photo: det jordbrugsvidenskabelige fakultet/århus universitet

# Choose the right crops for the biogas plant

**With the right combination of various growing systems, farmers can supply energy crops with a high gas potential for the biogas plants all year round.**

*Fodder beets are the absolute top scorer among the tested energy crops with regard to output as well as energy production.*

*By Poul Erik Lærke, Margrethe Askegaard, Henrik B. Møller and Uffe Jørgensen*

With the latest energy settlement, which laid the ground for an expansion of the biogas production from the current 4 PJ per year to 12 PJ per year before 2025, there will be competition for the organic waste, which has ensured the finances of most biogas plants so far. Thus, many of the new plants should be prepared to only be supplied with the more meagre livestock manure, possibly supplemented with energy crops, which often have significant gas potential.

A group of researchers under the leadership of the Innovation Centre for Bioenergy and Environmental Technology (CBMI) has therefore chosen to investigate how the farmers can optimise their production of energy crops. In a sandy clay soil at the testing station Foulum Forsøgsstation, they have registered the energy production in 2006/2007 from nine different growing systems, and in that connection, it has turned out that there is a number of different combination that can make it interesting for the farmer to grow crops for the production of biogas.

The combination of crops in the various systems can be seen in figure 1, where the first crop in systems 1 to 6 was established in the autumn of 2006, while the crops in systems 7 to 9 were not established until the 30th of March, 11th of April and 17th of April 2007 respectively. The dates for harvesting can be seen in the figures.

The calculation of energy production from the crops is based on the production of methane in small test plants, which provides a good simulation of the conditions in a full-scale biogas plant. There was the best gas potential in green rye, where the production amounted to 395 $m^3$ of methane per ton organic matter, and the worst in the tops of Jerusalem artichokes, which only produced 300 $m^3$ of methane. The other crops had a gas potential of about 350 $m^3$ of methane per ton of organic matter.

Subsequently, the net energy production has been calculated by subtracting the energy consumption for field work and fertiliser, as well as the consumption of electricity and heat at the biogas plant. Energy consumption connected with transport of the biomass and any need for storage of the crops have not been taken into consideration.

## Fodder beets is the top scorer

Fodder beets were the absolute top scorer in the test, with regard to output as well as energy production. This crop produced about 22 tons of dry matter per hectare, which resulted in a net energy production of 250 MJ per hectare.

At the other end, we find system 8 with spring triticale/rye grass, where the production only reached almost 11 tons per hectare, followed by hemp with a production of about 13 tons per hectare. In the other growing systems, the production was between 16 and 18 tons of dry matter per hectare, corresponding to a net energy production of between 150 and 200 MJ per hectare.

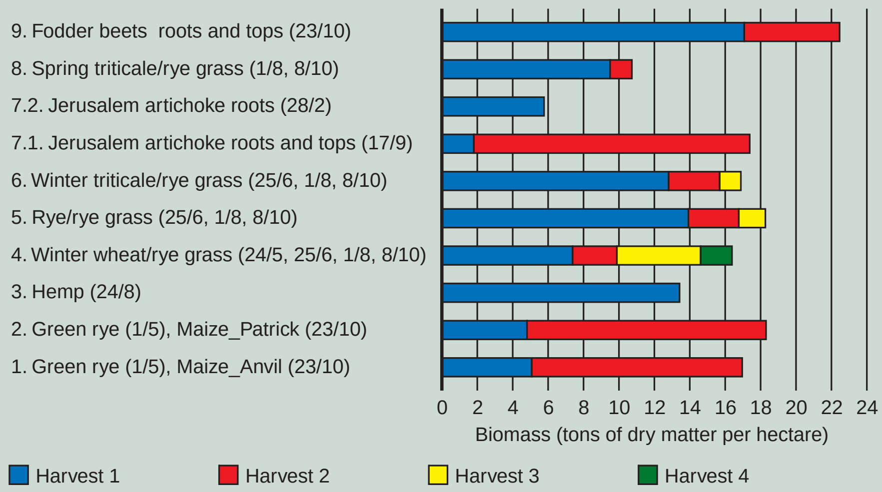


*Figure 1. Production of biomass in 9 different growing systems. The dates in parenthesis show the time of harvesting.*

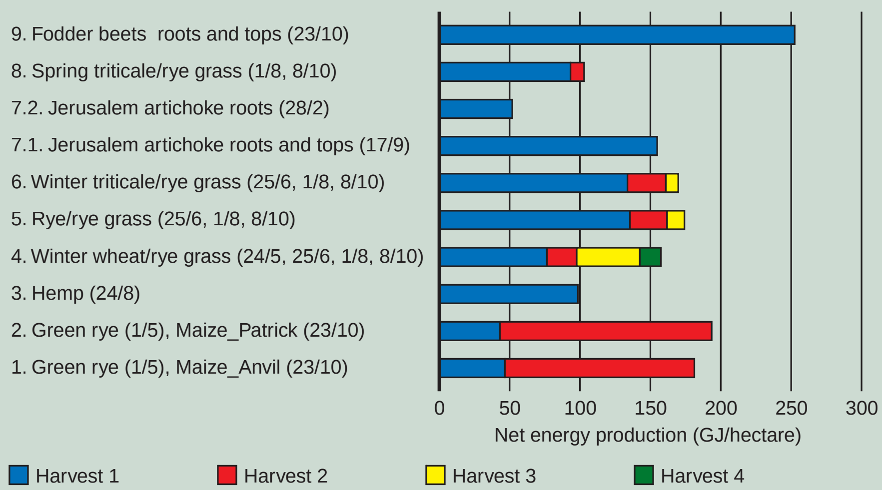


*Figure 2. Net production of energy in the 9 growing systems. The dates in parenthesis show the time of harvesting.*

The results also showed that the roots of the Jerusalem artichokes contain less than half the amount of dry matter that they can supply after the tops have withered. Therefore, it is necessary to harvest the tops before they wither in order to achieve an acceptable total output from the crop.

## Choose more crops

By choosing crops from several different growing systems, it would be possible to reduce the expenses connected with storage of the biomass. This kind of strategy could look like this:

Harvest of green rye in the spring before the sowing of maize, harvest of grass fields throughout the summer, continue with the tops of Jerusalem artichokes followed by beets or maize during the winter. At the end of the winter, you can supplement with the roots from Jerusalem artichokes, if there is a need for thinning out of the roots before the following growth season.

The study “Production of bioenergy and biofuels from biomass” (“Produktion af bioenergi og biobrændsler fra biomasse”) has been carried out with support from the Danish Ministry of Science, Technology and Innovation and the Danish Ministry of Food, Agriculture and Fisheries.

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## Genetic modification is to make bioethanol less expensive

**A group of American researchers have genetically modified a bacterium that can reduce the production costs of bioethanol significantly.**

Everywhere in the world, researchers are working intensely to develop the so-called 2nd generation technology that is going to make it possible to produce bioethanol on the basis of cellulose-containing residual products, such as straw and wood waste. In that way, you can avoid using raw materials that are normally used for production of foodstuffs, and you get the possibility of using a wide selection of different residual products that would usually be considered to be waste.

So far, the production of bioethanol has taken place with the use of naturally occurring bacteria. When dealing with sugar-containing crops, this has been unproblematic, but when using waste and residual products, it has been necessary to supplement with enzymes, as the bacteria are not able to keep the process going when the temperature exceeds 37 °C.

The new genetically modified bacteria, which has been given the name ALK2, can ferment all the sugar available in the biomass, and it works at temperatures of up to 50 °C. In this way, the supply of expensive enzymes can be reduced significantly. Thus, controlled tests at Darthmouth College in New Hampshire show that the amount of enzymes can be reduced two and a half times by using ALK2 instead of the naturally occurring bacteria.

Another advantage of the genetically modified bacteria is that there is no production of by-products in the shape of organic acid. The only organic product released with ALK2 is pure ethanol.

*Source: www.biofuels.com*