Productivity and carbon footprint of perennial grass-forage legume intercropping strategies with high or low nitrogen fertilizer input - DTU Orbit (08/11/2017)

Productivity and carbon footprint of perennial grass-forage legume intercropping strategies with high or low nitrogen fertilizer input

A three-season field experiment was established and repeated twice with spring barley used as cover crop for different perennial grass-legume intercrops followed by a full year pasture cropping and winter wheat after sward incorporation. Two fertilization regimes were applied with plots fertilized with either a high or a low rate of mineral nitrogen (N) fertilizer. Life cycle assessment (LCA) was used to evaluate the carbon footprint (global warming potential) of the grassland management including measured nitrous oxide (N2O) emissions after sward incorporation. Without applying any mineral N fertilizer, the forage legume pure stand, especially red clover, was able to produce about 15 t aboveground dry matter ha− 1 year− 1 saving around 325 kg mineral N fertilizer ha− 1 compared to the cocksfoot and tall fescue grass treatments. The pure stand ryegrass yielded around 3 t DM more than red clover in the high fertilizer treatment. Nitrous oxide emissions were highest in the treatments containing legumes. The LCA showed that the low input N systems had markedly lower carbon footprint values than crops from the high N input system with the pure stand legumes without N fertilization having the lowest carbon footprint. Thus, a reduction in N fertilizer application rates in the low input systems offsets increased N2O emissions after forage legume treatments compared to grass plots due to the N fertilizer production-related emissions. When including the subsequent wheat yield in the total aboveground production across the three-season rotation, the pure stand red clover without N application and pure stand ryegrass treatments with the highest N input equalled. The present study illustrate how leguminous biological nitrogen fixation (BNF) represents an important low impact renewable N source without reducing crop yields and thereby farmers earnings.

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