

Mashhad (Iran)



EXPERIMENT GOALS

- Evaluation of biochar effects on macro- and micro-nutrients availability for crop plants (wheat and lentil crops) over the growing seasons,
- fast and slow pyrolysis biochar
- growth crops comparison under conventional standard practices.

4-year experiment

SITE DESCRIPTION

A field experiment was carried out at the agricultural research center of Technical and Vocational Trading Organization (TVTO) in northeast of Iran. The research area (59° 36' E, 36° 16' N) was 985 m above the sea level with annual precipitation and temperature range of 281–320 mm and – 2.9 to 42.1 °C, respectively. The soil was clay loam with 16.8, 43.7, and 39.5% of sand, silt, and clay, respectively.

Two major crops planted in consecutive growing seasons from 2013 to 2017 were winter wheat (*Triticum aestivum* L) and lentil (*Lens culinaris* Medik).

BIOCHAR AND ITS APPLICATION IN THE FIELD

Two kind of biochar produced from walnut shell (treated by slow and fast pyrolysis processes) provided by a local research start up incubator (Tehran, Iran). First biochar (**B1**) was obtained through slow pyrolysis process (4 h, 450 °C) while the second biochar (**B2**) was produced at 800 °C for 30 min (fast pyrolysis). The experiment was laid out in a complete randomized block design (**control**, **B1**, and **B2**) with three replicates. Moisture rich biochars (200%) were manually applied once on 3rd of September 2013 (before starting the first year experiment) at 5 t ha⁻¹ into the plots and were incorporated to a depth of 20 cm by moldboard plow.

Measured parameters

Soil analysis at T0

pH, Carbon content, Nitrogen, Potassium and Phosphorus content, Calcium, Bulk density, SSA, Ash content, Total pore volume, Micro pore volume

Soil – Biochar interactions

periodic soil analysis, pH, TOC, CEC, TN, WHC (water holding capacity), bulk density, AK (available potassium), AP (available phosphorus)

Key findings

- Biochars improved soil properties by 10–23% during the first and second years while positive effects of biochars on weed growth were drastically higher (60–78% higher weed density) during the 4 year-experiment
- Increased bioavailability of nutrient ions like K^+ and Ca^{+2}
- Improved soil chemical properties like higher CEC which did not persist after the second year

Production data

plant height, underground biomass, grain number in spike (wheat), pod number per plant (lentil), and 1000-seed weight were measured randomly with 5 plants taken from each plot. N and P contents of the plants and seeds. Mid-day leaf water potential, Weed density inside each treatment and Total weed biomass.

PRESENTATION OF THE WORKING GROUP

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Bibliography and publications of the experiment, online information material, websites

Safaei Khorram, Mahdi, Gan Zhang, Akram Fatemi, Rudolf Kiefer, Adeel Mahmood, Sasan Jafarnia, Mohammad Pauzi Zakaria, and Gang Li. 2020. 'Effect of Walnut Shell Biochars on Soil Quality, Crop Yields, and Weed Dynamics in a 4-Year Field Experiment'. *Environmental Science and Pollution Research* 27 (15): 18510–20. <https://doi.org/10.1007/s11356-020-08335-w>.

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