Biogas tests with Elephant grass (Pennisetum purpureum) and Guatemala grass (Tripsacum laxum)

Date: 19 April 2012
Author: Bart Frederiks

Introduction

For several years, FACT Foundation has been working in the field of biogas production and use. Biogas is a highly relevant form of bioenergy for communities in developing countries: it is a relatively uncomplicated technology that can be applied from very small (household) to very large (industrial) scales. The biogas can be used for the production of electrical or mechanical power, or for cooking or chilling. A wide range of feedstocks can be used, including agricultural residues and energy crops. In order to add to the existing knowledge on suitable biogas feedstocks, and to support its partners in developing countries with new knowledge, FACT has been commissioning tests with different types of biomass. It concerns tests on potential biogas yields, but also of the composition of materials.

Methodology

Underlying report concerns the results of tests with Elephant grass (Pennisetum purpureum) and Guatemala grass (Tripsacum laxum). These two species of fast growing grass commonly occur in large parts of Africa and are being considered for use in biogas systems by partners of FACT Foundation.

Samples of fresh material from both species have been brought in from Uganda, by visiting FACT staff. Biogas yield tests have been carried out by DUMEA in Wijhe, The Netherlands. Dry solids content and organic solids content were measured. Samples were added to a sewage sludge inoculum, and maintained at 35°C throughout the test. Both biogas and methane content were measured over time. In addition, Carbon and Nitrogen contents were determined by BLGG AgroExpertus in Wageningen, The Netherlands.

Results

Table 1 below gives an overview of the (organic) solids content analyses of the samples.

Table 1 Total solids content and organic solids contents of the different samples

Sample	Total solids content (ts)	Organic solids content (os)	Organic solids content (os)	Carbon content (C)	Nitrogen content (N)	C:N ratio
	g/kg product	g/kg product	%ts	g/kg ts	g/kg ts	(-)
Elephant grass	202.2	182.4	90.2%	443.6	16.7	26.6
Guatemala grass	212.0	192.5	90.8%	442.4	14.5	30.5

The cumulative gas production of the samples is shown in figures 1 and 2 below.

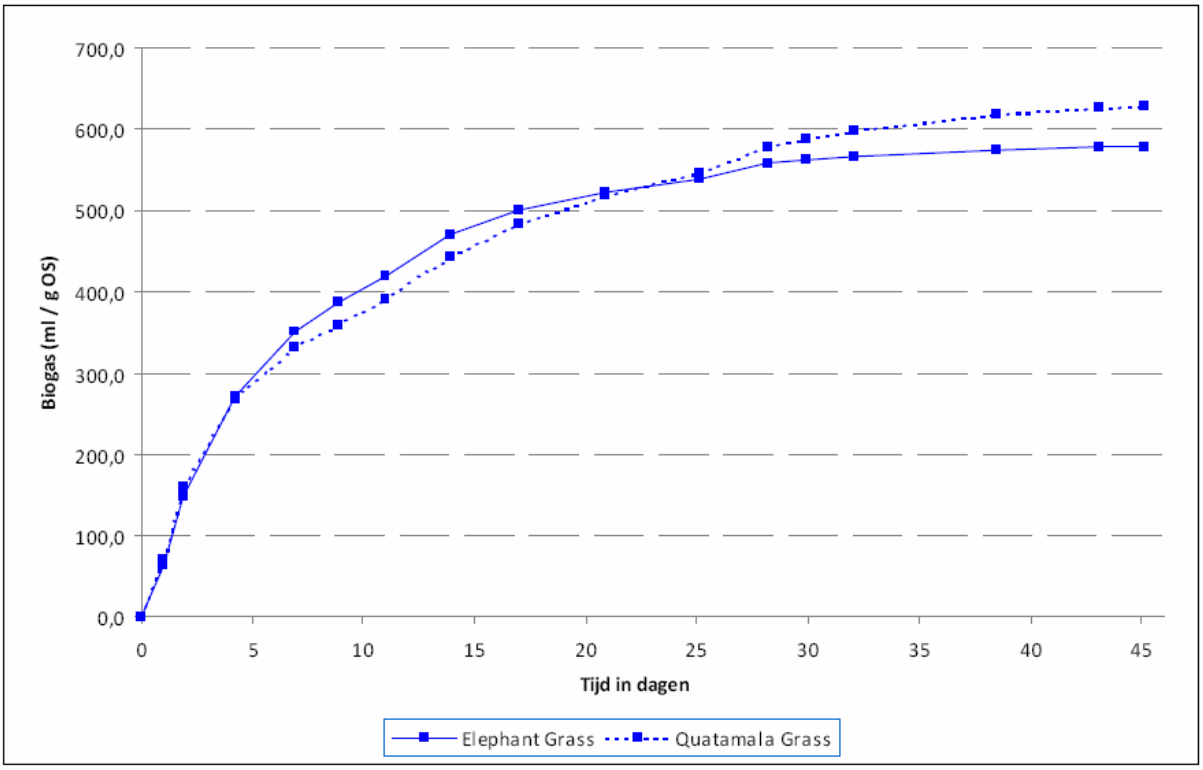

Figure 1 Cumulative gas production of samples (ml/g organic substance)

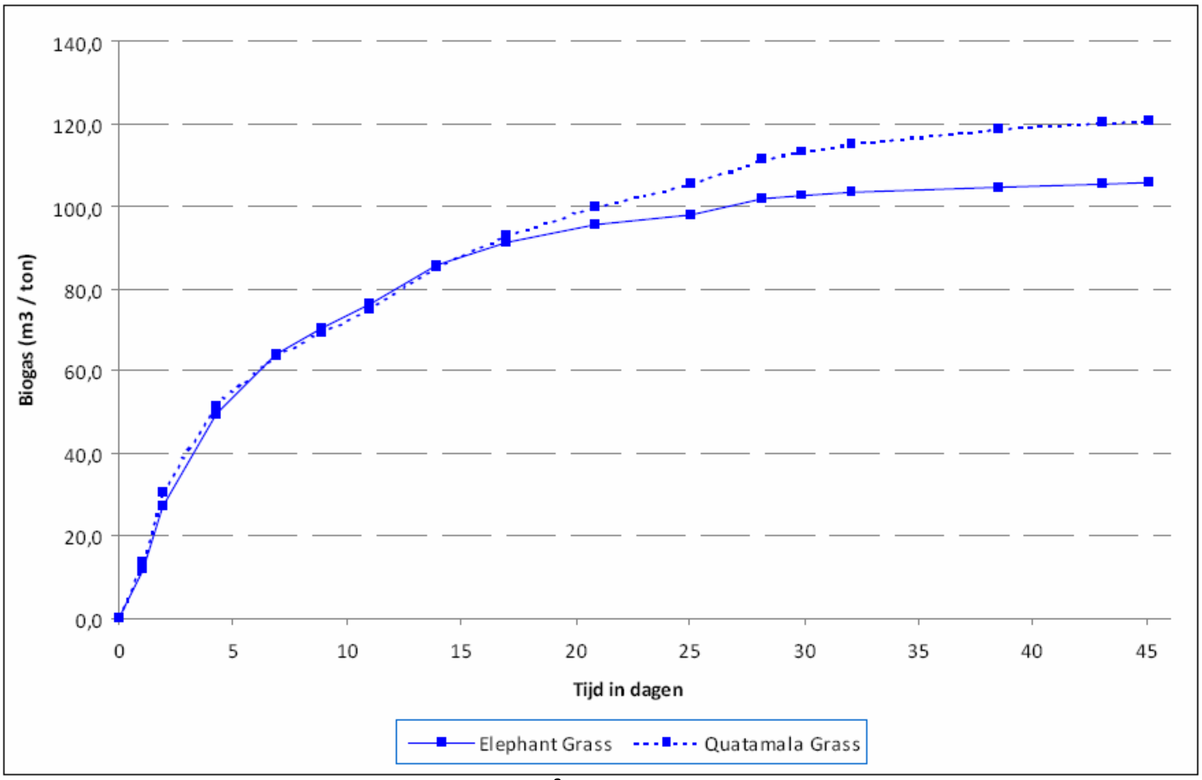

Figure 2 Cumulative gas production of samples (m^3 biogas / tonne of product)

Table 2 below gives an overview of the biogas production tests after 45 days.

Table 2 Results of the biogas production tests after 45 days

Sample	Biogas production		CH_4	Methane production		pH	
	ml/g os	m^3/t product	%	ml/g os	m^3/t product	Begin	End
Elephant grass	579.1	105.6	58.5	338.8	61.8	7.3	7
Guatemala grass	627.5	120.8	58.1	364.6	70.2	7.3	6.9

Conclusions

- The results of the biogas productivity tests show that both grasses seem to digest fairly quickly (30-35 days), with biogas yields and methane contents that are similar to those of common pasture grass (range 450-700 l/kg os, average 575 l/kg os; approx 57% methane)[1].
- The C:N ratio of both substrates is favourable for digestion, although the Guatemala grass may benefit from additional nitrogen due to its lower N content.
- Guatemala grass seems to have a slightly higher gas yield per mass unit of organic substance (+8%) and, due to its higher (organic) solids content, per mass unit of product (+14%). As it concerns single measurements with randomly taken samples, the significance of these differences may be considered small.

[1] Eder, B. and Schulz, H. (2007) Biogas Praxis. Ökobuch Verlag, Freiburg (Germany)