

## **Cover-crops – improvement of soil fertility and provision of biomass**

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Besides climate change, erosion, inadequate crop rotation and intensive tillage may turn arable land into marginal land. On the other hand, reclamation approaches which include arable farming methods may result only in short-term success if they do not consider their effects on humus content and erosion. Additionally, effective reclamation will also have to address the growing need for food production besides biomass provision. Therefore, we investigated if cover or catch crops (CC) may accomplish both goals: Improve soil quality and humus content even if CC-biomass is used for biogas production.

**Humus content and soil fertility:** In comparison to complete fallow in a crop rotation with silage maize and cereals the humus balance can be improved from -50 to +280 kg humus carbon (C) ha<sup>-1</sup> year<sup>-1</sup> through additional CC (4.5 t DM ha<sup>-1</sup>) used for biogas production and an equivalent amount of digestate returned to the field. With a CC-yield of 2.5 t DM ha<sup>-1</sup> the humus balance results in ~ 220 kg C ha<sup>-1</sup> year<sup>-1</sup>. It is still slightly higher if the same CC remains on the field as green manure (170 kg C ha<sup>-1</sup> year<sup>-1</sup>). Additionally it is important to consider that 20 – 50 % of the assimilated carbon can be found in the plant roots and that roots and root exudates as well as CC harvest residues provide fresh organic matter for soil life. Furthermore, biomass production of cover crops was considerably higher, if they were used for biogas production because of earlier cultivation and later harvest than mulching.

**Erosion control:** The risk of erosion can be reduced by approx. 50 % in comparison to complete fallow if CC with 2.5 t DM ha<sup>-1</sup> remain on the field as green manure. A comparable reduction can be achieved, if CC with 4.5 t DM ha<sup>-1</sup> are harvested for biogas production. Because of better weed suppression, tith and soil structure of CC with higher biomass, it is more likely to apply conservation tillage and avoid ploughing. Without ploughing a CC with 4.5 t DM ha<sup>-1</sup> used for biogas the risk of erosion can even be reduced by approx. 75 % in comparison to complete fallow with ploughing.

**Water balance and quality:** On the plots of our field experiments approx. 30 % of the precipitation contributed to groundwater recharge in crop rotations without CC. With 2.5 t CC DM ha<sup>-1</sup> remaining on the field as green manure groundwater recharge was reduced to approx. 27 % whereas 4.5 t DM CC ha<sup>-1</sup> caused a reduction to approx. 25 %. On the long term it can be expected that reduced erosion and increased humus content may improve the water storage capacity of soils and in this way reduce surface runoff and the risk of flooding. Additionally we found that CC remaining as green manure reduced the total nitrate leaching by 6 %. CC used for biogas reduced total leaching in comparison to complete fallow by 26 %.