

EFAO 2021: Research Protocol

Biochar for rooftop substrate

Farmer-researcher(s): Ines Lacarne, Ryerson Urban Farm - Central

Project type: Research trial

Research priorities: Soil health

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Objective

The Ryerson Urban Farm team would like to know if biochar added to the green roof soil blend supplied to their new rooftop farm plots will ameliorate the soil so that they can successfully grow spray-free vegetables at similar yields to their older plots.

Background

In 2020, Ryerson Urban Farm installed a new rooftop farm plot on the existing farm, as well as a new rooftop farm, with a green roof soil blend (ZinCo Blend-F) that appears to be higher in aggregate (with lots of crushed brick and large particle sizes) and lower in organic matter than the growing media on the rest of the farm. Green roof soil blends are not designed to support food production, and are typically engineered to meet a German green roof standard ("FLL") for longevity, drainage, flammability, structural load, etc.

The reason Ryerson's older green roof soil blend is good is because it was installed before Toronto's green roof bylaw, and so didn't have to adhere to FLL standards, plus it has 17 years of organic matter accumulation and biological life. The team at Ryerson Urban Farm are hoping to come up with a strategy to amend the soil and hopefully meet the high quality standards set by their original soil, while maintaining the structural engineering requirements for loading (2.5 kPa).

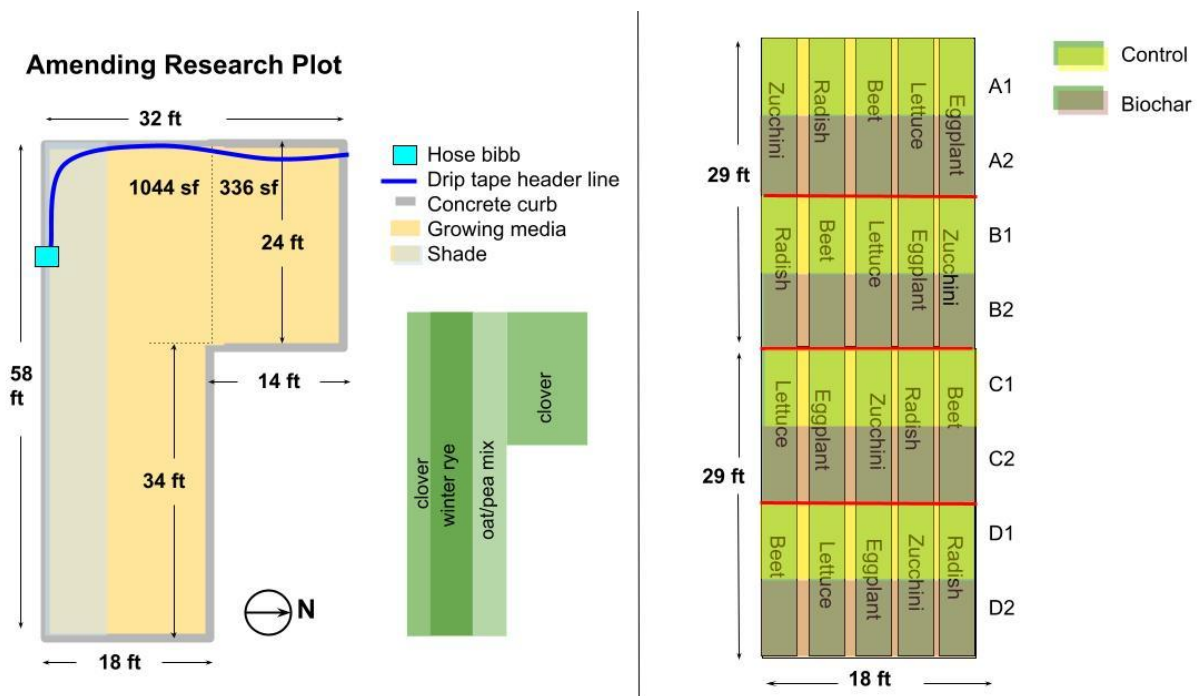
In an attempt to prepare the soil for growing the following season, they planted cover crops in fall 2020 (winter rye, oat/pea mix and crimson clover). Unfortunately they had issues with germination and where the cover crops grew they appeared deficient and stunted. Soil tests performed in fall 2020 confirmed the team's suspicions and revealed that organic matter and other soil health markers were low and that the pH was significantly higher in these two plots (pH 8.0 and 8.3) than in older plots on the farm (ranging from pH 7.6-7.8).

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Experimental Design

To amend all plots, the farm team has applied elemental sulfur (to lower pH) and 2 applications of NurtureGrowth, an amendment recommended by ZinCo (green roof growing media supplier).

They will set-up 5 beds in the new plot from and establish 4 replicate pairs of growing media (control) and growing media + biochar (treatment) with 5 crops randomly assigned to each experimental section as shown below. Measurements will be taken on zucchini, radish, beets, lettuce and eggplant.



Statistical Model

For each crop, a one-way ANOVA with four replicates, and with bed and previous cover crop as random effects (*note that cover crop residue was minimal in all plots*). Note that paired t-test could be used if the random effects were not a consideration.

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Measurements

Marketable weight - Quantitative

For each harvest, they will track the marketable weight from each replicate plot for a total of 8 measurements per crop per harvest. Marketable weight refers to weight from produce they can sell/distribute.

Crate strategy:

- Will use crates that are all the same weight (hopefully reserve the crates for the trial)
- And subtract crate weight from vegetable weight

Crop	Harvest window	Harvest Duration	Harvest frequency
Radish	Spring	~2 weeks	3x week
Lettuce	Spring	~ 3 weeks (cut and come again)	TBD
Beet	Late spring/early summer	~ 2 weeks	TBD
Zucchini	Late spring/early summer	~ 12 weeks	3x week
Eggplant	Summer	~ 8 weeks	TBD

Back-up plan: Use marketable units (e.g. bunches)

Crop quality and appearance - Qualitative

The team will take notes and photos on overall crop quality and appearance throughout the season.

Soil health indicators

Fall 2020 analysis - A&L Laboratories

Rooftop substrate analysis

Vitallus

Bio Soil Health

Fall 2021 analysis

Depends on results that the team sees over the season

Maybe a single consolidated sample for more expensive soil tests

pH meter

Photos

The team will take photos throughout the season.

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Research Plan

Time	Task	Methods & Measurements or Action Item
March 31st	Elemental Sulfur application	Apply elemental sulfur to the whole plot as per supplier recommendation, rake in cover crop residue
April 9th	Nurture Growth application (1 of 2)	Apply liquid biofertilizer to whole plot as per supplier recommendation
April 23rd	Nurture Growth application (2 of 2)	As above
Week of May 10th	Biochar charging	"Charge" biochar by mixing with compost 50:50, leave for 2 weeks (or more if possible)
Week of May 10/17 *TBD	Stale seedbed	Lay down silage tarp for 2 weeks before planting
Week of May 17th	Bed prep	-Add compost to whole plot + incorporate into top inch of soil -Dig paths (~18") and shape beds (~30" wide) -Divide plot into 4 sections, approx 14.5 x 18 ft each, then divided into treatment and control (see diagram)
Week of May 24th	Biochar application	Apply biochar to treatment subplots (A2, B2, C2, D2)
Week of May 31st	Install irrigation	Run drip lines down length of plot along beds
Week of May 31st/June 7th	Plant	-Direct seed radishes and beets -Transplant summer squash, eggplant and lettuce -Label subplots
June - August	Harvest/ Record	Harvest schedule: M/W/F Plant health observations: Wednesdays - Harvest record (+plant health observations) - Observations log : record qualitative observations throughout season, with as much detail as possible (insects, weed pressure, etc) - Activity record : record all actions including planting, irrigation, weeding, etc - Photo folder
September/October	Soil testing	

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*Please note that if data is submitted after the submission deadline, EFAO staff cannot guarantee that your data will be analyzed and written up before the Research Symposium and/or the next growing season.

Staff check-ins

Monthly

Materials

Please list all materials, supplies and equipment that will be reimbursed for this project. If possible, please also indicate a short-list of any in-kind materials, supplies and equipment that you will use.

Material	Unit	Quantity Required	Total Cost*	Note
All material is in-kind				
Total			In-kind	

Acknowledgements

Farmer-fee

In-kind

Memorandum of Understanding

You agree to keep an active membership with EFAO throughout the duration of your trial.

<https://form.jotform.com/210625202854246>

To check the status of your membership, log in here:

<https://efao.z2systems.com/np/clients/efao/login.jsp> or contact Martina, martina@efao.ca.