West Pomeranian University of Technology, Szczecin

Chair of Agronomy

PROJECT TOPIC:

Possibility of sorghum (*Sorghum bicolor* Moench.) cultivation in northern Poland and its profitability under production conditions

The team under the direction of Prof. Dr. Hab. Eng. Sławomir Stankowski:

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Introduction

Sorghum (*Sorghum bicolor*), as a plant similar to corn, while characterized by lower climate requirements (especially a much higher resistance to drought), can be a good supplement for maize designated for biogas production. Sorghum, like corn, is a plant with C4 photosynthesis trail. Plants of that photosynthetic trail are characterized by better utilization of CO2, and higher yielding efficiency than the plants with C3 cycle. Sorghum, thanks to a deep root system and the ability to go into sleep state during high water shortages, characterized by a higher resistance to drought than maize. Moreover a sorghum leaves, thanks to a layer of wax covering the blade and leaf sheath, transpirate less water than corn. Sorghum can be grown on most Polish soils. It develops particularly well on light soils, but does not tolerate cultivation on very heavy soils, that are cold and damp. This plant prefers slightly acidic soil (pH 5,6-6,5) and is quite resistant to soil salinity. Although there is no grain sorghum cultivars registered in Poland, farmers can benefit from the EU catalogue of varieties [Acts. EU Laws 2011/C380 A/01], in which more than 250 varieties of this species are classified.

The planned study will include the execution of field experiments in the Agricultural Experimental Station in Lipnik and fief experiments on the farm of the Seed Central, aimed at comparing growth and development of several varieties of sugar sorghum (*Sorghum bicolor*), and also determining the suitability of varieties available in Europe for cultivation in light soil conditions of Western Pomerania. Understanding the biology of these species, their response to agrotechnic and climate conditions of Western Pomerania, learning the agro technology of their cultivation (sowing time, seeding, weed control, pest risk, care, harvest timing and technique) and the impact on the crop rotation is no less important to the study.

Experiments purpose

The purposes of the proposed experiments are:

- Determining of sorghums agro technology in the Western Pomerania region
- Determining the potential yields of sorghum and methane efficiency of its ensilage
- Determining of fertilization dosage on the yielding of sorghum

Methodology

Field implementation experiment on feed/silage sorghum

Three-way field experiment:

A. Factor I - Species

- Maize (silage)
- Sorghum

B. Factor II – Variety (cultivars):

- 3 varieties of each species

C. Factor III - Nitrogen fertilisation (kg N · ha^{-1}):

- 50
- 100
- 150

SORGHUM			MAIZE		
V_1	V_2	V_3	V_2	V_3	V_1
D_1	D_1	D_1	D_1	D_1	D_1
D_2	D_2	D_2	D_2	D_2	D_2
D_3	D_3	D_3	D_3	D_3	D_3

The field experiment aims to examine the potential yields of sorghum biomass in a large-scale field crop. Learning the potential hazards that may occur during the cultivation. Estimation of realistic yields. And assessment of the impact of cultivation on soil and the plants fertilizing needs.

Prior to founding the experiment and after its completion soil samples will be taken from the experiments area for chemical analysis. The balance of macro- and micronutrients and organic matter content will be determined. This will allow examining the impact of sorghum cultivation on the soil and the plants demand for nutrients.

During vegetation canopy height will be measured to determine growth dynamics. Leaf Area Index (LAI) and chlorophyll content (SPAD) will also be measured in order to determine the degree of utilization of sunlight by the plants, as well as periods of peak demand for nitrogen.

After harvest seed yields will be estimated. Representative samples will be taken and subjected to analysis designed to determine the content of: ash, fat, protein, fibre and nitrogen-free extracts.

Execution of the fief experiment does not allow for results with high accuracy. It will be necessary to perform a strict experiment in Agricultural Experimental Station in Lipnik, in which plots are established on a smaller area. Although they do not fully reflect the real conditions of full scale cultivation, but allow for a better understanding of some processes in the plant and soil. This enables more accurate assessment of parameters such as the quality of the yield, the optimum time of treatments, and the most favourable date of harvest. Moreover this strict experiment, due to a much smaller scope allows the use of experimental layouts by which it is possible to eliminate the influence of soil variation on the obtained results.

Strict experiment on feed/silage sorghum

Two-way strict experiments in a split-plot block layout:

A. Factor I - Variety:

3 varieties of sorghum

B. Factor II - Nitrogen fertilisation (kg N · ha^{-1}):

- 50
- 100
- 150

The experiment will be conducted in a split-plot block layout in the conditions of light soil on the premises of The Agricultural Experimental Station in Lipnik.

Prior to founding the experiment and after its completion soil samples will be taken from the experiments area for determining the balance of macro- and micronutrients and organic matter content. This will allow assessing the pressures caused by the cultivation of each variety on the soil, fertilizer needs and fertilizer utilization by the plant.

During vegetation canopy height and diameters of selected shoots will be measured to establish growth dynamics. This will allow designating the optimal harvest term and in

correlation with weather data will allow for determination of the impact that weather occurrences have on the plants development.

During the plants growth the Leaf Area Index (LAI) and chlorophyll content (SPAD) will be measured in order to determine the degree of utilization of sunlight by the plants during their development. This will lead to determining the period of highest nitrogen demand and proper terms for applying fertilizer doses. It will also allow for designating the best performing varieties under the climatic conditions in the region of Western Pomerania.

After harvest biometric measurements on 10 selected shoots from a plot will be conducted (including the height and diameter of shoots). Potential biomass yields will be estimated. Representative samples will be taken and subjected to analysis designed to determine the content of: ash, fat, protein, fiber and nitrogen-free extracts (factors that determine the fodder quality of biomass and potential for biogas production).

It will be possible to ensilage part of the gathered biomass for further biogas efficiency analysis (not included in the cost calculation).

In the course of the experiments observations will be carried out on the occurrence of diseases and pests on plants, if there is such a need appropriate measures will be used to control hazards.

Cost calculation for the strict experiment

No.	Task	Cost
1	Preparing and conducting experiments	10 500 zł
2	Delegations/Commuting	1 500 zł
3	Maintenance	4 000 zł
4	Protective treatment	250 zł
5	Chemical analysis	3 000 zł
6	Equipment amortization	750 zł
7	**Total**	**20 000 zł**

Cost calculation for the implementation experiment

No.	Task	Cost
1	Delegations/Commuting	3 000 zł
2	Maintenance	500 zł
3	Chemical analysis	1 500 zł
4	**Total**	**5 000 zł**

Responsibilities:

1. **Prof. Dr. hab. eng. Sławomir Stankowski - Manager**, control and supervision over the whole project, statistical data analysis
2. **Dr. hab. eng. Marek Bury - Executor**, supervision, work on field analysis, harvest
3. **Dr. eng. Grzegorz Hury - Executor**, supervision, work on field analysis, harvest
4. **MSc eng. Barbara Amroży - Executor,** supervising the experiments in situ, conducting current plant treatment, conducting everyday observation, work on field analysis, harvest
5. **MSc eng. Krzysztof Kuglarz - Executor,** work on analysis (field and laboratory), harvest and plant material preparation
6. **Additional staff** - 4 persons

We see the possibility of making two doctoral theses in full-time or extra curriculum.

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