his engagement, including developing nutrient amendment recommendations and the assessment tool and for his involvement in root feeding and data collection.

Thank you to **Owen Goltz** of Riverdale Farm and Forest for sharing his expertise on biochar and for loaning the root feeding equipment.

Thank you to the **Trillium Mutual Roots Community Fund** for the Solvita® Field Kit.

Reference 1: Nielsen, S. et al. (2014). Comparative analysis of the microbial communities in agricultural soil amended with enhanced biochars or traditional fertilisers. Ag., Eco. & Env.