

## ANALYSIS OF REED CANARY GRASS CHEMICAL CONTENT

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**Abstract.** The aim of the research is to establish the chemical content of reed canary grass and their (C, S (SO<sub>2</sub>, SO<sub>3</sub>), Na, K) interconnection. Apart from this, there is a large role for environment – friendly growing technologies, which should guarantee qualitative soil tillage, suitable variety cultivation and the use of fertilizers according to the agrochemical parameters. In order to assess the suitability of the varieties of reed canary grass plants for energy production with the combustion process there were made the analysis of the chemical content in plants and factors (different N fertilizer rate) affecting it using canary reed grass. Field trial was carried out during 2011-2012. Carbon content for reed canary grass varieties “Bamse” and “Marathon” is by approximately one percent greater than for the variety “Pedja”. On average the carbon content was within the range 46-48 %, depending on the fertilizer rates and variety. As the phosphorus content increases in the energy plants, the potassium content increases, which is the main alkali element. For the reed canary grass variety “Pedja” a significant positive correlation between the phosphorus and sulfur content was found.

**Keywords:** chemical content, reed canary grass, fertilizer rate.

### Introduction

Reed canary grass (*Phalaris arundinacea* L.) is a cereal grass of Poaceae family perennial tendril covergrass C<sub>3</sub>. Reed canary grass is with vigorous root growth, which allows it to endure dry periods. Reed canary grass also endures lengthy periods of flooding. Reed canary grass produces a full crop in the third year after sowing [1]. Reed canary grass is suitable for the production of biomass as its productivity cycle exceeds ten years [1; 2] as well as that perennial grass crops have a positive influence on the surrounding environment, as they reduce soil erosion and improve the quality of the soil [3-5].

Alkali and alkaline earth elements in biomass are organically combined in various carbon structures [6; 7]. Biomass ashes contain relatively small amounts of calcium (Ca), but they have a high potassium (K) and silicon (Si) content, as a result of which oxidation starts to form, and the ashes melt at a considerably lower temperature in comparison to ashes from fire-wood fuel [8]. It is shown in a lot of the research, that the large amounts of alkali metals in the biomass produce corrosion in the central heating boilers. As a result such biomass is not very suitable for heating [8; 9].

Sulphur burns (but relatively badly) forming sulphur dioxide. The sulphur combustion heat is low – 9300 kJ·kg<sup>-1</sup>, therefore, as a burning element its value is small. Burning sulphur forms SO<sub>2</sub> and a small amount of SO<sub>3</sub> (in a relationship approximately of 95:5) [10]. Sulphur is a non-metal and biogenic element, as it is included in some amino acid contents (cysteine, methionine) as well as other biologically active substances. Sulphur is an important element for the human organism. Its exploitation is in many forms: for the production of sulphuric acid, for the vulcanization of caoutchouc, for the production of matches, and as a fungicide in agriculture.

Carbon is the main burning element in fuel, producing a high combustion heat, and it forms the main part of the burning mass [10; 11]. By burning carbohydrates, carbon dioxide and water are produced, the energy from the sun is freed.

The aim of the research is to establish the chemical content of reed canary grass and their (C, S (SO<sub>2</sub>, SO<sub>3</sub>), Na, K) interconnection.

### Methodology

Field trial was carried out during 2011-2012 in the research and study farm “Pēterlauki” (56°53’N, 23°71’E) of the Latvia University of Agriculture, in sod calcareous soils pH KCl 6.7, containing available for plants P 152 mg·kg<sup>-1</sup>, K 128 mg·kg<sup>-1</sup>, organic matter content 21 to 25 g·kg<sup>-1</sup> in the soil. The field test fertiliser rates are shown in Table 1. Seed sowing rate – 1000 germinant seeds per 1 m<sup>2</sup>; usage type: mowing two-three times.

For reed canary grass the whole of the plant has been used for analysis, (starting from 5-8 cm above the top soil) the samples being ground for chemical analysis. The reed canary grass dry matter

was established by drying the samples in a temperature of 105°C until a constant mass remained (ISO 6496). Dry matter is an important quality index of grass. All the nutrients and energy are concentrated in dry matter. Amount of dry matter is increasing during the grass plant vegetation period as well as the yield of grass plant. Sulfur (S), carbon (C) and nitrogen (N) content in various samples was determined in the accredited Laboratory of Agronomic Analysis of the Latvia University of Agriculture using the analyzer “Eltra CS-500 Analyzer”, and in compliance with the standard LVS EN ISO 5983-2:2009. Potassium content was determined by the standard LVS EN ISO 6869:2002. Phosphorus content was determined by the spectrometric method ISO 6491:1998.

Table 1

Field test fertilizer rates and usage types

No.	Fertilizer, kg·ha <sup>-1</sup>	Symbol in text
1.	N0P0K0 (control)	MP1
2.	P <sub>2</sub> O <sub>5</sub> - 80; K <sub>2</sub> O - 120 (background) (F)	MP2
3.	F+N30	MP3
4.	F+N60	MP4
5.	F+N90	MP5
6.	F+N120 (60+60)	MP6
7.	F+N150 (75+75)	MP7
8.	F+N180 (90+90)	MP8

The meteorological conditions were different in both trial years. The meteorological conditions during the vegetation period in 2012 have a significant deficit in rainfall. The temperature was in compliance with the long-term average. In the winter of 2011/2012 snow was observed to be greater and the temperature was lower than the long-term average.

The trial data were processed using correlation analyses and descriptive statistics. The means are presented with LSD<sub>95</sub> test and the figures were made using MS Office program Excel 2010.

## Results and discussion

The average sulfur content varies for the reed canary grass varieties “Pedja” and “Marathon” 0.11 % ± 0.01 %, for “Bamse” 0.09 % ± 0.01 % (Fig. 1). It is shown that the maximum allowed sulfur content for the wood pulp granule standard EN14961 is up to 0.1 % [12].

For the reed canary grass varieties “Pedja”, “Marathon” the sulfur content exceeded the standard by 0.01 %, which is unsubstantial. The fertilizer norm implementation for MP2, MP4 and MP7 helps promote the sulfur content increase for all three varieties of reed canary grass dry matter.

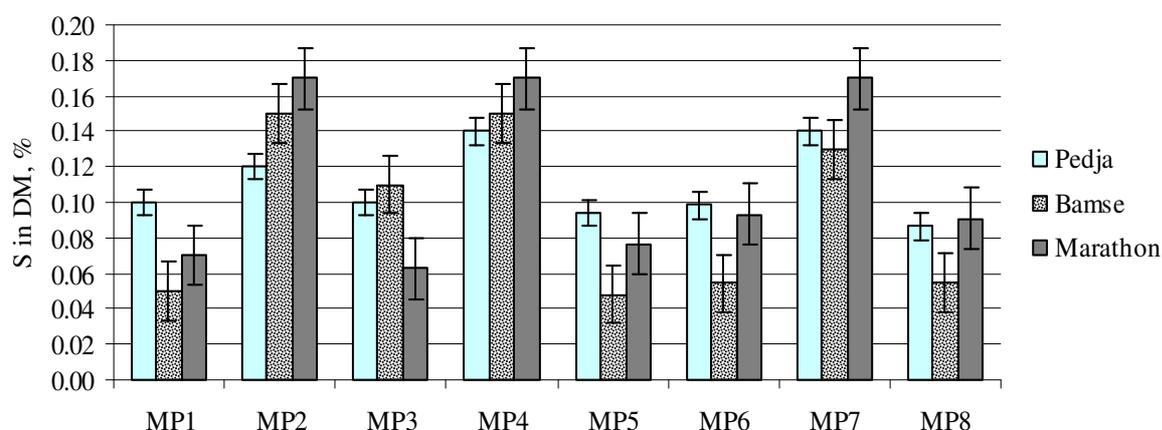


Fig. 1. Sulfur content depending on reed canary grass variety and N fertilizer rates: MP1– MP1–N0P0K0 (control); MP2 –P<sub>2</sub>O<sub>5</sub> – 80; K<sub>2</sub>O – 120 (F – background); MP3 – F+N30; MP4 – F+N60; MP5 – F+N90; MP6 – F+N120 (60+60); MP7 – F+N150 (75+75); MP8 – F+N180 (90+90)

For the reed canary grass variety “Pedja” the phosphorus content in the harvested dry matter is  $0.26 \% \pm 0.10 \%$ , for “Bamse”  $0.25 \% \pm 0.15 \%$ , for “Marathon”  $0.26 \% \pm 0.20 \%$  (Fig. 2). The fertilizer rate MP2, MP4 and MP7 implementation helps promote the phosphorus content increase for all three varieties of reed canary grass dry matter. As the phosphorus content increases in the energy plants, the potassium content increases, which is the main alkali element. For reed canary grass alkaline and alkali earth elements, a positive influence was noted for the ash melting temperature.

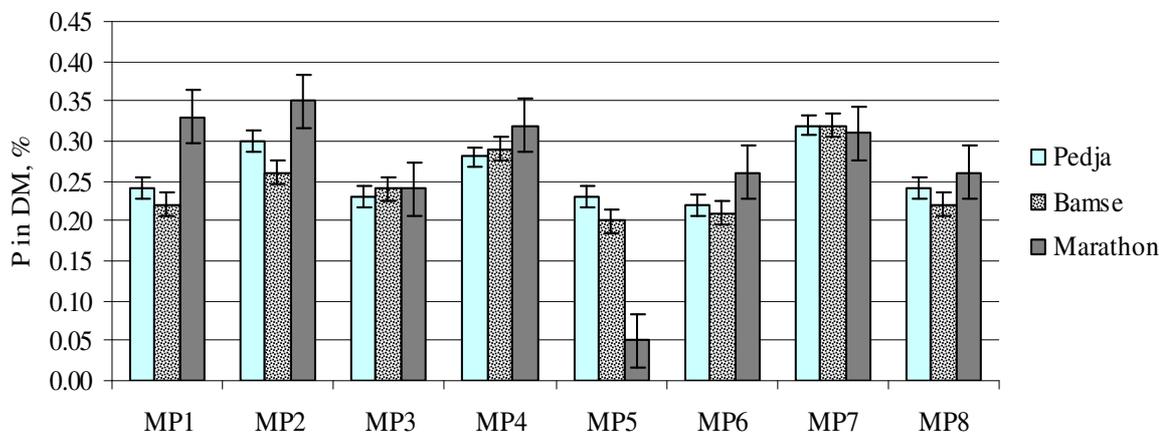


Fig. 2. Phosphorus content depending on reed canary grass variety and N fertilizer rates: MP1 – N0P0K0 (control); MP2 –  $P_2O_5$  – 80;  $K_2O$  – 120 (F – background); MP3 – F+N30; MP4 – F+N60; MP5 – F+N90; MP6 – F+N120 (60+60); MP7 – F+N150 (75+75); MP8 – F+N180 (90+90)

Potassium is an important chemical compound guaranteeing living processes, but in return it is desirable for fuel to have a smaller amount of alkaline metal content. Depending on the fertilizer rates the potassium content in reed canary grass dry matter varied within these limits; variety “Pedja” 1.97-2.48 %, “Bamse” 1.88-2.53 %, and “Marathon” 1.69-2.31 % (Fig. 3). Therefore, on average the least potassium content was for the variety “Marathon”.

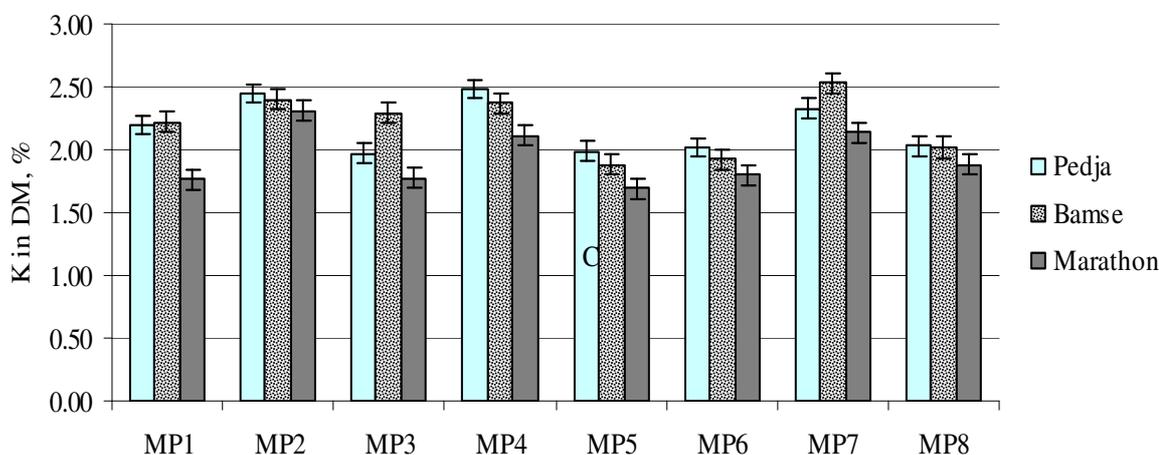


Fig. 3. Potassium content depending on reed canary grass variety and N fertilizer rates: MP1 – N0P0K0 (control); MP2 –  $P_2O_5$  – 80;  $K_2O$  – 120 (F – background); MP3 – F+N30; MP4 – F+N60; MP5 – F+N90; MP6 – F+N120 (60+60); MP7 – F+N150 (75+75); MP8 – F+N180 (90+90)

Carbon content in biomass varies between 42–71 %, on the other hand, C in peat and coal is 56-87 % [7]. Carbon content in energy plants and fuel is influenced by various factors:

- the type of fuel and the location conditions (coal 59 %) [13];
- that it varies for different plants, varieties within the framework of species and plant [14; 15];
- it is also dependent on the way the samples are taken [1; 2].

Carbon content for reed canary grass varieties “Bamse” and “Marathon” is by approximately one percent greater than for the variety “Pedja” (Fig. 4). On average the carbon content was within the range 46-48 %, depending on the fertilizer rates and variety.

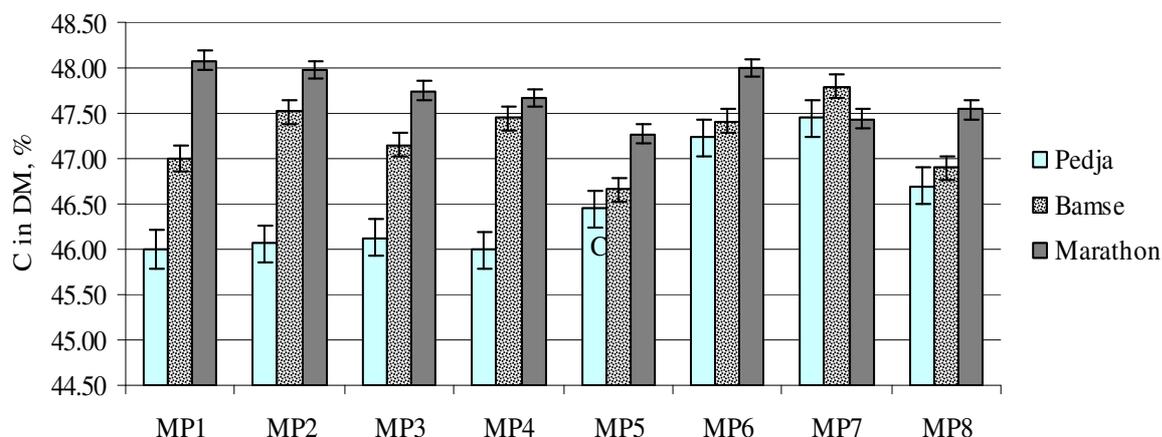


Fig. 4. Carbon content depending on reed canary grass variety and N fertilizer rates: MP1 – N0P0K0 (control); MP2 – P<sub>2</sub>O<sub>5</sub> – 80; K<sub>2</sub>O – 120 (F – background); MP3 – F+N30; MP4 – F+N60; MP5 – F+N90; MP6 – F+N120 (60+60); MP7 – F+N150 (75+75); MP8 – F+N180 (90+90)

In the research the relationship between the chemical elements for the three reed canary grass varieties is shown in Table 2. In the research it was noted that a positive linear correlation was found between the total nitrogen and phosphorus, and calcium for the reed canary grass varieties “Pedja”, “Bamse” and “Marathon”.

Table 2

**Correlation coefficients between chemical elements in reed canary grass variety “Pedja” in yield dry matter (DM) 2012**

Variety	Parameter	Absolute dry matter, %	Crude N, %	P, %	K, %	C, %
“Pedja”	Crude N, %	-0.338	-	-	-	-
	P, %	-0.198	0.689*	-	-	-
	K, %	-0.421	0.868**	0.631*	-	-
	C, %	-0.122	0.770**	0.160	-0.214	-
	S, %	-0.016	0.336	0.576*	0.410	0.077
“Bamse”	Crude N, %	-0.217	-	-	-	-
	P, %	-0.402	0.693*	-	-	-
	K, %	-0.368	0.866**	0.674*	-	-
	C, %	-0.409	0.799**	0.671*	0.735*	-
	S, %	-0.117	0.720*	0.649	0.728*	0.669*
“Marathon”	Crude N, %	-0.673*	-	-	-	-
	P, %	-0.144	0.624*	-	-	-
	K, %	-0.684*	0.944**	0.615*	-	-
	C, %	0.299	0.037	0.636*	0.097	-
	S, %	-0.578*	0.839**	0.429	0.856**	-0.002

\* Correlation is significant at the 0.05 level

\*\* Correlation is significant at the 0.001 level

For the reed canary grass variety “Pedja” a significant positive correlation between the phosphorus and sulfur content was found. Absolute dry matter shows insignificant negative correlations with the P, K, C, S content in dry matter.

## Conclusions

1. The fertilizer rate: P<sub>2</sub>O<sub>5</sub> - 80; K<sub>2</sub>O - 120 (background) (F) (MP2), F+N60 (MP4) and F+N150 (75+75) (MP7) implementation promotes an increase in the phosphorus content in the dry matter for all three varieties of reed canary grass.
2. For the wood-pulp granule standard EN14961 the sulfur content indicator corresponds to the reed canary grass dry matter sulfur content.
3. Comparing the three reed canary grass varieties "Pedja", "Bamse" and "Marathon", the carbon content was higher by 1 % for "Bamse" and "Marathon"; the sulfur content for the varieties "Pedja" "Marathon" was slightly greater than for the variety "Bamse".
4. To understand the chemical element differences for the three reed canary grass varieties "Pedja", "Bamse" and "Marathon", it was clarified that a positive linear correlation is formed by the total nitrogen with phosphorus and carbon, as also phosphorus with potassium; but with the other chemical element relationship there are differences within the framework of the varieties.

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