Comparison of nutrient composition of sorghum varieties depending on different soil types

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Abstract: The aim of this study was made to compare the nutrient composition of 7 selected varieties of sorghum. The comparison was done two different localities, with different soil types (clay loam soil – fluvial soil and light sandy soil) in the region of South Moravia. The sampling of sorghum varieties were at two different locations and was realized 12 weeks after sowing, followed by analysis of nutrient composition as dry matter, N-substances, fibre, ADF - Acid Detergent Fibre and NDF – Neutral Detergent Fibre. Based on the data found it was concluded that it depends more on sorghum variety and its form than on the soil type.

Key Words: sorghum, silage sorghum, nutrition, C4-plants, chemical composition

INTRODUCTION

Origins of wild predecessors of *Sorghum bicolor* (L.) Moench extend to year 8000 BC in African countries such as Sudan and Ethiopia, but later it spread further to the world and it is heavily used as a multifunctional crop nowadays (Gamar et al. 2018, Venkateswaran et al. 2018). Main producers are U.S.A., Nigeria and India, with world annual production of almost 64 million tonnes (Tayyib et al. 2016). It is known for its high drought resistance, with capacity to extract soil water from up to 114 cm from the plant's position (Nielsen et al. 2018).

Primarily is sorghum used as a cereal in human diet comparable to other grains. Nutritional value is high due to 4.4–21.1% protein, 2.1–7.6% fat, 1.0–3.4% crude fibre, 57.0–80.6% total carbohydrates, 55.6–75.2% starch, 1.3–3.3% total ash, total minerals 179–1360 mg per 100 g and unique phytochemicals (Ratnavathi 2019). Some authors compare its feeding value to corn, it has potential to be used in forage and silage for ruminants or added into dry food formulations for pets (Alvarenga et al. 2018, Ronda et al. 2018, Vermerris et al. 2013).

Other uses of this C4 crop include fibre and biofuel crop with growth period of only 3–5 months (Barcelos et al. 2016, Sathya et al. 2016). However the ethanol yield per hectare of sorghum is estimated to 13 600 l (Barcelos et al. 2016). Sorghum is also being tested for its phytoremediation use thanks to its ability to absorb heavy metals from soil, unfortunately insufficiently in field conditions (Sathya et al. 2016, Soudek et al. 2014).

The aim of this study was compare the nutrient composition of selected varieties of sorghum at two different locations, resp. different soil types in South Moravia region.

MATERIAL AND METHODS

Characteristic of field experimental station in Žabčice

The field experiment was realised in Žabčice, GPS location Obora (49°011596.7N 16°602572.2E), and Písky (49°0041.8N 16°3609.3E). 179 meter above sea level, located in maize production area of the region of South Moravian. This territory belongs among the warmest regions in the Czech Republic. The drought is increased by the winds that cause a large evaporation of soil moisture.

There were two locations where the sorghum was sown. First location named Obora has clay loam soil and the soil type is fluvial soil. Obora has good availability of groundwater (Svratka River), which fluctuates 0.8–2.5 m below the soil surface during the year. The second location named Písky has light sandy soil and it is drier than the first. Part of the seeds was furnished by KWS Company and SEED SERVICE Company. The soil was prepared on the 24th April 2018 with harrows, than the first sowing was done on the 24th May 2018, in 3cm depth. Harvesting has taken place on the 21th August 2018, 12 weeks after sowing. Parcels size is 18.1 m².

Characteristic of selected varieties

Seven varieties were chosen: DSM 45-480, Sweet Susana, Buffalo Grain BMR, Big Kahuna BMR, Nutri Honey BMR, Nutri Honey and KWS Freya.

Sampling of sorghums varieties (7 on Obora and the same 7 varieties on Písky location) was realized on the 28th July 2018 (12 weeks after sowing). From each variety was sampled about 2 kg of fresh matter, then the samples were chopped and processed.

Data has been processed by Microsoft Excel (USA) and Statistica version 12.0 (CZ). We used one-way analysis (ANOVA). To ensure evidential differences, Schaeffer's test was applied and $P < 0.05$ was regarded as statistically significant difference.

RESULTS AND DISCUSSION

The important indicator of sorghum quality by silage preparation is dry matter, which should be between 28% and 35% in silage harvest period. From Table 1 can be seen that dry matter values of sorghums are very different – they range from 17% to 29%. Big Kahuna BMR has lower dry matter value; conversely the highest value was apparent in DSM 45-480 variety on both locations and variety KWS Freya at Obora location. Dry matter value correlated with earliness of varieties. From Table 1 is apparent that some varieties mature earlier than others.

Přikryl et al. (2010) compared changes in nutritive value of sorghum depending on the date of sampling. He decided the optimal time for the preservation of sorghum was determined when the dry matter was about 16%. He said for the preservation of sorghum is necessary to choose a two-phase harvest with respect to the low content of dry matter. By intensive withering is necessary to adjust the dry matter content to at least 28%. So he decided to choose phase with low dry matter, and his experiment was based on other parameters, especially N-substances. At this time was N-substances value 17.1% which is optimal.

Rajčáková (2005) compared sorghum at four different locations in south Slovakia. She determined N-substances in range 13.1–18.6% also in optimum values.

N-substances are the highest quality indicator of sorghum. Range of N-substances contain in sorghum is from 13% to 18% (Doležal 2014). The results in table 1 show that N-substances are relatively low, especially at Obora locations, even though urea fertilization. Second habitat Písky, which should be less productive, was not fertilized by nitrogen and had highest contain of N-substances. This may correspond with the fact that the soil is well supplied by nitrogen. However, low values do not mean problem, because we can increase N-substances in crop by higher fertilization.

Another important parameter is NDF. Professional literature states that if the NDF content is too high, it cause increase of feed volume and reduce the potential intake of dry matter by animals. The range of NDF values by Rajčáková (2005) was from 54% to 55.2%. In our research were the values of this parameter from 41.72% to 54.12%, this is very large dispersion which related to the content of fibre. These results demonstrate large divergence among selected varieties. Differences between habitats are not too high, but it depends on variety.

The dry matter is more or less the same on both location, the more fertile Obora and less fertile Písky, it depends mainly on the variety of sorghum. Only N-substances and ash are heavily influenced by habitat conditions, but these parameters can be affected mainly by fertilization.

Table 1 Nutritional characteristics of different sorghum varieties collected on 21th august 2018

1.	DSM 45-480	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		29	8.50	2.61	19.48	22.17	41.72
Písky		29	8.38	2.58	29.66	32.08	54.04
2.	Sweet Susana	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		27	8.08	2.03	28.66	37.54	54.58
Písky		27	12.62	2.53	22.07	25.24	50.4
3.	Buffalo Grain BMR	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		23	7.89	2.53	24.28	27.32	47.30
Písky		22	14.05	2.92	21.66	23.77	48.00
4.	Big Kahuna BMR	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		19	9.10	2.66	25.58	29.26	48.06
Písky		17	14.2	2.72	23.28	24.64	47.05
5.	Nutri Honey BMR	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		23	7.94	2.3	24.94	28.04	47.58
Písky		21	10.99	2.8	26.14	30.14	50.83
6.	Nutri Honey	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		27	7.11	2.21	23.46	30.01	44.92
Písky		27	9.08	2.7	21.98	26.41	45.46
7.	KWS Freya	Dry matter	N-compounds	Fat	Fibre	ADF	NDF
Obora		29	6.59	2.06	30.51	34.73	54.12
Písky		26	10.02	2.12	25.86	29.05	49.63

Legend: ADF – Acid Detergent Fiber, NDF – Neutral Detergent Fiber

CONCLUSION

The results of this research testify that differences of selected nutrition parameters between comparing locations are not too high. And this is very interesting detection, because we can state that both locations are appropriate for sorghum growth – dried and less fertile Písky as well as more fertile Obora. The results show that dry conditions of South Moravia region are not problem for sorghum growing. In some cases can be desirable because of differences in specific parameters.

It cannot be state that the dry matter is demonstrably higher at one or at the other habitat; it depends mainly on the variety of sorghum. Only N-substances and ash are heavily influenced by habitat conditions, but these parameters can be affected mainly by fertilization.

But if we talk about differences between grain and non-grain forms of sorghum regardless of habitat, we can state that these divergent are very big. So the form of sorghum is also very important if we have to choose the ideal sorghum variety for animal nutrition.

ACKNOWLEDGEMENTS

The research was financially supported by the AF-IGA-2018-tym001: Comparison of the impact of climate change on photosynthesis C3 and C4 plants cycles which are used in livestock feed.

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