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Abstract submitted for a scientific poster presentation

Energy crop (*Sida hermaphrodita*) fertilization using digestate and legume intercropping under marginal soil conditions

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The global demand for energy security and mitigation of climate change are the main drivers pushing energy-plant production. However, the cultivation of these plants may cause land use conflicts since agricultural soil is mostly used for crop production for human and animal feed. A sustainable alternative to the conventional cultivation of food-based energy-crops is the cultivation of energy-plants with the ability to grow on marginal lands. To further increase the sustainability of energy-plant cultivation systems the dependency on synthetic fertilizers needs to be reduced via closed nutrient loops in the biomass production cycle.
In the present study we evaluated the ability of the high potential energy-plant *Sida hermaphrodita* (Malvaceae) to grow on a marginal sandy soil. We applied different fertilization treatment using either digestate from biogas production compared with a commercial mineral NPK-fertilizer for a whole growth-period under outdoor conditions with plants growing in large microcosms. To further increase independency from synthetically produced N-fertilizers, the legume plant *Medicago sativa* was intercropped to fix atmospheric N_2 into the cropping system and to produce additional biomass. NPK fertilization created rapid growth in the first months after planting compared to the organic digestate application, but the latter extended the vegetation period of *Sida hermaphrodita* by 20 days. Both fertilization techniques showed a clearly increased biomass production compared with the control plants without any fertilization. Intercropped legume plants fixed additional N into the cropping system and could increase the total biomass production per area, even though they reduced the yield of *Sida*. Highest biomass was observed in the digestate-fertilized variant, intercropped with *Medicago sativa*. Here the legume could increase the total yield by 100% resulting in a biomass dry matter yield equivalent of 2.5t ha^{-1} after the first growing season.
The presented results show the yields of the establishment year. As *Sida hermaphrodita* and *Medicago sativa* are perennial plants and store assimilates in their rhizomes, yields are expected to be considerably higher in the second year after the establishment. We can show that marginal lands with soil characteristics that do not meet the requirements for conventional crops can be used for biomass production by the use of perennial energy-crops like *Sida hermaphrodita* in special adopted production systems.

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