COMPARISON OF ESTIMATED BIOGAS YIELD WITH REGRESSION FORMULA AND MEASURED BIOGAS YIELD WITH BATCH TEST OF DIFFERENT GRASS SILAGE

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BACKGROUND & OBJECTIVE

- Political decisions in Western Europe are driving the demand for alternative biogas substrates—grassland is a more cost-effective and environmentally friendly option compared to maize
- However, the biogas yield (BY) and methane Yield (MY) of grass silage varies considerably due to factors such as plant species, degree of maturity and harvest time
- For management purposes, a precise prediction is necessary, thus several formulas have already been developed to link chemical composition with BY/MY

Aim: comparison of the experimentally determined batch test results with the calculated Weissbach formula (2008) for evaluating the BY/MY of grass silage for biogas plants

MATERIAL & METHODS

- The study included 13 different grass silages (1st /2nd cut) originate from UK or Germany
- Forage samples were analyzed for dry matter, crude protein (CP), crude fiber (CF), hemicellulose (HC), sugar, crude fat (CL) and ash, see Table 1
- Experimental batch test according to VDI 4630 were carried out to determine BY_B/MY_B and additionally theoretical BY_W/MY_W by Weissbach formula (2008) were calculated for each silage, see Table 1
- Statistical evaluation: First, the Pearson correlation coefficients between the experimental BY/MY and the parameters of the chemical composition were determined, and then two linear models with the fixed effects CP, CL and CF were calculated to evaluate the influence of the parameters on the BY/MY; the significance level was 5 %

RESULTS

- BY_B and MY_B (NL/kg DM) of all 13 silages was higher with 606.6 (± 38.9) and 348.5 (± 29.4) analyzed with the batch test compared to the theoretical values BY_W and MY_W according to Weissbach (2008) with 555.6 (± 54.6) and 291.7 (± 28.7), see Table 1

Table 1. Overview of the average (standard deviation) chemical composition (% DM) and the experimental (_B) and theoretical (_W) determined biogas and methane yield (BY/MY) in NL/ kg DM of the 13 grass silages included in this study.

	Dry matter	Crude protein	Crude fat	Sugar	Crude fiber	Hemicel-lulose	Ash	ME	BY_B	BY_W	MY_B	MY_W
Average (SD)	28.7 (± 3.6)	14.8 (± 3.2)	3.8 (± 0.4)	7.3 (± 4.7)	24.9 (± 5.7)	21.1 (± 3.6)	8.6 (± 2.0)	10.6 (± 1.0)	607 (± 39)	556 (± 55)	349 (± 30)	292 (± 39)

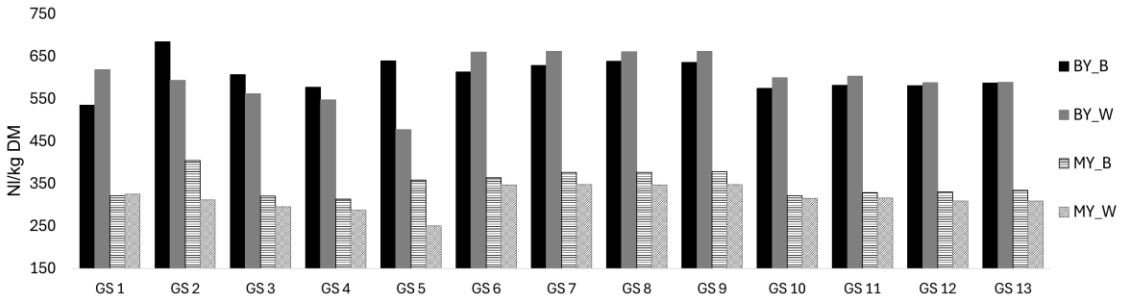

Figure 1. Overview of the experimental measured biogas and methane yield (BY_B; MY_B) and the theoretical values (BY_W; MY_W) according to Weissbach (2008) of each grass silage (GS).

- Significant moderate correlations were found between BY_B/MY_B and chemical components: positive for CL (0.35/0.39), negative for CF (-0.14/-0.38) and HC (-0.23/-0.33)
- The linear models confirmed a significant influence of CP, CF and CL on both BY_B and MY_B ($p < 0.05$), with CP showing the strongest effect on BY_B
- The results of these linear models are in line with other studies, whereas CP, HC and ADL were identified as significant predictors of BY/MY, therefore it is recommended to go beyond a Weender analysis
- The results reflects the need to describe the actual physiological stage of the plant and not only its composition – protein content decreases during plant senescence, while fiber and ADL increases, attributing to lower digestibility and resulting in lower BY/MY

CONCLUSION

Grassland with high protein and low fiber content is a suitable biogas feedstock and a promising alternative to corn. For improved yield prediction, multiple regression models including detailed cell wall parameters are recommended.

References:
Weissbach, F. (2008). Zur Bewertung des Gasbildungspotentials von nachwachsenden Rohstoffen. Landtechnik 6.