CHANGES IN THE CONTENT OF DRY MATTER AND ENERGY DURING THE DEVELOPMENT OF MAIZE

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ABSTRACT

The aim of this study is to study and evaluate the results of changes in the content of dry matter and energy content during genetic development in selected genotypes of maize which have been sown and grown in a field trial. This study was carried out on land blocks in the ZD Krásná Hora nad Vltavou, the aim being to determine genotypic differences in dry matter and energy in the sown maize. In a pilot experiment three genotypes of maize were tested: Sumaris variety, which the vendor recommended for silage for biogas production; Surael: Fit for silage for livestock feed or in biogas plants and the cultivation of grain; Kuratus: recommended for silage for biogas stations with a tendency to have the “stay green” effect. This is the first genetically modified hybrid (GMO) from KWS in the country. Using combustion calorimetry, was of dry plant material of the institutions determining the contents of energy-rich compounds. The gross calorific value were measured gross calorific value calorimeter IKA C 200. Weight maize corn and net energy content were influenced not only by vegetable material, but also ontogenetic development of plants, and weather in the growing year. Lowest corn weight was established in genotype Surael in 2011 (66.79 g) and the highest weight (284.68 g) was established in 2010, also in the same variety. The lowest value of the net energy spike was established in 2011 in the fourth sampling for genotype Surael (14.91 $kJ.g^{-1}$) and the highest net energy value of 19.02 $kJ.g^{-1}$, which was established in genotype Sumaris was also the fourth sampling in the same year.

Key words: dry matter, materiality, energy

Introduction

The aim of is to determine genotypic differences in both mass and the amount of energy in corn. Among the tested variants were the three genotypes of maize. Sampling the plants were allowed to dry and then weighed. We used the calorimeter for different parts of plants in determining the energy. The test material was corn. Corn is not only an important cereal, but they also have other uses such as animal feed or as a source of renewable energy. The two selected genotypes (Kuratus and Sumaris) were recommend by vendors as the most profitable silage for biogas. The third genotype (Surael) is a new variety, which should also be on silage for biogas production. The importance of corn to mankind is obvious, because they are among the most important cereals in the diet of people today and an important feed, industrial, and energy crops along with wheat, rice and sorghum. A comparison of the sown area, total harvest, and yields of the four major cereals shows that corn is not only productive, but also provides the best conditions for further growth in its revenues due to the level bred and use of GMOs. Corn is a crop with a very wide range of options that are now used much more than in the past (wet grain harvest, the raw material for the production of isoglucose, biogas and ethanol, higher use in human nutrition, etc.).

MATERIAL AND METHODS

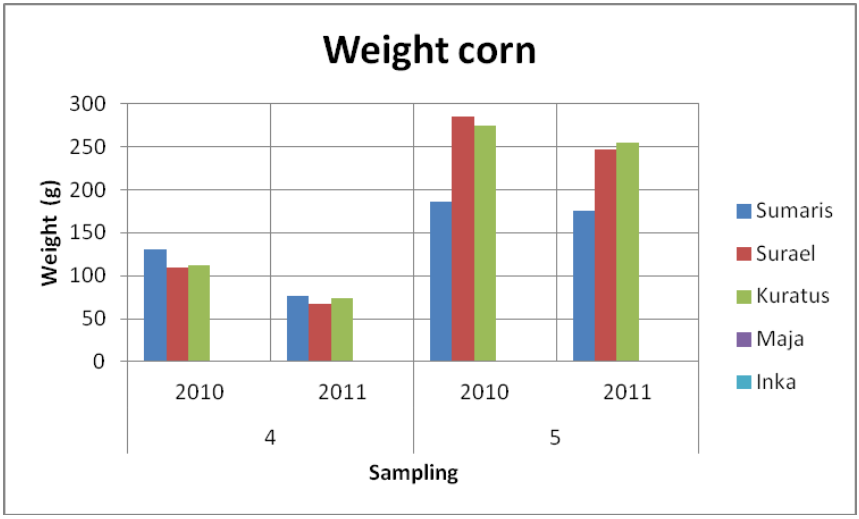
The plant material was chosen after consultation with the principal agronomist ZD Krásná Hora nad Vltavou a. s. These are the three genotypes of maize which were sown: Sumaris from the company Saaten-Union, Kuratus (GMO), and genotype (Surael). From each genotype is selected developmental stages (13, 24, 53, 69, 83). From experimental plots were removed twenty-five plants in four replications. The plant material was divided into different organs (roots, stems, leaves and reproductive organs) and was analyzed in the laboratory of the Department of Botany and Plant Physiology CUA in Prague. The samples were dried to constant weight at 80°C, according to the guidelines Šesták et al., (1965). The method of combustion kalorimetry was determined of the biomass by change in energy content. The principle of combustion calorimetry is burning weighed samples introduced into the combustion bomb at 100% oxygen atmosphere. The values of thermal jump determine the content of gross energy (the amount of energy converted to 1 gram dry weight of ash) and net energy (net amount of energy converted to 1 gram ash-free dry weight) in the organs of the plant body. The net energy content of biomass was determined on semi-isoperibolic gross calorific value calorimeter IKA C 200, German company IKA.

RESULTS AND DISCUSSION

In all three genotypes of maize corns began to differentiate in the fourth and fifth samplings. In the fourth sampling in 2010 was the highest cob weight in the variety Sumaris (130.41 g) and in the second year (76.91 g). But the weight was lower in comparison with varieties Surael and Kuratus, where the value of 245 g. Genotype Sumaris weight corn in 2010, 186.49 g, and 175.24 g in 2011 between genotype and Surael and Kuratus were found significant differences. For maize varieties Surael the fourth collection of 2010 corn weight 109.59 g and 2011 66.79 g. This genotype significantly increased the weight of the corn in the fifth term in 2010 to 284.68 g and 247.13 g the year after of similar trend was also observed in genotype Kuratus, in which the weight of the spike in 2010 and 2011, (111.69 g and 74.23g, respectively) (4th term) at a later date the weight of 273.82 g and 254.67 g. The difference between the highest and lowest weight corn was quite extreme. Maximum weight corn was established in 2010 in the fifth sampling for genotype Surael, and 284.68 grams while the lowest weight was measured in genotype Sumaris 186.49 g, where the difference between the two genotypes reported 98.19 g. By Natr (1976) who believes that the theoretical 1 % utilization of solar radiation is fixed solar energy entirely sufficient for achieving high productivity. Reducing the amount of energy accumulated in the generative organs of wheat

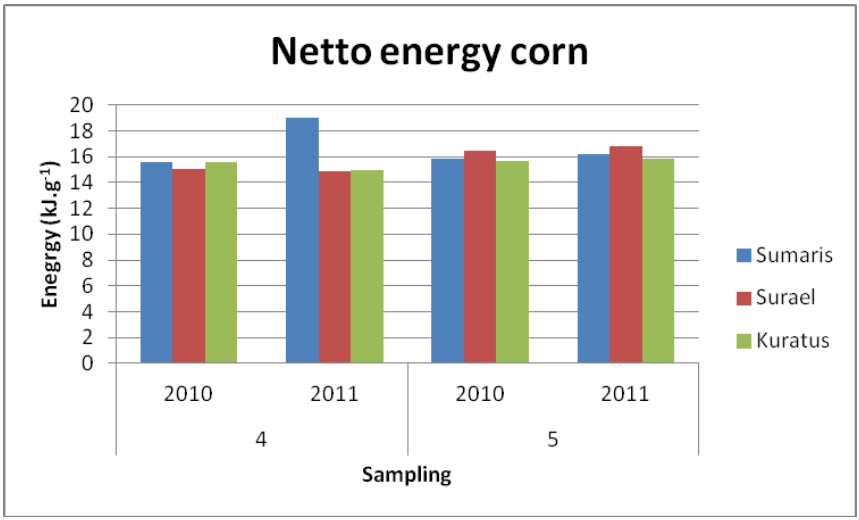
after exposure to abiotic stressors, such as drought, high temperature, in their work and Firlová and Simon (1978). Usable energy from biomass is currently very promising. Research by the so-called energy crops is focused on crops with high biomass production and energy yield. When evaluating these crops yield is monitored, calorific value per unit weight of dry matter and economic profitability thus obtained energy (Petříková, 1996).

Graph. I. Weight corn in the fourth and fifth collection for 2010 and 2011



Graph has less values because differentiation of generative organs began in the second half of the vegetation. Genotype Surael had the final collection of the highest net energy value in both years of testing. For 2010, the net value of fixed energy kJ.g^{-1} 16.49 – 16.76 2011 kJ.g^{-1}. Corn Kuratus, which had a very balanced net energy values of corn during the growing season, but were not provided the highest values in this chart. Ranged from 14.91 to 15.85 kJ.g^{-1}. The highest value of net fixed energy was recorded in the fourth Sumaris corn consumption for 2011 19.02 kJ.g^{-1} and the fifth was a net energy consumption for 2010 15.85 kJ.g^{-1} and for year 2011 16.23 kJ.g^{-1}, when slightly lagged behind Surael genotype. Among all samplings generative parts of plants tested for both years were net energy value relatively constant balance. Net energy spike was between the values kJ.g^{-1} from 16.67 - 14.91 kJ.g^{-1}. Only the genotype Sumaris the fourth collection of 2011 increased the value of the net energy value of 19.02 kJ.g^{-1}. During maturation, the greatest amount of energy is accumulated in the buds and reaches values that are comparable to the amount of energy located in the remaining part of the plant, leaves and stems (Fuksa et al., 1999). The energy value of plant material is a function of genotype and depends on the environmental conditions - irradiance, photoperiod, nutrient availability, soil types, etc. (Golley, 1961; Hnilička et al., 2009). Hoffmann (1988) found that in 14 -day-old wheat plants different calorific values of plant parts at different developmental forms. The measured values of the average bracts samples varied from 18.6 kJ.g^{-1} to 20.5 kJ.g^{-1}, the stalks from 17.9 kJ.g^{-1} to 24.1 kJ.g^{-1} and corn from 14,3 kJ.g^{-1} to 18,4 kJ.g^{-1} of dry ash-free. According Hniličková et al., (2002), during the growing period, a gradual increase in the total amount of energy in the plant is observed.

Graph. II. Weight corn in the fourth and fifth collection for 2010 and 2011



CONCLUSIONS

In terms of the field train three genotypes were grown maize (SUMARIS, SURAEL, KURATUS). Net energy kontent was determined by combustion calorimetry the tested genotypes in plant organs, then followed the mass of plant parts. From the obtained results, the following conclusions, which can be observed: The weight of the spike showed higher values of genotypes from the breeding company KWS. All three genotypes showed similar values of net energy and can therefore be concluded that it is possible to use all three genotypes for cultivation in the area and subsequent processing silage with good energy yield.

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