Third Workshop of the EU Project:
4F CROPS – Future Crops for Food, Feed, Fiber and Fuel

"Can the production of non-food crops that can be environmentally friendly and economic viable?

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Renewable resources in Poland –could they be environmentally friendly and economically viable?

I. INTRODUCTION

Could crops cultivated in Poland as renewable resources be environmentally friendly?

The answer is positive: YES.

- **Crops in Poland are cultivated and utilized according to the rules of Good Agricultural Practices.**
- **From January 2009 the Polish farmers, applying for direct subsidies and support within Common Agricultural Policy are obliged to follow the demands of cross compliance.**
- **Not observance of the rules of natural environment protection results in limiting or loosing the financial support.**

Profitability

There is no a simple answer.

Profitability depends on several factors e.g.:

- **climate and soil**
- **on selection of species, cultivars and varieties**
- **on the way (manner) of the utilization of renewable resources and others, which are the subject of research and implementation of positive results in agricultural and industrial practice.**

II. The kinds of renewable resources for the bioenergy production

- **The regulation about biocomponents and biofuels, which entered in force in Poland from January 2007, describes the goals and obligations regarding production and utilization of renewable resources**

II. The kinds of renewable resources for the bioenergy production-cont

Rapeseed

- winter rapeseed cultivated on 1.0 up to 1.5 mln ha – able to cover the needs for food and 50 % for the energy production
- biodiesel is manufactured with the addition of rapeseed oil

Liquid bioethanol

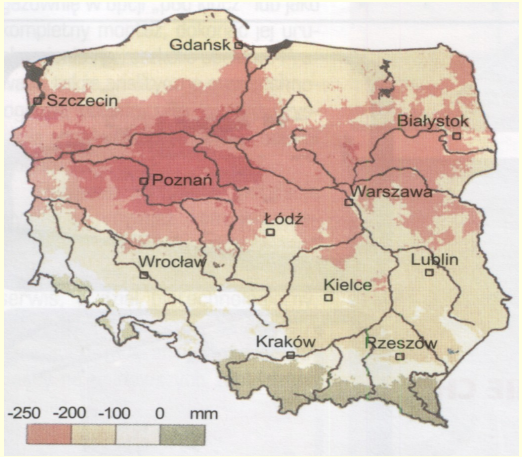
- **The second biofuel in Poland – liquid bioethanol produced from cereals, corn, potatoes, beetroot, etc.**
- **600 000 ha to 2020 – to cover the needs of fuel industry**
- **Obviously the production and supply of bioethanol are regulated on the base of market rules**

BIOMASS

In Polish conditions the most economically viable way of gaining bioenergy from 1ha of agricultural land is the biomass production.

- **Biomass used by electric power stations to burn alone and burn together with coal**
- **Biomass is an appropriate feedstock for the production of biogas, as the addition to diversified plant and municipal wastes.**
- **That is why estimation of the conditions determining the profitability of biomass production is the subject of the investigation of our Institute and other research institutions.**

III. Climate and soil conditions of Wielkopolska region



Climatic balance of water in Poland from April to September acc. To Górski T. and Kozyra J.

-In 1971 – 2005 the annual sum of rainfall in Poznan region totaled on average at 507 mm, of which only 225 mm from April to September.

- the quality and agricultural suitability of Wielkopolska region ranks 5th behind region of Białystok, Warsaw, Łódź and Zielona Góra (acc. to IUNG).

IV. The selection of crops for the biomass production

Appropriate for the light soils and low rainfall rate (Wielkopolska):

- **sorghum**
- **corn**
- **industrial hemp**

Corn

Prof. H. Burczyk and Industrial hemp

IV. The selection of crops for the biomass production-cont.

Appropriate for heavier soils and higher rainfall rate:

- **willow**
- **miscanthus**
- **sida**

Willow

Miscanthus

Sida

V. The results of comparative tests of cultivars on the medium soils

Table 1 Yields of compared crops for energy in Experimental Farm Sielec Stary in 2007-2009

Plant	Yields of green mass [t/ha]				Yields of air dry mass [t/ha]			
Plant for energy	2007	2008	2009	Average	2007	2008	2009	Average
Sorghum	78.9	68.4	85.2	77.5	31.6	27.3	44.0	34.3
Corn	70.7	41.9	69.4	60.7	35.6	18.9	32.4	29.0
Industrial hemp	60.9	40.0	59.0	53.3	27.8	13.9	30.8	24.2

Table 2. Energy efficiency of compared crops in Experimental Farm Sielec Stary in 2007-2009

Plant for energy	Yield [t/ha]		Energetic value [GJ/t]	Energetic value per ha	
	green mass	Dry mass		[GJ]	[t of coal]
Sorghum	77.5	26.6	18.4	489	19.6
Corn	60.7	24.3	18.1	440	17.6
Industrial hemp	53.3	20.2	18.5	373	14.9

* acc. to Mining Institute 1 t of coal = 25 GJ.

Table 3. Economical efficiency of production in experiments of INFMP (Poznan) in 2007-2009 (loco field)

Specification/ plant	Sorghum	Corn	Industrial hemp
Production costs in PLN/ha/year	2 390	2 340	2 400
Yields in ton dry mass/ha/year	26.6	24.3	20.3
Price in PLN/ha	288	288	288
Income in PLN/ha	7 488	6 912	5 760
Profit in PLN/ha/rok	5 098	4 572	3 360

Table 4. Yields of compared species in experiments of IUNG, Puławy [t/d.m./ha]. Results from 2004-2007

Plant Species	2004	2005	2006	2007	Average
	Heavy soil -	black soil			
Miscanthus	10.2	19.2	15.6	15.8	15.2
Willow	14.7	12.8	11.1	12.7	12.8
Sida10 000 plants/ha	7.4	10.0	10.3	9.3	9.2
Sida-20 000 plants/ha	14.8	20.8	20.4	17.1	18.3
	Brown	soils -	medium	heavy	
Miscanthus	13.9	20.7	16.7	21.0	18.1
Willow	13.3	10.8	11.5	12.4	12.0
Sida-10 000 plants/ha	6.4	9.0	11.4	9.6	9.1

Table 5. Economical efficiency of biomass production in experiments of IUNG, Puławy. Average in 2004-2007 (loco field)

Specification/ plant	Willow	Miscanthus	Sida
Production costs in PLN/ha/year	1 723	2 945	2 705
Yields in ton dry mass/ha/year	9 (7-11)	12 (9-15)	9 (7-11)
Price in PLN/ha	288 (256-320)	288 (256-320)	288 (256-320)
Income in PLN/ha	2 592	3 456	2 592
Profit in PLN/ha/rok	869	611	-113

XI. Conclusion

1. **The tests proved that in the conditions of Wielkopolska region sorghum, corn and fibrous (industrial) hemp are the most suitable crops for the production of biomass for energy.**

2. However, the utilization of hemp in agricultural practice in Poland will depend on the relevant novelization of the regulation on counter drag abuse, which will enable the use of fibrous hemp also for the energy production.

3. The energetic value of the biomass of compared species do not vary significantly.

That is why the choice of the species or even kind will be depended on the potential yielding and production costs.

XI. CONCLUSION- cont.

4. The supply of the feedstock for agricultural biogas plants will depend e.g. on the involvement of agricultural advisors aiming ~~at organization of producers groups and the service stations,~~ equipped in the specialized machines, on providing the sale system and profitable prices for these producers those who purchase biomass (based on bilateral commercial agreements).

5. Moreover, the significant role will play the active involvement of local authority organizations, which should contribute to gaining the waste feedstock's for biogas plants, where the plant biomass should be the supplement only.

XI. CONCLUSION- cont.

6. Finally, it is necessary to underline, that the success in gaining the renewable energy in the plant biogas plants will depend on the level of profitability in the entire chain; from industry through the realization of the investment and exploitation program – up to the sale of the final product.

Thank you for your Renewable attention!