# REED CANARY GRASS (*PHALARIS ARUNDINACEA* L.) PRODUCTIVITY AND QUALITY DEPENDING ON AGRO-METEOROLOGICAL CONDITIONS

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**Abstract.** The study aims to evaluate the effects of meteorological conditions on reed canary grass (*Phalaris arundinacea* L.) varieties "Marathon" and "Bamse" productivity and energy indicators. The weather conditions in Latvia are favourable in the continent temperature zone and herbaceous crops every year to ensure a stable and high yield. In the territory of Latvia reed canary grass (*Phalaris arrundincacea* L.) biomass today is regarded as one of the alternative sources of raw materials for the production of pellets in the Baltic and Northern Europe. Trials with reed canary grass (*Phalaris arundinacea* L.) varieties "Marathon" and "Bamse" were carried out in 12 August 2008 and 29 April 2009. The ash content of indicators includes 4.91 – 15.51 %. Regression ratio $R^2 = 0.95$ is indicative of significant interconnection between the reed canary grass productivity and meteorology conditions, as well as there is significant interconnection between the ash content of reed canary grass and meteorology conditions ($R^2 = 0.79$).

**Keywords:** *Phalaris arundinacea* L., ash, yield.

## Introduction

Each structural element of the yield (yield, ash content in a plant, etc.) develops within a specific period of time and the meteorological conditions are among the factors that affect the length of the vegetation period [1; 2]. In addition, structural elements of yield respond differently to changes in climatic conditions.

The Latvian climate is favourable for the cultivation of grassland. Productive perennial capacity of the grassland stand provides a perennial and stable biomass production under less favourable climatic conditions, reduces production costs and saves resources [3].

Reed canary grass (*Phalaris arundinacea* L.) growing for energy needs could be an alternative for Latvian farmers, which eliminates, for example, dairy farming. Reed canary grass is used for production of fuel briquettes and pellets [4 – 7], since when these are burnt, less harmful emissions are created (2): carbon dioxide released into atmosphere does not shift the balance in nature and does not involve any increase in the greenhouse effect, as opposed to the effects of black fuel oil or fossil fuel heating (when heating black fuel oil at home is replaced by pellets, the released carbon dioxide pollution is reduced by about 4.8 tonnes per year).

Biomass cultivation could become an alternative to those farmers who have become victims of economic crisis in the country and are unable to continue activities in the former sectors, as well as those whose agricultural land is not suitable for cultivation of cereals. On the other hand, the use of renewable energy resources could ensure national energy independence.

One major source of the fuel material quality characteristics is ash. However, larger quantities of ashes are causing problems to consumers with automation of the combustion process [7].

The objective of the research: to assess the effects of meteorology on the ash content and yield capacity of the reed canary grass (*Phalaris arundinacea* L.) varieties "Marathon" and "Bamse".

## Materials and methods

The field tests with RCG varieties "Marathon" and "Bamse" were carried out in sod-podzolic loamy soil (the organic content of the soil – 5.2 %, pH KCl – 5.8, $P_2O_5$ – 20 mg·kg$^{-1}$, and $K_2O$ – 90 mg·kg$^{-1}$ of the soil) in the Agricultural Science Centre of Latgale. The area of the plots was 16 m$^2$, the location of the plots was randomised. The RCG was sown after bare follow. Before sowing a complex fertilizer was applied N:P:K (5:10:25) – 400 kg·ha$^{-1}$. The RCG varieties "Marathon" and "Bamse" were sown 29$^{th}$ April in 2009. The nitrogen supplementary fertiliser rates: N0 – control, treatments – N30, N60, N90 kg·ha$^{-1}$. N fertilizer (ammonium nitrate) was applied on the 22$^{nd}$ July 2009 and 21$^{st}$ April 2010. On the 13$^{th}$ April 2010 the RCG plant growth was renewed. The dry matter

(DM) samples were taken from 0.25 $m^2$ areas on three replications on the 12th October 2009 and 6th October 2010.

In the winter of 2009/2010 snow was observed to be greater and the temperature was lower than the long-term yearly average. On the 23rd and 24th of April, 2010 there was snow and hail. The plant growth period in 2010 was characterized by higher temperatures and a lack of precipitation in April, July, August and September. In all growth years the hydrothermal coefficient (HTC) was slightly above 1.5. HTC of Selianinov calculated by formule [8]:

$$\text{HTK} = \frac{\sum N}{\sum t_{>10^{\circ}C}} \times 10; \quad (1)$$

where $\sum N$ – sum of the precipitations for the month, mm;
$\sum t_{>10\,^{\circ}C}$ – sum of the temperature above 10 ºC.

Criteria:

HTK ≤ 0.5 – strong, very strong drought;
HTK = 0.6 – weak drought;
HTK ≤ 0.7 – dry conditions;
HTK ≥ 1.0 – characterizes the sufficient moistening.

Table 1

**Hydrothermal coefficient (HTC) in 2009-2010**

| Parameter | 2009 | 2010 |
|---|---|---|
| HTC in April | 0.00 | 0.66 |
| HTC in May | 0.61 | 1.75 |
| HTC in June | 2.23 | 2.77 |
| HTC in July | 2.12 | 0.9 |
| HTC in August | 0.74 | 0.74 |
| HTC in September | 1.68 | 1.71 |

The trial data were processed using regression and variance analyses of two factors (ANOVA) and descriptive statistics. The means are presented with their LSD test. Representative average samples of the indicators were used in the calculations.

**Results and discussion**

Grassland yield is a complex feature, which is formed gradually and is highly dependent on meteorology of the vegetation period [7]. Our research has also shown that the yield and meteorology are significantly interrelated (Fig. 1). The higher HTC, the greater the yield.

Average dry matter yield for reed canary grass varieties “Marathon” and “Bamse” sown in 2009 was 2.02-2.33 $t \cdot ha^{-1}$ dry matter (Fig. 1). The research conducted in Finland has found that the heat quantity from combustion of one tonne of reed canary grass dry matter is 4.5 MWh [4], so from one hectare with such reed canary grass yield the following combustion heat could be obtained: variety “Marathon” – 9.6 MWh, “Bamse” – 11.9 MWh.

When comparing the specific weight of impact on the ash content of different factors for varieties of reed canary grass sown in 2009, it was found that there are significant ($p < 0.000$) impacts between the varieties (22.8 %) and norms of additional N fertilizers used (24.6 %), as well as high specific weight of impact for the factors being not subject to the research – 22.3 %. It is likely that to these results the differences between the varieties and meteorological conditions have contributed, which have made analysis of the factors subject to the research (norms of variety and N additional fertilizer) difficult [6]. The incombustible part of the fuel material consists of ashes. Ashes are those mineral substances that are left over when fuel is burnt down, or inorganic substances [7]. Considering the HTC and ash content interconnections, it is evident that the meteorological conditions are important factors (Fig. 2). The ash content for the “Bamse” variety in 2009 was higher than for the “Marathon” variety, i.e., 15.4 % on average.

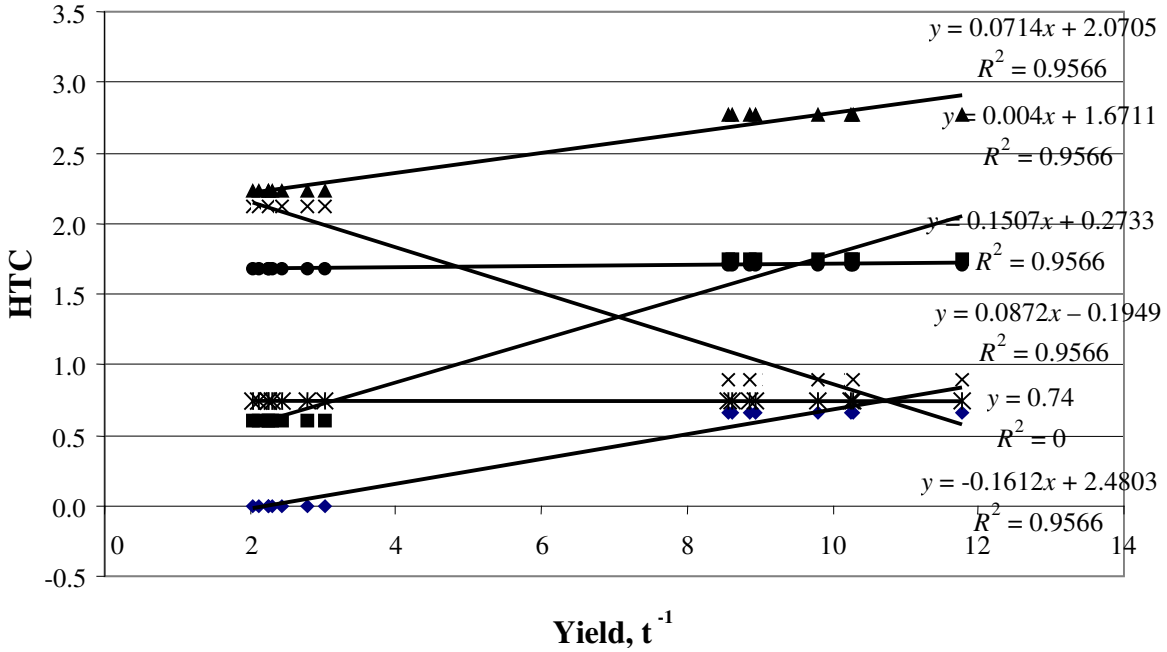


Fig.1. **Interconnection between hydrothermical coefficient and yield of reed canary grass in 2009-2010**

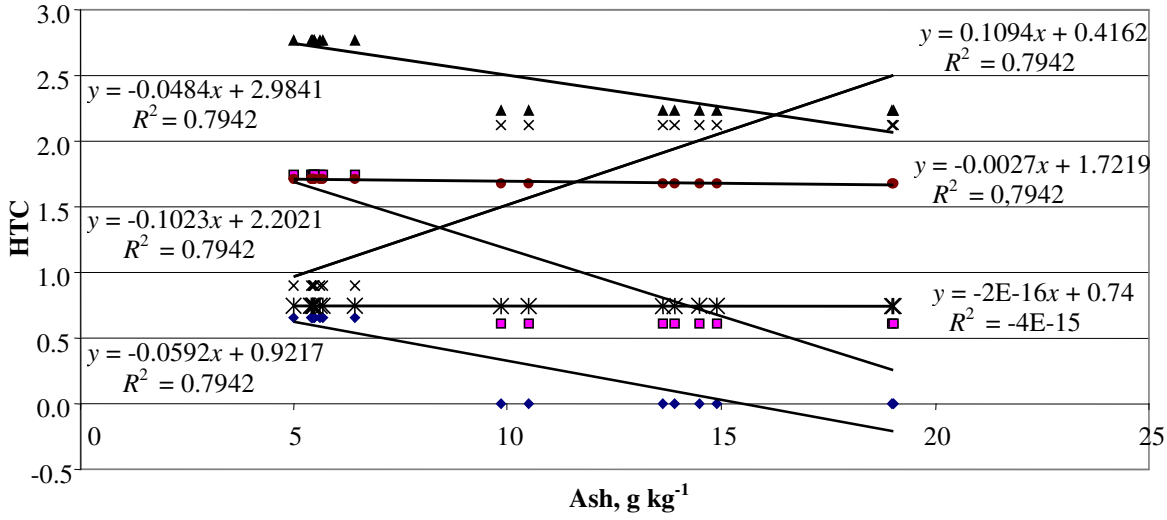


Fig. 2. **Interconnection between hydrothermical coefficient and ashes in 2009 – 2010**

Wood processing companies in Latvia are using a variety of wood raw materials. As a result manufacturers of pellets and other biomass fuels are starting to observe the lack of raw materials and research of new, non-traditional materials – grassland, including reed canary grass – is going on in Latvia. As noted by scientists [4; 5], perennial cultivated plants have a positive impact on the environment because they reduce soil erosion and improve the soil quality. Therefore, it is important to continue research on the possibilities to use reed canary grass for production of solid biofuels.

## Conclusions

1. The regression coefficient is $R^2$ = 0.95, which is indicative of significant interconnection between the productivity of reed canary grass and meteorology. The productivity of reed canary grass develops on a continuous basis and depends on meteorology during the whole vegetation period.

2. The regression coefficient $R^2$ = 0.79 indicates that there is a significant interconnection also between the ash content and meteorology.
3. Reed canary grass is indiscriminative in terms of soil and high-yielding, it can be used for production of thermal energy in Latvia – for making pellets. Use of the first year yield of reed canary grass would not be desirable for production of biofuels, since biomass is with high ash content.

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