SUMMARY

RESEARCH ON ACHIEVING RENEWABLE ENERGY – BIOGAS – BY USING PLANTS BIOMASS UNDER COSTA RICA AND ROMANIA CONDITIONS

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Keywords: biomass, energy crops, *Pennisetum purpureum* L., *Zea mays* L., *Sorghum bicolor* var. *saccharatum* L., biodigestor, biogas production

Introduction

The Biomass has been used for the energy production since ancient times. The term covers a wide range of products, for instance, residues from agriculture and forestry, municipal as well as industrial waste. According to the European Union law, "The Biomass is the biodegradable fraction of the waste and residues from agriculture (including vegetal and animal substances), forestry and related industries and the biodegradable fraction of the municipal and industrial waste" (Vagda, 2012).

An increasing attention is payed to the energy crops for several reasons: the production of alternative fuels to the fossil ones, CO_2 emissions reduction, acquiring more energy independence, ground exploitation etc.

The Biogas can be generated by a wide range of raw materials, such as byproducts of the agricultural industry, industrial waste, wastewater, energy crops and municipal organic waste.

In order to produce bioenergy from agricultural products, the most used plants are: the sugarcane, the maize, the sorghum, but these one compete directly with the mission of the world's population feeding, therefore, there were controversies in the developed countries (mainly Germany) concerning the use of maize for the energy production.

The purpose of this research is to determine the biogas production by the mesophilic biodigester systems, using energy crops that do not affect the food security of the population, such as King grass *Pennisetum purpureum* compared to the conventional plants such as corn and sweet sorghum.

Research objectives

The studies concerning the use of the plant-based biomass for the biogas production as an alternative energy source under Romania and Costa Rica conditions have had several objectives:

- Establishing biogas production using plant-based biomass that do not affect the food security of the population;

- A comparative study between *Pennisetum purpureum* species, *Zea mays* and *Sorghum* sp., in order to determine the effectiveness of the energy potential of *Pennisetum purpureum* culture, used as biomass for the biogas production;

- A biogas production system scheme design using bio digesters with a membrane support system with an external sliding system and a mechanical and manual crossbar stirring system;

- Promotion of the manual shaking mesophilic digesters, that can be used by the local population and small producers of the biogas as a renewable energy source.

Materials and Methods

In order to determine the biogas production three comparative species have been analyzed: *P. purpureum, Zea mays* and *Sorghum* sp. under Costa Rica conditions and the corn under Romania conditions.

For this purpose, experiences have been accompished which within byometrical elements have been analyzed, for instance: plants hieght,stem diameter and leaves number; the total biomass production and fractional productions per components.

In the laboratory, the production of the dry substance, ashes content and volatile substancies production, as well as the amount of the produced biogas have been established.

The analyzed genotypes of the 3 species have been: „Bajura" and „Altura" of *P. purpureum*, „Diamond" and „EJN2" of the corn and the "0936" assortiment of *Sorghum* sp. as for Romania two maize assortiments – „Diamant" and „PR37N01" have been studied.

The biomass harvesting has been accomplished at 3 months from the maize sowing and at 5 months in case of *P. purpureum* and *Sorghum b.* var. *saccharatum*. The analyzes have been accomplished according to the specialized protocols and methodologies.

Research results

After carriyng out the research during the period 2014-2015, we could record that the development of *Penisetumm purpureum* plant was much faster than the maize and sorghum development;

Plant height

- Concerning the *P. purpureum* plants, their height was of 235.26 cm for the Bajura variety and of 263.98 cm for the Altura variety. Maize plants have recorded, at 3 months of growth, a height of 164.5 cm – the Diamant variety and sorghum has grown, in 5 months of vegetation, of 154.0 cm.

The biomass production in Costa Rica in terms of species *Penisetum purpureum* has been of 705.1 g / plant of green biomass and the dry substance weight was of 193.4 g / plant. Maize and sorghum generated lower biomass quantity.

The accomplished studies and observations have led to the conclusion that the best results were obtained from the *Penisetumm purpureum* Altura variety that had a greater quantity of biomass, the plants were more vigorous and more developed than the maize and the sorghum.

Under Romanian conditions, the corn hybrid PR37N01 Romania has achieved the average of 33.3 t / ha of green biomass and 12t / ha of dry substance and the Diamant variety has recorded a total biomass production of 47.3 t / ha and 12.3 t / ha of dry substance.

Analysis of the biogas productionpotential

The content of substances involved in biogas production, the methane and biogas production itself are higher in *P. purpureum* Altura variety. The biogas production reaching 539 liters / kg SV compared to the Diamant corn variety where biogas production is of 427.7 l / kg SV.

The analysis of the biogas production potential from the corn biomass obtained at Moara Domneasca, on the basis of determined parameters shows that the biogas production corresponding to 1 kilogram SV is of 419 L at PR37N01 variety and of 490 at Diamant variety.

We can mention that based on the results of *Pennisetum purpureum*, this is a plant with a great energy potential in producing biogas being of high efficiency in producing electricity for Costa Rica.

Mesophilic digesters with transversal axis stirring system (mechanical and manual) use, sliding system and resistance structure.

The dimensions of these digesters may vary depending on the amount of the available biomass and the energy needs.

The biomass in the digester is compacted in case of lack of agitation, resulting in the digester life reducing. The stirring is important in triggering mesophilic fermentation.

The mesophilic digester with hand stirring system has also a window system that allows visual monitoring of the biomass in digester.

Following the research results, we can conclude that the shared carbon biomass is very important in order to increase the efficiency of biogas production and, consequently, the methane production.

In the recipes where a mix of *P. purpureum* plant and animal manure has been used, by adjusting the ratio C/N, the hydrogen sulfide concentration could be controlled, that, at high values, reduces the life of the equipment and decreases the biogas performance.

The led research in diferent recipes mixtures, shows that the highest level of biogas production is recorded when mixtures of 1:1 ratio between animal manure and plant-based biomass are used.

Conclusions and recommendations

P. purpureum generates a higher biomass production than the corn and sorghum. This specific feature leads to the production of a larger quantity of biogass, compared to other evaluated crops.

The advantages of this plant consist, on the one hand, in the fact that, after they have been reaped, the plants get regenerated quicklier and are growing faster, and on the other hand, they can be grown on less fertile lands, not being appropriate for food crops.

Romania is a country with great agricultural potential and consequently with consistent biomass resource that is not used enough for the bioenergy production.

The mesophilic biodigestor model designed in Costa Rica following the results and the possibility of dimensioning the volume depending on the existing biomass resources, can be implemented in other geographic areas, including Romania, providing a resource of renewable energy accessible to small consumers or remote areas communities.