Bioresource Technology 127 (2013) 143–150

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Anaerobic methane production from five common grassland species at sequential stages of maturity

Joseph McEniry, Padraig O'Kiely *

Animal & Grassland Research and Innovation Centre (AGRIC), Teagasc, Grange, Dunsany, Co. Meath, Ireland

HIGHLIGHTS

- ▶ CH_4 yield values were positively related to increasing herbage digestibility.
- ▶ Increasing fibre content with advancing harvest date negatively impacts CH_4 yield.
- ▶ Negative impact of advancing harvest date on CH_4 yield was similar for each grass.
- ▶ A similar specific CH_4 yield was observed for grasses at the same growth stage.
- ▶ The cocksfoot variety in this study was least suitable for anaerobic digestion.

ARTICLE INFO

Article history:
Received 12 March 2012
Received in revised form 14 August 2012
Accepted 21 September 2012
Available online 29 September 2012

Keywords:
Anaerobic digestion
Grass species
Plant maturity
Methane yield

ABSTRACT

Since grass will likely be a dominant feedstock for on-farm anaerobic digestion in Northwest Europe, changes in the chemical composition of five common grass species with advancing harvest date in the primary growth were investigated and related to specific CH_4 yields. The increase in fibre components with advancing harvest date had a negative impact on the specific CH_4 yield (253 and 225 Nl CH_4 kg^{-1} VS for 12 May and 7 July harvests, respectively), and this impact was similar across the five grass species. At common growth stages, only small differences in herbage digestibility was observed between the grass species and this was reflected in similar specific CH_4 yields; however, the 26% lower area-specific CH_4 yield of the cocksfoot variety (*Dactylis glomerata* L. var. Pizza) would make it the most expensive of the five grass species to produce and the least suitable for anaerobic digestion.

1. Introduction

Methane-rich biogas can be produced from a wide range of feedstocks (e.g. organic fraction of municipal waste, animal manure and slurry, agricultural crops, etc.) through anaerobic digestion (AD), and can be used as a replacement for fossil fuels in both heat and power generation and as a vehicle fuel (Weiland, 2010). The production of biogas in central Europe is closely linked to the agricultural sector and farm based AD plants are widespread (Murphy et al., 2011). Most plants operate on manure-based substrates, with a range of dedicated energy-rich crops including maize, cereals, sugar beet and grass. In Germany for example, maize silage is the dominant feedstock for on-farm AD (48% of total solids (TS) utilised) followed by whole plant cereal silage, grass and grass silage, cereal grain and early rye silage (FNR, 2009).

However, C_4 crops such as maize, which provide significant quantities of biomass in central Europe, do not grow as well in temperate Northwest Europe, where lower temperatures and levels of solar radiation can result in suboptimal yields and quality (Farrell and Gilliland, 2011). Grass forms the backbone of most animal production systems in these regions with, for example, approximately 75 and 67% of the utilised agricultural area in Ireland and the United Kingdom being used for permanent grassland, respectively (Eurostat, 2011). Not only is grass plentiful, but some of the highest grass yields (up to 20 tonnes TS ha^{-1} $annum^{-1}$) in Europe are also observed in these regions. In addition, grass often represents the cheapest biomass feedstock to produce (McEniry et al., 2011) and farmers have existing machinery and expertise for growing, harvesting and storing grass and grass silage. Furthermore, a study by Smyth et al. (2009) suggests that grass biomethane (i.e. upgraded biogas) may be the optimal indigenous biofuel for Ireland and other temperate European countries. Consequently, grass will likely be the dominant biomass feedstock for on-farm AD in Northwest Europe, provided a high CH_4 yield per area of land can be achieved (Prochnow et al., 2009).

* Corresponding author. Tel.: +353 46 9061100; fax: +353 46 9026154.
E-mail addresses: joseph.mceniry@teagasc.ie (J. McEniry), padraig.okiely@teagasc.ie (P. O'Kiely).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.09.084