



## Organic Biochar Based Fertilization

Hans-Peter Schmidt (1), Bishnu Hari Pandit (2), Gerard Cornelissen (3), and Claudia Kammann (4)

(1) Ithaka Institute for Carbon Strategies, Ancienne Eglise 9, Arbaz 1974, Switzerland, (2) Ithaka Institute for Climate Farming (IICF), Ratanpur, 33900 Tanahu, Nepal, (3) Institute for Environmental Sciences (IMV), University of Life Sciences (NMBU), As, Akershus 1432, Norway, (4) WG Climate Change Research for Special Crops, Department of Soil Science and Plant Nutrition, Hochschule Geisenheim University, Von-Lade-Str. 1, Geisenheim D-65366, Germany

Biochar produced in cost-efficient flame curtain kilns (Kon-Tiki) was nutrient enriched either with cow urine or with dissolved mineral (NPK) fertilizer to produce biochar-based fertilizers containing between 60-100 kg N, 5-60 kg P<sub>2</sub>O<sub>5</sub> and 60-100 kg K<sub>2</sub>O, respectively, per ton of biochar. In 21 field trials nutrient-enriched biochars were applied at rates of 0.5 to 2 t ha<sup>-1</sup> into the root zone of 13 different annual and perennial crops. Treatments combining biochar, compost and organic or chemical fertilizer were evaluated; control treatments contained the same amounts of nutrients but without biochar. All nutrient-enriched biochar substrates improved yields compared to their respective no-biochar controls. Biochar enriched with dissolved NPK produced on average 20% ± 5.1% (N=4) higher yields than standard NPK fertilization without biochar. Cow urine-enriched biochar blended with compost resulted on average in 123% ± 76.7% (N=13) higher yields compared to the organic farmer practice with cow urine-blended compost and outcompeted NPK-enriched biochar (same nutrient dose) by 103% ± 12.4% (N=4) on average. 21 field trials robustly revealed that low-dosage root zone application of organic biochar-based fertilizers caused substantial yield increases in rather fertile silt loam soils compared to traditional organic fertilization and to mineral NPK- or NPK-biochar fertilization. This can likely be explained by the nutrient carrier effect of biochar causing a slow nutrient release behavior, more balanced nutrient fluxes and reduced nutrient losses especially when liquid organic nutrients are used for the biochar enrichment. The results promise new pathways for optimizing organic farming and improving on-farm nutrient cycling.