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SWEET POTATO (*IPOMOEA BATATAS* L.) GROWING IN CONDITIONS OF SOUTHERN SLOVAK REPUBLIC

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ABSTRACT

The sweet potato (*Ipomoea batatas* L.) belongs to very important crops from aspect of its world production. It is grown in large areas in Asia, on the contrary, sweet potato production in Europe presents minimal part of its total world rate. The sweet potato is less-known crop, grown only on small area in home gardens in Slovak Republic. Tubers of sweet potato are characterized by anti-diabetic, anti-oxidant and anti-proliferative properties due to the presence of valuable health-promoting components, such as carotenoids or vitamin C. The main objective of study was testing of sweet potato growing in conditions of southern Slovak Republic with focus on quantity and quality of its yield. The field trial was realised on land of the Slovak University of Agriculture in Nitra in 2015. Within trial, effect of cultivar and mulching on the selected quantitative (average tuber weight; yield per plant; yield in $t.ha^{-1}$) and qualitative (total carotenoids; vitamin C) parameters were tested. One certified cultivar of sweet potato 'Beauregard' was used as a comparative cultivar. Other two cultivars were marked according to the market place at which were purchased and sequentially used for seedling preparation. Tubers of first un-known cultivar were purchased in the Serbian market (marked as 'Serbian'). Tubers of next sweet potato cultivar were purchased on the market in Zagreb (marked as 'Zagrebian'). Outplating of sweet potato seedlings were realised on the 19th May 2015. The sweet potato was grown by hillock system. Each cultivar was planted in two variants (rows): non-mulching (bare soil) and mulching by black non-woven textile. All variants were divided to three replications with 6 plants. Difference between rows was 1.20 m and seedlings were planted in distance of 0.30 m in row. The harvested tubers were classified in two size classes: >150 g (marketable yield) and <150 g (non-marketable yield). Total carotenoid content was determined spectrophotometrically. The vitamin C content was measured chromatographically (HPLC). The highest values of average tuber weight, yield per plant and total yield ($t.ha^{-1}$) were found in cultivar 'Serbian'. Statistical analysis showed statistically significant difference in all yield quantitative parameters of cultivar 'Serbian' against cultivars 'Beauregard' and 'Zagrebian'. The highest content of total carotenoids was determined in cultivar 'Serbian' (99.52 $mg.kg^{-1}$ fresh weight) with orange-creme flesh color, followed by cultivar 'Beauregard' (94.78 $mg.kg^{-1}$) with orange flesh color and cultivar 'Zagrebian' (28.79 $mg.kg^{-1}$) with yellow-creme flesh color. Differences among all cultivars were showed as statistically significant. The highest vitamin C content was detected in tubers of cultivar 'Serbian' (155.70 $mg.kg^{-1}$), followed by cultivar 'Beauregard' (154.37 $mg.kg^{-1}$) and cultivar 'Zagrebian' (146.33 $mg.kg^{-1}$). Statistical analysis confirmed differences among cultivars as statistically non-significant. The mulching of sweet potato plants had statistically significant impact to all quantitative and qualitative characteristics of sweet potato. The application of black non-woven textile resulted in increase of average tuber weight, tuber yield and vitamin C content in sweet potato tubers. On the contrary, higher total carotenoid content was found in non-mulching variant compared to the variant with mulching.

Keywords: Slovak Republic; sweet potato; yield; carotenoids; vitamin C

INTRODUCTION

The sweet potato (*Ipomea batatas* L.) belongs to the *Convolvulaceae* family and it is original from South America. Due to Christopher Columbus, it was imported to the Europe about century earlier than classical potatoes - *Solanum tuberosum* L. **(Valíček et al., 2002)**. According to **FAOSTAT (2016)**, total world production of sweet potato tubers was more than 100 milions tones in 2014. The main production area was Asia (75.3 %), followed by Africa (20.2 %), American continents (3.7 %) and Oceania (0.8 %). Sweet potato production in Europe presented the least part of its total world value (0.1 %) and the European production was only 56 113 tones in 2014. The main European producers of sweet potatoes was Spain and Italy. From world-wide aspect, China is the main producer of sweet potatoes within recent period. The production of this commodity was more than 70 milions tones in 2014. The other important producers was Nigeria, Tanzania, Ethiopia or Indonesia. **Šlosár (2016)** state that sweet potatoes are less-known crop, grown only on small area in home local gardens in Slovak republic.

The sweet potato, known as batatas, is well known long-term species in a warm and hot climate zone and an annual plant (spring) in temperate zone. It produces moist and delicate tubers with a sweetish taste, pleasant and aromatic smell. In addition, young leaves can also be used for consumption **(Antonio et al., 2011)**. Tubers are characterized by diverse size, shape (round, ovate, elliptic etc.), skin and flesh color (white, cream, yellow, orange, red or purple), depending on a cultivar **(Moulin et al., 2012)**.

The main nutritional compounds in tubers of sweet potato are carbohydrates (simple sugars and starches), proteins, fats and fat-soluble vitamins **(Allen et al., 2012)**. The glycemic index of sweet potatoes is quite high, thus, it is unsuitable for diabetics and overweight persons. Total carbohydrate content of this crop is 201 g. kg^{-1} of fresh weight (f. w.); starch content is 160 $g.kg^{-1}$ and soluble sugar content is 42 $g.kg^{-1}$ f. w. The proteins and fats are contained in sweet potatoes in small quantities **(Maria and Rodica, 2015)**. According to **USDA (2015)**, energetical value of fresh sweet potato is 359 kJ per 100 g. From mineral complex, potassium (337 mg.100 g^{-1}), sodium (55 mg) and phosphorus (47 mg) are the most abundant in sweet potato tubers.

Tubers of sweet potato are characterized by anti-diabetic, anti-oxidant and anti-proliferative properties due to the presence of valuable nutritional and mineral components **(Abubakar et al., 2010)**. Sweet potato cultivars with an orange or yellow flesh contain significant amounts of carotenoids which are known as provitamins A **(Allen et al., 2012)**. Carotenoids show strong antioxidant capacity to scavenge free radicals because of their conjugated double bonds **(Fu et al., 2011)**. **Lichtenstein (2009)** indicates that carotenoids or their metabolites are associated with cardiovascular diseases. According to **Rao and Rao (2007)**, higher carotenoid intake in the food form helps to decrease of several cancer type risk (stomach, colon or larynx) and prevent to bone calcification, eye degeneration and neurotic diseases.

The vitamin C, also known as ascorbic acid, is another important substances within vitamin complex in sweet potato tubers **(USDA, 2015)**. Due its properties, vitamin C is characterized as very effective antioxidant. The human organism is not able to synthesize vitamin C, thus, it must be ingested in the food form, mainly vegetables and fruits **(Keresteš et al., 2011)**. The vitamin C plays an important role in immune system, stimulation of leucocytes to the increased bacteria degradation, secretion of antibodies and body resistance increase to the coldness **(Hacişevki 2009)**. According to **Feiz and Mobarhan (2002)**, sufficient vitamin C intake helps to eliminate *Helicobacter pylori* bacteria considered as important risk factor in stomach cancer formation. **Iqbal, Khan and Khan Khattak (2004)** state that vitamin C contributes to prevent human organism by elimination of nitrosamine formation which descend from nitrates contained in many food sources.

The main objective of present study was testing of sweet potato growing in conditions of southern Slovak Republic with focus on selected quantitative and qualitative parameters of its yield.

MATERIAL AND METHODOLOGY

The field trial with sweet potato was realised on the land of the Slovak University of Agriculture in Nitra in 2015. The experimental area is situated at an absolute altitude of 144 m above sea level. The climate of experimental area is characterized by warm and dry summer and slightly warm, dry or very dry winter. According to the climatic normal 1951-2000 for Nitra, annual mean temperature is 9.9 °C and mean rainfall total is 548 mm **(Šlosár and Uher, 2013)**. Within trial year 2015, the average month air temperature was 11.5 °C. The rainfall total was 418.2 mm in 2015.

Plant material

Sweet potato seedlings were purchased from Croatian producer (Ing. Darko Ďurica, Ilok). According to him, the situation with cultivar sortiment of sweet potato in Europe is often unclear and confusing. A lot of producers, including him, produces seedlings according to the tuber availability on the market. Thus, the origin of sweet potato seedlings on market is often un-known.

Within trial, one certified cultivar of sweet potato 'Beauregard' was used as a comparative cultivar. Other two cultivars were marked according to the market place at which were purchased and sequentially used for seedling preparation. Tubers of first un-known cultivar were purchased in the Serbian market. In this study, cultivar is marked as 'Serbian'. Tubers of next cultivar of sweet potato were purchased on the market in Zagreb (Croatia). Within study, the cultivar is marked as 'Zagrebian'.

Experiment organisation

The sweet potato is warm-requiring crop. It needs warm season lasting at least four month with an average temperature more than 20°C and without freeze **(Antonio et al., 2011)**. From this reason, outplanting of sweet potato seedlings was realised on the 19th May 2015 when the risk of later spring freeze is reduced.

Within soil preparation for sweet potato growing, nitrogen was only applied on the soil supply level of 60 $kg.ha^{-1}$ according to results of agrochemical soil analysis (tab. 1). The sweet potato plants were grown by hillock system, similar to the carrot growing (height of 0.30 m). The distance between hillock rows was 1.20 m. In each row, 18 sweet potato seedlings were planted in distance of 0.30 m. Rows for all tested cultivars and variant were divided to three replications with 6 sweet potato plants.

Within experiment, two variants for each cultivar were tested:

- non-mulching - bare soil (one row),

Table 1 Agrochemical soil characteristics before trial realisation.

pH_{KCl}	Humus (%)	Nutrient content ($mg.kg^{-1}$ of soil)					
		N_{min}*	P	K	Ca	Mg	S
7.16	3.25	19.1	245	149.5	6340	643.5	7.5

Note: *N_{min} - N mineral (N inorganic).

- mulching by black non-woven textile (one row).

The harvest of sweet potato tubers was realised on the 6th October 2015.

Morphological characteristics of cultivar

Selected morphological parameters of tubers for each cultivars were evaluated in order to its more accurate characteristics (table 2). It was realised by using of relevant international descriptor for sweet potato - *Ipomoea batatas* L. **(UPOV, 2010)**. The evaluation of morphological characteristics was done in 20 tubers of each cultivar. Following parameters of tubers were evaluated:

- shape,
- main color of skin,
- secondary color of skin,
- main color of flesh,
- intensity of main color flesh,
- secondary color of flesh,
- depth of eyes.

Quantitative parameters of sweet potato

Harvested tubers of sweet potato were classified according to average weight of tubers in two size classes:

- >150 g - marketable yield of tubers,
- <150 g - non-marketable yield of tubers.

Within experiment, average weight of tubers (g) and average yield quantity per plant (g) were evaluated. The sweet potato yield in $t.ha^{-1}$ was calculated on the basis of average plant yield. The density of plants, used for calculation, was 27 000 seedlings per hectare with using the same plant spacing as it was in realised experiment.

Total carotenoid content estimation

The estimation of total carotenoid content was realised in the laboratory of Department of Vegetable Production SUA in Nitra. The content of total carotenoids was estimated by spectrophotometric measurement of substances absorbance in petroleum ether extract on spectrophotometer PHARO 100 at 445 nm wavelengths. As an extraction reagent, acetone was used acetone **(Hegedüsová et al., 2007)**.

Vitamin C content estimation

The estimation of total carotenoid content was realised in the certified laboratory of Regional Public Health Authority in Nitra. HPLC method of vitamin C content estimation **(Stan, Soran and Marutoiu, 2014)** was used by the help of liquid chromatograph with UV detector, for separation was used RP C18 column, mobile phase was methanol : water (5:95, v/v), UV detection was adjusted to 258 nm (HPLC fy. VARIAN).

Statistical analysis

A statistical analysis was performed using Statgraphic Centurion XVII (StatPoint Inc. USA). Obtained results were evaluated by analysis of variance (ANOVA) and average values were tested by Tukey HSD test performed at the significance level of 95%.

RESULTS AND DISCUSSION

Average weight of sweet potato tubers

From aspect of marketable yield, the statistical analysis showed statistically significant differences of average tuber weight (AW) among cultivar 'Serbian' and cultivars 'Beauregard' and 'Zagrebian' (tab. 3). Difference between cultivars 'Beauregard' and 'Zagrebian' was evaluated as statistically non-significant. From aspect of marketable yield part (tuber > 150 g), values of AW were varied from 332.73 g ('Zagrebian') to 428.15 g ('Serbian'). Values in this range were similar to results in study of **Maria and Rodica (2015)** who found variability of AW from 210 g to 400 g in experiment in Romania. Similarly, **Ellong, Billard and Adenet (2014)** also found higher AW (308.91-647.75 g) in Martinique compared to our results. Thus, it is evident that locality for sweet potato growing expressively affects the awerage tuber weight, one of the

Figure 1 Sweet potato cultivars in realised treatment.

most important parameters of sweet potato from aspect of its total production.

Regarding to non-marketable part of sweet potato yield (<150 g), AW was ranged from 36.00 g ('Serbian') to 58.94 g ('Beauregard'). Statistical analysis of results showed statistically significant differences of its values among all tested cultivars.

Yield of sweet potato tubers per plant

Values of yield/plant (marketable yield) were increasing from 1185.62 g 'Zagrebian' to 1455.54 g 'Serbian'. Difference between mentioned values was evaluated as statistically significant. On the contrary, statistical analysis showed statistically non-significant difference between cultivars 'Beauregard' and 'Zagrebian'. **Yildirim, Tokuşoğlu and Öztürk (2011)** tested the impact of genotype on the yield of sweet potato per plant (13 genotypes) in Turkey. Its values, found by authors, were ranged from 210.5 g 621.8 g. It means markedly lower range of values compared to our trial results. The lower yield of sweet potato per plant (380-460 g) was also presented in study of **Uwah et al. (2013)**. On the contrary, **Maria and Rodica (2015)** reached comparable tuber yield per plant (1071-1600 g) to obtained trial results.

The yield of non-marketable tubers per plant was varied from 106.07 g ('Zagrebian') to 241.96 g ('Beauregard'). According to the statistical analysis, statistically significant differences between cultivars 'Beauregard' and 'Serbian'/'Zagrebian' were found.

Yield of marketable sweet potato tubers per hectare

The total marketable yield of sweet potato, in dependency on cultivar, was ranged from 32.01 $t.ha^{-1}$ ('Zagrebian') to 39.30 $t.ha^{-1}$ ('Serbian'). Statistical analysis confirmed statistically significant difference of yield between mentioned cultivars, similarly as between 'Beauregard' and 'Serbian'. Yield difference between cultivars 'Beauregard' and 'Zagrebian' was evaluated as statistically significant. **Maria and Rodica (2015)** found expressively higher yield in sweet potato cultivar 'Pumpkin' (53.3 $t.ha^{-1}$) compared to our results. On the contrary, total yield of cultivar 'Chestnut' (35.6 $t.ha^{-1}$) was comparable to results in our study. Comparable values of sweet potato yield were presented by **Jian-wei et al.**

Table 2 Evaluated morphological characteristics of sweet potato tubers.

Tuber parameters	Beauregard	Serbian	Zagrebian
Shape	oblong	ovate	ovate
Main color of skin	brownish orange	purple red	medium purple
Secondary color of skin	pink	orange	orange
Main color of flesh	orange	orange	yellow-creme
Main flesh color intensity	medium	medium	light
Secondary color of flesh	absent	beige	orange
Depth of eyes	shallow	medium	shallow

Table 3 Effect of cultivar on quantitative parameters of sweet potato yield.

Cultivar	Marketable tubers (>150 g)			Non-marketable tubers (<150 g)		Ratio of marketable tubers
	AW* (g)	Yield/plant (g)	Yield ($t.ha^{-1}$)	AW* (g)	Yield/plant (g)	(%)
Beauregard	348.54^a	1213.34^a	32.76^a	58.94^c	241.96^b	81.58^a
Serbian	428.15^b	1455.54^b	39.30^b	36.00^a	116.63^a	92.82^b
Zagrebian	332.73^a	1185.62^a	32.01^a	48.36^b	106.07^a	91.31^b

Note: * AW - average weight of sweet potato tubers.
Different letters (a; b; c) within the same column means statistically significant difference (at 95.0 % confidence level).

Table 4 Effect of mulching variant on quantitative parameters of sweet potato yield.

Cultivar	Marketable tubers (>150 g)			Non-marketable tubers (<150 g)		Marketable share of tubers
	AW* (g)	Yield/plant (g)	Yield ($t.ha^{-1}$)	AW* (g)	Yield/plant (g)	(%)
Non-mulching	232.24^a	981.05^a	26.49^a	52.03^b	164.42^a	85.46^a
Mulching	351.76^b	1588.62^b	42.89^b	43.51^a	145.53^b	91.68^b

Note: * AW - average weight of sweet potato tubers.
Different letters (a; b; c) within the same column means statistically significant difference (at 95.0 % confidence level).

(2001) who grown this crop in nine localities in China. The average yield of sweet potatoes, found in Chinese study, was 36.7 $t.ha^{-1}$. The marketable yield of sweet potato cultivar 'Beauregard' (22.5 – 36.8 $t.ha^{-1}$ in depdendency on vegetation period) presented by **Bonte and Wilson (2008)** was also comparable to the yield of this cultivar found in our trial. Within study of **Uwah et al. (2013)**, total yield of sweet potato was varied from 20.8 $t.ha^{-1}$ to 25.5 $t.ha^{-1}$ in dependence on the cultivar and experimental year. The markedly lower yield of sweet potato tubers (3.4 –14.4 $t.ha^{-1}$), compared to obtained results, was reached within study of **Yildirim, Tokuşoğlu and Öztürk (2011)**. The lower yield of marketable sweet potato tubers, compared to our trial, was also found in studies of other authors **(Hartemink, 2003**; **Oliveira et al., 2010**; **Sowley, Neindow and Abubakari, 2015)**.

Ratio of marketable yield

The highest ratio of marketable sweet potato tubers from total yield was found in cultivars 'Serbian' (92.82%), followed by cultivars 'Zagrebian' (91.31%) and 'Beauregard' (81.58%). Statistically non-significant difference was between cultivars 'Serbian' and 'Zagrebian'. Other differences between cultivars were evaluated as statistically significant. **Sokoto, Magaji and Singh (2007)** examined the effect of various intra-row spacing on the ratio of marketable yield in trial with sweet potato. Within variant, in which the same spacing was used as in our trial (0.30 m), marketable ratio of sweet potato was 48.99 %. It was expressively under value found in our trial. **Hartemink (2003)** found that marketable ratio of sweet potato tubers was varied from 83.53% to 89.56%, dependent on the growing year. It is comparable to results obtained in our trial.

Total carotenoid content

According to **Sebuliba, Nsubuga and Muyonga (2001)**, orange-fleshed sweet potato tubers are rich sources of carotenoids. Compared to cultivars with yellow and white flesh color, orange-fleshed sweet potato has expressively higher content of total carotenoids.

The content of total carotenoids was increasing in following cultivar order: 28.79 $mg.kg^{-1}$ fresh weight ('Zagrebian') <94.78 $mg.kg^{-1}$ f. w. ('Beauregard') <99.52 $mg.kg^{-1}$ f. w. ('Serbian'). The statistical analysis of results showed statistically significant differences among cultivars with orange flesh color ('Beauregard' and 'Serbian') and cultivar 'Zagrebian' with yellow-creme color of tuber flesh. Difference between cultivars with orange flesh color was not statistically significant.

Kammona et al. (2015) found the significant variability of carotenoid content in dependency on the color of sweet potato flesh. Total carotenoid content in orange-fleshed tubers was more than three-fold higher compared to sweet potatoes with yellow, purple and white flesh color. The strong interaction between flesh color and total carotenoid content in sweet potato was also presented in study of **Ellong, Billard and Adenet (2014)**, **Grace et al. (2014)** and **Hussein et al (2014)**. Within trial in China**, Tang, Cai and Xu (2015)** found higer total carotenoid in sweet potato tubers compared to results showed in our trial. The total carotenoid content in cultivar with orange flesh color was 157.9 $mg.kg^{-1}$ f. w. Cultivars with yellow-creme (75.4 $mg.kg^{-1}$), light-purple (5.19 $mg.kg^{-1}$), white (4.46 $mg.kg^{-1}$) and deep-purple color of tuber flesh had several-fold lower content of total carotenoid compared to orange sweet potato cultivar.

The most important and predominant carotenoid substance in sweet potatoes is β-carotene (**USDA, 2015**). According to study of **Kammona et al. (2015)**, β-carotene ratio from total carotenoid content is variable in relation with flesh color of sweet potato. The highest β-carotene ratio was found in purple-fleshed tubers (97.9%), followed by tubers with orange (93.8%), yellow (84.1%) and white (79.0%) flesh color.

Within study with ten cultivars of sweet potato, **Yildirim, Tokuşoğlu and Öztürk (2011)** found marked variability of β-carotene content in cultivars with yellow-creme color of tuber flesh (50.1 – 70.3 $mg.kg^{-1}$ f. w.). The β-carotene content in orange tubers was 70.3 $mg.kg^{-1}$. This results were in contrast to our study where expressive difference between orange and yellow-creme sweet potato was found. **Suparno, Prabawardani and Pattikawa (2016)** found similar β-carotene content values in yellow-creme sweet potato (62.98 – 64.69 $mg.kg^{-1}$ f. w.) compared

Table 5 Effect of cultivar on qualitative parameters of sweet potato tubers (marketable yield).

Cultivar	Total carotenoids ($mg.kg^{-1}$ fresh weight)	Vitamin C ($mg.kg^{-1}$ fresh weight)
Beauregard	94.78^{b}	154.37^{a}
Serbian	99.52^{b}	155.70^{a}
Zagrebian	28.79^{a}	146.43^{a}

Note: Different letters (a; b; c) within the same column means statistically significant difference (at 95.0 % confidence level).

Table 6 Effect of mulching variant on qualitative parameters of sweet potato tubers (marketable yield).

Cultivar	Total carotenoids ($mg.kg^{-1}$ fresh weight)	Vitamin C ($mg.kg^{-1}$ fresh weight)
Non-mulching	77.81^{b}	143.23^{a}
Mulching	70.92^{a}	161.10^{b}

Note: Different letters (a; b; c) within the same column means statistically significant difference (at 95.0 % confidence level).

to study of previous authors. Results in study of **Aywa, Nawiri and Nyambaka (2013)** also confirmed fact that orange flesh cultivars of sweet potato have markedly higher content of β-carotene (46.19 – 48.89 $mg.kg^{-1}$ f. w.) compared to the tubers with yellow flesh color (20.17 – 26.28 $mg.kg^{-1}$ f. w.).

Obtained results confirmed that cultivar is important factor influencing on the content of carotenoids in sweet potatoes. The expressive impact of cultivar to the total carotenoid content was found in the experiments with tomato **(Mendelová et al., 2012)**, bell pepper **(Ignat et al., 2013)** or sea buckthorn **(Mendelová et al., 2016)**.

Vitamin C content

Compared to total carotenoid content, variability of vitamin C content among cultivars was not marked. The vitamin C content was from 146.43 $mg.kg^{-1}$ ('Zagrebian') to 155.70 $mg.kg^{-1}$ f. w. ('Serbian'). According to statistical analysis, differences of vitamin C among cultivars were evaluated as statistically non-significant. Comparable values of vitamin C content (129-142 $mg.kg^{-1}$ f. w.) in sweet potato were presented by **Maria and Rodica (2015)** in field trial in Romania.

Within trial in Poland, **Krochmal-Marczak et al. (2013)** found higher vitamin C in tubers of sweet potato compared to our trial results. Its values were varied, dependent on cultivars, from 202.6 $mg.kg^{-1}$ to 242.0 $mg.kg^{-1}$ f. w. The higher content of vitamin C in sweet potato tubers, compared to our study, was also presented in study of **Suparno, Prabawardani and Pattikawa (2016)**. Authors found variable content of vitamin C in dependency on the flesh color of sweet potato tubers. The highest vitamin C content was determined in purple cultivars (727.1 $mg.kg^{-1}$), followed by cultivars with white (672.2 $mg.kg^{-1}$) and yellow flesh color (204.7-254.4 $mg.kg^{-1}$). According to study of **Ellong, Billard and Adenet (2014)**, determined vitamin C content in yellow or creme sweet potatoes varied from 177.5 $mg.kg^{-1}$ to 290.5 $mg.kg^{-1}$ f. w. It meant higher values of vitamin C content in comparison with our trial. **Yildirim, Tokuşoğlu and Öztürk (2011)** also stated that cultivar and flesh color had an significant impact on the vitamin C content in sweet potato tubers. Within yellow-creme flesh cultivars, vitamin C content was ranged from 237 $mg.kg^{-1}$ to 386 $mg.kg^{-1}$ f. w. The cultivar with orange flesh color ('Regal') showed lower vitamin C content than most of yellow-creme cultivars.

On the contrary, markedly lower content, compared to trial results, was presented in study of **Gichuhi, Kokoasse Kpomblekou and Bowel-Benjamin (2014)**. In cultivar 'Beauregard' (the same cultivar as in our study), value of vitamin C content was 64.3 $mg.kg^{-1}$ f. w. Similarly, lower values of vitamin C content were found (48.5 – 57.3 $mg.kg^{-1}$ f. w.) in the field trial realised in different localities of Western Kenya **(Aywa, Nawiri and Nyambaka, 2013)**.

Compared to obtained results, more expressive and statistically significant impact of cultivar to the vitamin C content was found in studies with vegetable pepper and tomatoes **(Valšíková et al., 2010)**, broccoli **(Koh et al., 2009)** potatoes **(Mareček et al., 2016)**.

Effect of mulching on sweet potato yield

According to **Novak et al. (2007)**, sweet potato [*Ipomoea batatas* (L.) Lam] needs a yearly minimum of three month with air temperatures above 15 ºC for its growth and development. For the purpose of achieving the highest possible sweet potato yield during a relatively short vegetation period in middle Europe, using of mulching material (PE foil, non-woven textile or organic materials) is necessary for succesfull growing. **Wees, Seguin and Boisclair (2016)** similarly emphasize that use of black mulch to heat the soil can markedly improve and optimize yields of sweet potato and attain its market quality standards in cooler climate.

The statistical analysis showed statistically significant increase of particular quantitative parameters of sweet potato marketable yield in mulching variant (black non-woven textile) compared to variant without mulching (tab. 6). Between mentioned variants, increase of average tuber weight and total sweet potato yield ($t.ha^{-1}$) was presented by values of 51.5% and 61.8%. In mulching variant, the marketable ratio of tubers was higher about 7.3% compared to the non-mulching variant (bare soil). According to study of **Novak, Zutić and Toth (2007)**, mulching with black PE-film had a significant effect on the yield and average weight of sweet potato tubers. Within study, higher yield about 5.3 $kg.m^2$ was found compared to non-mulching variant.**Novak et al. (2007)** found a significantly higher yield of marketable tubers of sweet potato in mulching variant by black PE film mulch compared to uncovered soil. In mentioned study, realised in Croatia, marketable yield was increased from 1.16 to 2.53 $kg.m^{-2}$ (118 %). **Aregheore and Tofinga (2004)** tested effect of mulching by using of organic materials (guinea grass, dadap leaves) on the yield of sweet potato tubers. In all tested mulching treatments, sweet potato yield icncrease was reached compared to the treatment without mulch, varying from 4.6% to 12.2%. According to **Laurie et al. (2015)**, using of organic (grass straw) and inorganic (black plastic foil) mulching materials resulted in higher total and marketable yield of sweet potato tubers compared to the un-control treatment. The application of grass straw was showed by increase of total yield about 33.3% and marketable yield about 63.5%. In the treatment with black plastic foil, total and marketable yield of sweet potato were higher about 77.7% and 69.4% subsequently. Positive impact of mulching on the sweet potato yield was also presented in study of **Ossom et al. (2001)**.

Compared to experimental results, **McKinley Sullen (2010)** found minimal and non-significant impact of mulching by variously colored plastic material on the total carotenoid content in sweet potato (cultivar Beauregard). Its value was varying in this treatment order: black PE foil (159.4 $mg.kg^{-1}$ f. w.) < red PE foil (159.6 $mg.kg^{-1}$ f. w.) < control - bare soil (159.9 $mg.kg^{-1}$ f. w.) < silver PE foil (160.1 $mg.kg^{-1}$ f. w.) < white PE foil (160.4 $mg.kg^{-1}$ f. w.) < blue PE foil (160.6 $mg.kg^{-1}$ f. w.). The effect of mulching on the total carotenoid content (TCC) in sweet potato is not well-documented. On the other side, TCC in dependency on mulching was examined in studies with other crops. **Siwek, Libik and Zawiska (2012)** tested various biodegradable mulching materials and their impact on the TCC in butterhead lettuce. Authors found non-statistically significant increase of TCC in treatments with applied mulching materials compared to the control treatment. Differences to control treatment in TCC were varying from 1.5% to 6.7%. **Szafirowska and Elkner (2009)** found variable effect of mulching on the content of β-carotene, main carotenoid substance, in sweet pepper by using of various materials. The application of cloves (organic mulching) resulted in statistically significantly higher TCC in pepper fruits compared to the control treatment. On the other hand, TCC decrease was detected in treatment with black polypropylene foil used for mulching in comparison with control. According to **Moreno et al. (2014)**, lycopene is the main carotenoid susbtance in tomato fruits. The using of different mulching materials (papers; biodegradable foil; black PE foil; straw) was showed by increase of lycopene content in tomato fruits in the range from 1.6% to 15.1% compared to control treatment.

In realised trial, positive impact of mulching on the vitamin C content in sweet potato was found. It is consistent with study results presented by **McKinley Sullen (2010)** who tested variously colored plastic foil on the sweet potato yield. Author found higher vitamin C content in sweet potato tubers compared to the control treatment (bare soil), presenting increase of its value in the range from 4.6% (blue foil) to 22.3% (black foil). Positive impact of mulching on vitamin C content was also found in trial with chilli pepper (*Capsicum annuum* L.) realised by **Ashrafuzzaman et al. (2011)**. Authors found higher vitamin C content in chilli pepper fruits in all treatments with variously-colored plastic mulching foil (transparent, black and blue) compared to the control treatment. The most significant increase of its value was reached by using of black plastic foil. **Franczuk et al. (2009)** tested effect of different types of organic mulching (phacelia, vetch, serradella, oat) on the yield quality of tomato and onion. Authors also presented increase of vitamin C content in both vegetables as the results of all used mulching materials during growing period. According to **Dvořák et al. (2012)**, using of black textile mulch resulted in statistically non-significant increase of vitamin C content (9,8%) in potato tubers compared to the treatment with bare soil.

CONCLUSION

The sweet potato is marked warm-requiring crop, grown mainly in Asia. The mulching is important intesification factor of production influencing yield of sweet potato. From aspect of quantitative parameters of sweet potato yield, all tested cultivars were showed significant increase of selected quantitative parameters (yield per plant; average tuber weight; yield in t.ha^{-1}; marketable tuber ratio) in mulching treatment compared to the control treatment. The highest yield of tubers (39.30 t.ha^{-1}) was showed in sweet potato cultivar 'Serbian' . The cultivar and mulching had also expressive impact on the quality of sweet potato tubers (total carotenoids; vitamin C). The highest content of total carotenoids (99.52 mg.kg^{-1} fresh weight) and vitamin C (155.70 mg.kg^{-1} f. w.) was also found in tubers of cultivar 'Serbian'. Results gained in presented study indicate that sweet potato can be succesfully grown in conditions of Southern Slovak Republic.

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