Biogas digestate: a hotbed of pathogens and microorganism - relevance of plant pathogens surviving anaerobic digestion to agro-ecosystems

Yvonne Schleusner, Martina Bandte, Matthias Plöchl, Monika Heiermann, Carmen Büttner

Digestates are rich on useful components like plant nutrients (Fouda et al., 2014; Jonansen et al., 2013). Thus they are used as organic fertilizer on arable land. Möller and Müller (2012) describe crop residues, wastes derived from food industry, manures, municipal wastes and dedicated energy crops as principle feedstock for anaerobic digestion in biogas plants. The limited availability of organic wastes has increased the codigestion of agricultural crops over the past years (Weiland, 2000). In 2013 energy crops harvested from approximately 1.1 Mio ha were processed in biogas plants in Germany (FNR, 2013). But even good technical and scientific practice in crop production does not prevent the introduction of feedstock infected with plant pathogens. Consequently, it has to be ensured that digestates are sufficiently sanitized prior application as organic fertilizer on arable land.

Thus, we studied the viability of selected plant pathogens during anaerobic digestion under mesophilic conditions of different feedstocks: *Fusarium proliferatum* and *F. verticillioides* as typical pathogens of sorghum (*Sorghum bicolor*), the sclerotia-forming fungi *Sclerotinia sclerotiorum* and *Rhizoctonia solani* for sugar beet (*Beta vulgaris* subsp. *vulgaris* var. *altissima*) respectively potato (*Solanum tuberosum L.*), the ubiquitous fungi *Alternaria alternata* in fresh rye (*Secale cereal*) and wheat grains (*Triticum L.*) and the quarantine pest *Synchytrium endobioticum*, the causal agent of potato wart disease, and Potato virus Y in potato. Only *Synchytrium endobioticum* survived the anaerobic mesophilic digestion in lab-scale reactors. *Sclerotinia sclerotiorum, Rhizoctonia solani, Alternaria alternata* and PVY lost their viability within 6 h. The inactivation of both *Fusarium* ssp. required a maximum incubation time of 138 h. Using of ensiled substrates reduced the time required for secure complete inactivation to 24 hours in case of *F. proliferatum*-infected feedstock, and 6 hours for *F. verticillioides.* The inactivation of *A. alternata* in rye already took place during ensilage. Storage of digestate was shown to shorten the required time for inactivation. Results from lab-scale reactors were confirmed exemplarily for *Sclerotinia sclerotiorum* and *Fusarium* ssp. in full-scale biogas plants.

Secure inactivation of plant pathogens by mesophilic anaerobic digestion in biogas plants depends on crop and pathogen species (Bandte et al., 2013). Most of the investigated pathogens could be inactivated. But an inactivation of pathogens forming persistent resting structures like *Synchytrium endobioticum* cannot presupposed. Basically following measures are suitable to interrupt the infection cycles of pathogens and avoid theirs accumulation in the soil: professional practical experience in cultivation of energy crops, maintenance of required incubation time for a complete inactivation of the pathogens, milling and ensiling of plant raw materials, and storage of digestate for at least 4 weeks.

Refrerences:

Bandte M, Schleusner Y, Heiermann M, Plöchl M, Büttner C, (2013): Viability of plant-pathogenic fungi reduced by anaerobic digestion. BioEnergy Research 6, 966–973.

Fouda S, von Tucher S, Lichti F, Schmidhalter U (2014): Nitrogen availability of various biogas residues applied to ryegrass. Journal of Plant Nutrition and Soil Science. Volume 176. Issue 4. 572–584

FNR (2013): http://mediathek.fnr.de/grafiken/anbauflache-fur-nachwachsende-rohstoffe-2013-grafik.html; Zugriff 25.04.2014

Johansen A, Carter M S, Jensen E S, Hauggard-Nielsen H, Ambus P (2013): Effects of digestate from anaerobically digested cattle slurry and plant materials on soil microbial community and emission of CO_2 and N_2O. Applied Soil Ecology 63 (2013) 36– 44

Möller K, Müller T (2012): Effects of anaerobic digestion on digestate nutrient availability and crop growth: A review. Engineering in Life Sciences. 2012, 12, No. 3, 242–257

Weiland P (2000): Anaerobic waste digestion in Germany–Status and recent developments. Biodegradation 11, 415–421