High quality-grass – Potential for biogas production

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1. INTRODUCTION

Renewable energy production gains an important role in the German agricultural business. With this regard, grassland production is expected to get a major part of providing biomass for the rising demand of biogas plants. Security of biomass supply is another major challenge facing the next decades especially under changing environmental conditions. Grass species like perennial ryegrass are offering sound opportunities for the near future. Tetraploid varieties are associated with high sugar content which leads to a rapid fermentation during ensiling. Substrates and silages with high amounts of water-soluble carbohydrates are favorable to digest in biogas plants.
Field experiments are realized with four different tetraploid medium and late heading perennial ryegrass grass varieties (TWYMAX, DELPHIN, KUBUS, TREND) under the climate conditions of North-Germany. Silage trials with different silage inoculants were performed in order to investigate the ability to optimize the fermentation pattern for an improved biogas production.

2. MATERIALS AND METHODS

The trial site is located on a sandy loam. The swards were established in pure stands in 2008. Sowing rate was 35 kg/ha. Mineral Nitrogen fertilization in the first cut was 120 kg/ha N with usual Phosporus and Potash fertilization.

The harvest materials were ensiled untreated (UT) and treated (T) with a mixture of LAB (L. buchneri-LB, L. plantarum-LP, $2x10^5$ cfu/g; Lactosan Starterkulturen GmbH und Co.KG). Silage trials were performed in lab scale of 5 Liter capacity. Silage losses, chemical composition, aerobic stability according to HONIG (1985) and methane yield were determined after 90 days of ensiling. Dry matter is corrected according to WEISSBACH (2008)
Methane yield was determined in biogas-batch tests according to VDI directive 4630. Due to the comparatively high sample mass of approx. 500 g heterogenous samples, such as silages, can be tested without conditioning. Hence, influences of conditioning (e.g. drying or milling), which can cause losses of volatile substances, are excluded as far as possible.

Table 1: Forage quality parameters of different tetraploid ryegrass varieties

Harvest material	Dry Matter [%]	Ash [% DM]	Sugar [% DM]	Crude protein [% DM]	Crude fiber [% DM]
Twymax	27,1	10,1	24,7	8,3	28,4
Delphin	30,3	9,4	25,1	7,4	30,1
Kubus	22,5	11,2	23,1	8,9	28,5
Trend	25,9	9,4	26,0	9,3	26,9

Table 2: Silage quality parameters of tetraploid perennial ryegrass varieties (Delphin / Trend)

Variety	Delphin		Trend	
Treatment	untreated	L. buchneri treated	untreated	L. buchneri treated
$DM_{corr.}$	28,45	29,16	25,48	25,27
Lactic acid [% DM]	10,2	8,6	17,5	17,4
Acetic acid [% DM]	3,0	5,1	2,9	5,7
1,2-Propandiol [% DM]	0,4	3,9	0,6	5,5
Aerobic Stability [hours]	74	230	147	> 240

3. RESULTS AND DISCUSSION

All analyzed ryegrass varieties exhibited a sugar content between 23 and 26 % DM. Dry matter content varied between 22,5 and 30,3 %.
An average methane yield of 294 ± 8,8 m^3 / t $DM_{corr.}$ was achieved over all varities. Storage under oxygen environment had a significant impact on the methane yield of untreated silages. Due to the low aerobic stability the methane yield of Delphin was lowered by about 4,5 % (282 m^3 / t DM_{corr}) within 4 days of exposure to air. Due to heterolactic fermentation aerobic stability of the treated silage was improved and the energy yield was preserved (311 m^3 / t DM_{corr}). No changes in the methane yield occurred.