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THE EFFECT OF GROWING SYSTEM AND GROWING MEDIA ON THE MORPHOLOGICAL, BIOLOGICAL AND SENSORY QUALITY OF SWEET PEPPER (CAPSICUM ANNUUM L.)

UTICAJ PODLOGE I SISTEMA GAJENJA NA MORFOLOŠKI, BIOLOŠKI I SENZORNI KVALITET PAPRIKA BABURA (CAPSICUM ANNUUM L.)

Zita BIRKÁS[*], Gábor BALÁZS[*], Zsuzsanna FÜSTÖS[*], Attila RUSZTHI[**], Zoltán KÓKAI[***]
[*]Szent István University, Faculty of Horticultural Science, 1118 Budapest, Ménesiút 44, Hungary
[**] DUNA-R Ltd.,1224 Budapest IX. Utca 17
[***]SzentIstván University, Faculty of Food Science, 1118 Budapest, Villányiút 35-43. Hungary
e-mail: zita.birkas@phd.uni-szie.hu

ABSTRACT

Sweet pepper (Capsicum annuum L.) production is relevant today in Hungary.Due to the importance of the subject, the aim of the study was to evaluate morphological, biological and sensory quality of sweet pepper.The growing experiment was set up at DUNA-R company in Szentes. Three different type of fresh pepper hybrid (Zalkod F1, Gogorez F1, Kapitány F1) were evaluated in unheated plastic house and open field conditions using intensive technology. The fruits were blended and measured with manual digital refractometer (PAL-1, ATAGO). The vitamin C content was determined by the Spanyár-method. Sensory profile analysis was applied with 10 assessors. Based on our results it can be concluded that in forcing the three varieties produced larger fruits in soil culture than in soilless. However in all cases we measured better refraction values in soilless production than in soil culture. Based on the sensory profile analysis the type of growing technology affected mostly morphological parameters.

Key words: *sweet pepper, coconut fibre, morphological parameters, sensory evaluation.*

REZIME

Proizvodnja paprika babura (Capsicum annuum L.) je u današnje vreme značajna u Mađarskoj. Rad se stoga bavi ocenom morfološkog, biološkog i senzornog kvaliteta paprika babura. Eksperiment gajenja je realizovan u preduzeću DUNA-R u Sentešu. Ispitivana su tri hibrida paprika (Zalkod F1, Gogorez F1 i Kapitány F1) u plasteniku bez grejanja i na otvorenom uz pomoć intenzivne tehnologije. Dobijeni plodovi su izmešani i izmereni ručnim digitalnim refraktometrom (PAL-1, ATAGO). Sadržaj vitamina C je utvrđen metodom Spanijar (Spanyár). U senzornoj analizi je učestvovalo 10 ocenjivača. Rezultati istraživanja pokazuju da su plodovi sva tri hibrida bili veći kada se zemljište koristilo kao podloga u odnosu na plodove gajene u supstratu. Međutim, veće vrednosti refrakcije su izmerene kod svih plodova koji su gajeni u supstratu u odnosu na plodove gajene u zemljištu. Na osnovu senzorne analize utvrđeno je da tehnologija gajenja najviše utiče na morfološke parametre.

Ključne reči: *paprika babura, kokosova vlakna, morfološki parametri, senzorna ocena.*

INTRODUCTION

Sweet pepper (*Capsicum annuum* L.) production is relevant today in Hungary. In the year 2014 sweet pepper was planted on 1500 ha with 170 thousand tons of production. Furthermore, its open field production with 1000 ha is also significant. While in the recent years the forced and open field sweet pepper production area decreased, due to the technological development the yearly yield do not show the same tendency *(FAOSTAT, 2014).* Sweet pepper has excellent nutritional values *(Gelinger et al., 2007)* and very variable kind of vegetable, the varieties can diverse in size, colour and shape *(Orbán et al., 2011).*

Although the sweet pepper forcing is more productive than the open field production; its investment costs are higher as well. In pepper production, it must to use intensive technological elements such as raised beds, plastic soil mulch, training system, hybrids, transplants etc. The pepper production could be competitive only if intensive cultivation technology is used *(Ombódi et al., 2006).*

Plastic mulches has many advantages such as higher yield, better weed control, increased soil temperature, better nutrient uptake, earlier ripening *(Lament, 1993). Locher et al. (2005)* finds out in their experiment, that with the application of plastic soil mulch and raised bed the soil temperature increased.

In the vegetable growing practice the quality of transplants are also important, which is affected by the nutrient supply *(Jezdinsky et. al, 2016).* During the production season the nutrient demand a different types differ too *(Kappel et al., 2006).*

Due to the sustained pepper forcing the soils are infected increasingly. The change from soil culture to soilless culture has many advantages; the farmers avoid the soil borne diseases, increase yield and fruit quality and the production is more safe. Besides these advantages, the soilless production has many disadvantages as well like investment costs, special skill, consulting and service network is necessary. Horticultural studies usually focus on the effect of growing systems, fertilization, varieties or some further factors. In most of the cases the effect is measured on the morphological bases, chemical or physical parameters. However the sensory quality of the crop is also relevant, since a large proportion of horticultural commodities are sold in retail chains to consumers. Consumer perception strongly relies on sensory quality, so it is important to measure sensory differences among experimental factors *(Thybo, A.K., Bechmann, I. E., Brandt, K. 2005).* Since the available crop

quantity for sensory testing is usually limited, thus the application of trained panellists can be recommended to reveal significant differences. In a similar study on tomatoes *(Gajc-Wolska et al., 2015)* the authors have studied the influence of growth conditions and grafting on the yield, chemical composition and sensory quality. In case of the tomato study sensory quality was mainly influenced by the harvest date, the effect of growing system was less relevant.

Due to the importance of the subject, the objective of the study was to evaluate morphological, biological and sensory quality of sweet pepper. Besides measuring the morphological and biological parameters, the perceptible sensory differences could be evaluated due to the different production systems.

MATERIAL AND METHOD

The field tests were done at DUNA-R company in Szentes. Three different type of fresh pepper hybrid (*Zalkod F1, Gogorez F1, Kapitány F1*) were evaluated in unheated plastic house and open field conditions using intensive technology (soil mulch, dripping tube/dripping irrigation system, training system). In culture of forced pepper plants were tested in soil and soilless culture (coconut fiber) as well. For soil culture the plastic house was used, and for the soilless culture coconut fiber slabs were used. Table 1 shows some technological parameters.

Table 1. Technological parameters

Growing system	Sowing date	size of soil block	planting	Planting space	plant/m^2
Soil culture	20.04.2016	5×5×5	31.05.2016	80+30*30	6
Soilless culture	20.04.2016	10×10×6	06.06.2016	110+40*25	5.3
Open filed	19.04.2016	5×5×5	08.06.2016	60+30*30	7.4

The variety Zalkod F1 has hanging, tapered white fruits of 120-140 g weight. The fruits of Kapitány F1 variety has the variation of color from red to dark green, while variety Gogorez F1 has the mass of single fruit of 300 g and the shape as tomato.

After the picking the samples were measured at the Department of Vegetable and Mushroom Growing and at the Department of Sensory Science and Postharvest, Szent István University, Budapest, Hungary.

From all combination 20 fruit weight, size and its water-soluble dry material content was measured at the analytical laboratory of the department. The fruits were blended and measured with manual digital refractometer (PAL-1, ATAGO). The results granted in ^{o}Brix units. In this study the vitamin-C content was determined by the Spanyár-method, which was also applied by Orbán and co-workers (2011) in a research about Capsicum samples.

Sensory profile analysis was applied according to ISO 13299. A panel of 10 assessors were evaluated the sweet peppers in 3 sessions: a) white pepper; b) kápia and c) tomato-shaped. Attributes were analysed on unstructured line scales with the support of ProfiSens, a sensory analysis software *(Kókai et al., 2003).* Attributes involved: size, shape, colour homogeneity, surface gloss, freshness of colour, flesh thickness, the size of placenta, crispiness, skin chewiness, juiciness, odour intensity and sweet taste intensity. Tests were performed in standardized, computerized sensory booths (ISO 8589). Data was analysed with one-way ANOVA and Fisher LSD for testing significant differences.

RESULTS AND DISCUSSION

The calculated length/ diameter ratios are presented in Fig. 1. Due to the tomato- shaped fruits of Gogorez F*1* variety has the lowest rates. In case of Zalkod F1 variety in the forced soil culture, whilst in Kapitány F1 the soilless culture resulted in highest value, which means, that the fruits of this two cultivation technology had the longest fruit length compared to their diameters.

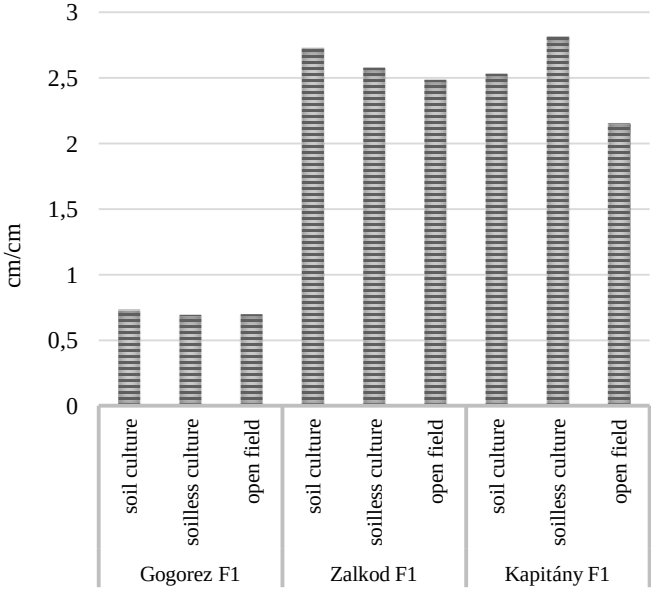

Fig. 1.Thefruit length/diameter ratio of the varieties (26.09.2016, Budapest)

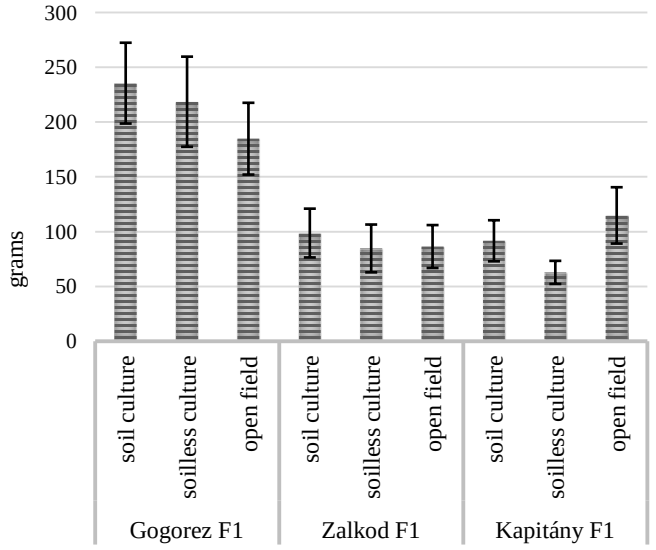

Fig. 2. The average weight of 20 fruits (26.09.2016, Budapest)

Figure 2 shows the average weight of the measured fruits in grams. In forcing the soil production of all three varieties have heavily fruits compare to soilless technology. The cultivation of

Kapitány F1 variety on the open field results in even heavier fruits compare to forcing one.

The average refraction values are presented in Figure 3. All three varieties showed the same tendency in soilless production showed the highest. The production in soil culture of two varieties Gogorez F1 and Zalkod F1 an average refraction exhibit the lowest values, compare to variety Kapitány 1F while in case of variety this low value is measured within the open field production.

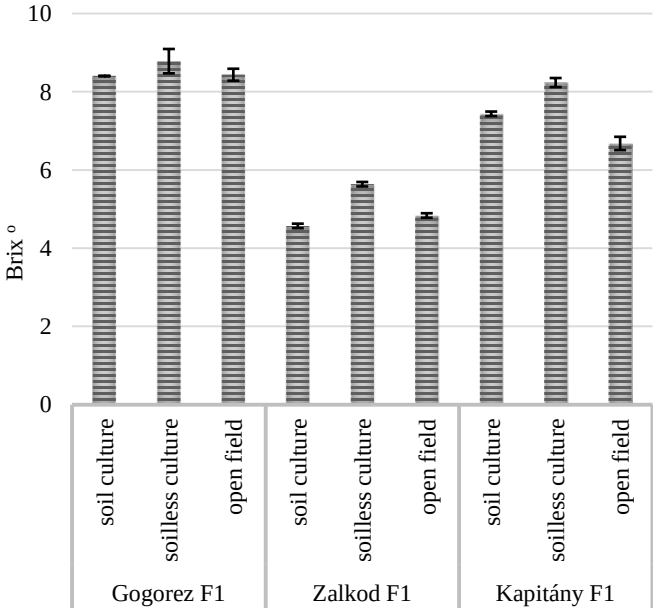

Fig. 3. The average refraction value of fruit (26.09.2016, Budapest)

The results of the Vitamin C content measurements are presented in Table 2. During this survey the contradictory results were observed. Orbán and co-workers (2011) reported that in greenhouse conditions of production, the level of Vitamin C level was higher. The white type of fruits has the content of this vitamin of 72 mg/ 100 g, in the shape kapia this content was 145 mg/ 100 g and in tomato shaped 71 mg/ 100 g. Figure 4. shows the sensory profiles of the Zalkod F1 variety's treatments. The significant differences in case of two varieties Kapitány F1 and Gogorez F1 are summarized in Table 3. In the case of ZalkodF1 variety the growing on coco resulted in the narrowest fruit with the most intense red surface colour and flesh colour. The placenta was the smallest among the treatments, and the flesh was the least crispy. In Thybo and co-workers study (2005) the soilless culture resulted in crispier fruits in case of tomatoes. Their results suggested that the sensory effect of soil media depends on the species. Kapitány F1 variety on the coco has produced the smallest and narrowest fruits. The colour was the most purple (both surface colour and flesh colour). The flesh was thin, the placenta was the smallest. The taste of the fruit was the sweetest compared to the other 2 treatments. The fruits of Gogorez F1 were larger than these grown on the field (but not larger than grown on soil under plastic). The colour of the internal fruit flesh was the darkest purple. The taste of the fruit was the sweetest among other two varieties.

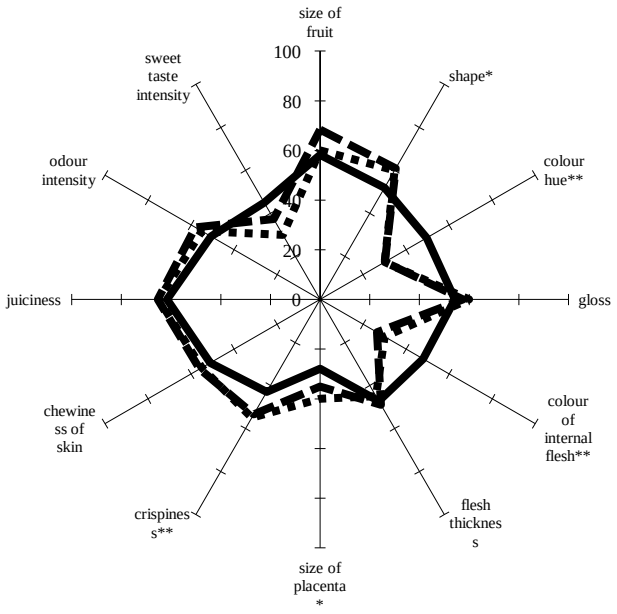

Fig. 4. Sensory profile of the Zalkod F1 sweet peppers
Legend: scattered lines: Zalkod F1soil culture, dotted lines: Zalkod F1open field, continuous line: Zalkod F1soilless culture (= $p_{0.05}$, ** = $p_{0.01}$)*

Table 3. Significant sensory differences among treatments in case of the tested cultivars

Attribute	Zalkod F1	Kapitány F1	Gogorez F1
size of fruit		**	**
shape	*	**	
colour hue	**	**	
gloss			
colour of internal flesh	**	**	**
flesh thickness		**	
size of placenta	*	**	
crispiness	**		
chewiness of skin			
juiciness			
odour intensity			
sweet taste intensity		**	*

*Significant differences: * p=0.05; ** p=0.01*

Table 2. Vitamin C content of fruits (mg/100g)

Gogorez F1			Zalkod F1			Kapitány F1		
soilculture	soillessculture	openfield	soilculture	soillessculture	openfield	soilculture	soillessculture	openfield
47.67	45.51	56.64	30.23	55.48	28.24	39.04	34.88	36.38

CONCLUSIONS

Based on these results of study, it can be concluded that in soil culture production type all three varieties have larger dimension of fruits compare to soilless production. However in all cases it was observed the better refraction values in soilless production than in soil culture. In case of soilless forcing of KapitányF1 the sensory profile proved that the thin of the fruits were significantly lower, thus the fruit weight was lower as well.

Based on the sensory profile analysis the type of growing technology effected mostly morphological parameters. In GogorezF1 the fruits grown on coco fibre were larger; in case of the other two varieties the fruits were smaller. Colour of the fruits is usually more intense. The placenta is usually the smallest. The sweet taste of Kapitány F1 and Gogorez F1 were the most intense on coco fibre. In order to better understand the effects of soilless cultures in case of *Capsicum annuum* further studies are necessary.

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