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YIELD AND NUTRITIONAL VALUE OF BASIL GROWN IN A GREENHOUSE

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A b s t r a c t. A two-factorial experiment was conducted in 2012-2014 in a greenhouse owned by the Department of Horticulture at the University of Warmia and Mazury in Olsztyn. The experiment had a randomised block design with three replicates. The first experimental factor were six botanical varieties of basil: sweet basil, Thai 'Siam Queen' basil, Greek 'Minette' basil, purple basil, lemon basil and cinnamon basil. The second experimental factor was container size and the number of plants per pot: 0.7 dm^3 container with one plant per pot, 3.0 dm^3 container with one plant per pot, 3.0 dm^3 container with four plants per pot. In successive years of the three-year experiment, between 22 and 24 February, containers filled with organic substrate (sphagnum peat) were placed on movable tables in the greenhouse, depending on pot size (0.7 and 3.0 dm^3). Once-over harvest of basil herbage was carried out between 17 April and 7 May. The plants were cut at 5 cm above the substrate surface. Total yield and marketable yield were identical because no mechanical damage to leaves or symptoms of leaf diseases were observed. The content of dry matter, total sugars and L-ascorbic acid in basil herbage was determined. Basil ecotype had a significant effect on leaf greenness index, fresh herbage yield, dry herbage yield, and on the content of dry matter and total sugars. Growing basil plants in 3.0 dm^3 containers, with four plants per pot, contributed to a significant decrease in fresh and dry herbage yields, in comparison with the remaining treatments.

K e y w o r d s: *Ocimum basilcum* L., fresh herbage yield, dry herbage yield, dry matter, chemical composition

INTRODUCTION

Basil is grown in tropical, subtropical and warm temperate climates. The world's largest producers of basil include Indonesia (Asia), Egypt and Morocco (North Africa), as well as France, Spain and Hungary (Europe) (Jadczak *et al*. 2006). Numerous basil varieties are cultivated. Basil leaves, used for seasoning, have a strong spicy aroma and a slightly sour taste. Basil is added to various dishes to enrich their flavour (Majkowska-Gadomska *et al.* 2015). Basil leaves are used to flavour soups, sauces, marinades, cheeses, meat and cured meat products, pâtés, tomatoes, pickled cucumbers, canned foods and liqueurs (Nurzyńska-Wierdak 2012, Frąszczak *et al.* 2015). In the experiment the best known varieties of basil in the Polish market were used. The production of plants in containers under cover is one of the branches of greenhouse vegetable production, providing an opportunity for additional income for the producers. Studies on the interdependence between substrate volume and plant characteristics have shown that the use of too small containers in the production reduces the yield and its biochemical quality (Frąszczak and Knaflewski 2009).

The aim of this study was to determine leaf greenness index, yield, content of dry matter, total sugars and L-ascorbic acid in six botanical varieties of basil grown in a greenhouse in containers of different sizes, with a different number of plants per pot.

MATERIAL AND METHODS

A two-factorial experiment was conducted in 2012-2014 in a greenhouse owned by the Department of Horticulture at the University of Warmia and Mazury in Olsztyn (NE Poland). The experiment had a randomised block design with three replicates. The first experimental factor were six botanical varieties of basil, characterised by different morphological traits: sweet basil, Thai 'Siam Queen' basil, Greek 'Minette' basil, purple basil, lemon basil and cinnamon basil. The second experimental factor was container size and the number of plants per pot: 0.7 dm^3 container with one plant per pot, 3.0 dm^3 container with one plant per pot, 3.0 dm^3 container with four plants per pot.

In successive years of the three-year experiment, between 22 and 24 February, containers filled with organic substrate (sphagnum peat) were placed on movable tables in the greenhouse, depending on pot size (0.7 and 3.0 dm^3). Four basil seeds were sown, and one (strongest) seedling was left per pot at the two (three)-leaf stage. Thinning was not conducted in the treatment with four basil plants per pot. Experimental unit area was 1 m^2, and each replicate consisted of sixty four 0.7 dm^3 containers with one plant per pot, and twenty five 3.0 dm^3 containers with one plant per pot or four plants per pot.

Greenhouse conditions were adjusted to the growth stage of basil plants. The recommended cultivation practices for basil were applied during the growing season (Kołodziej 2010). Individual weeds were removed, moss buds were removed from the substrate surface, and organic substrate was aerated using a three-pronged cultivator. Chemical crop protection agents were not applied during the experiment.

Yellow sticky traps were placed over the containers to control the number of pests (greenhouse whiteflies, Sciaridae). *Encarsia formosa* (3 insects per m^2) was used for biological control of greenhouse whiteflies.

The chlorophyll content of basil leaves was measured three times during the growing season, with the Konica Minolta SPAD 502 Plus chlorophyll meter, beginning in the first ten days of April, at 14-day intervals. The measurements were performed on three youngest fully developed leaves of 10 plants selected randomly in each treatment. The results of measurements were averaged.

Once-over harvest of basil herbage was carried out between 17 April and 7 May. The plants were cut at 5 cm above the substrate surface. Total yield and marketable yield were identical because no mechanical damage to leaves or symptoms of leaf diseases were observed. Basil herbage was dried in a thermal dryer, in accordance with Polish Standard PN-85/R-87017 as amended by Polish Standard PN-ISO 6754:1999, and air-dry weight was determined.

Laboratory analyses of basil herbage were performed after harvest. Fresh basil herbage was collected from each replicate to prepare 0.3 kg bulk samples per treatment and to determine the content of:

- dry matter – by drying the plant material to constant weight at 105°C (*Dry matter determination by the gravimetric method*, PN-90/A-75101/03);
- total sugars – by the Luff-Schoorl method (*Determination of the content of sugars and reducing sugars*, PN-90/A-75101/07);
- L-ascorbic acid – by the method proposed by Tillmans and modified by Pijanowski (*Determination of vitamin C content*, PN-A-04019:1998).

The results regarding the yield and nutritional value of basil were processed statistically by analysis of variance (ANOVA). Coefficients of correlation and determination were calculated for selected parameters. The significance of differences between means was estimated by Tukey's range test at $\alpha = 0.05$.

RESULTS AND DISCUSSION

The yield and biological value of basil are largely determined by the rate of photosynthesis which is affected by green leaf pigments, in particular chlorophyll. Numerous studies have demonstrated a close correlation between leaf greenness index and nitrogen content of leaves, which is responsible for biomass growth (Wu *et al.* 2007, Vrbnicanin *et al.* 2012). According to Wu *et al.* (2007), chlorophyll concentrations are influenced by environmental conditions, crop type and cultivation regime. Khalil *et al.* (2010) reported an increase in the concentrations of photosynthetic pigments (chlorophyll and carotenes) in response to increasing soil moisture content and foliar application of ascorbic acid. Kopsell and Kopsell (2005) demonstrated that field conditions had a beneficial influence on the concentrations of chlorophyll *a* and *b* in four basil varieties, whereas greenhouse conditions contributed to an increase in chlorophyll content of leaves only in two purple basil varieties. In a study by Politycka and Golcz (2004) in basil var. 'Dark Opal' the levels of all photosynthetic pigments were higher than in our study. The average values of the leaf greenness index, determined for three years of the study, varied significantly depending on the experimental factors (Tab. 1).

Table 1. The effect of basil ecotype, container size and the number of plants per pot on leaf greenness index (SPAD)

Varieties of basil		Pot volume (dm^3) / number of plants in pot	Mean of 2012-2014
Sweet basil		0.7 / 1 pc.	22.93
		3.0 / 1 pc.	28.30
		3.0 / 4 pcs.	28.47
	Mean		26.57
Thai 'Siam Queen' basil		0.7 / 1 pc.	26.70
		3.0 / 1 pc.	34.10
		3.0 / 4 pcs.	30.83
	Mean		30.54
Greek 'Minette' basil		0.7 / 1 pc.	19.13
		3.0 / 1 pc.	23.50
		3.0 / 4 pcs.	24.90
	Mean		22.51
Purple basil		0.7 / 1 pc.	31.43
		3.0 / 1 pc.	33.10
		3.0 / 4 pcs.	38.87
	Mean		34.47
Lemon basil		0.7 / 1 pc.	23.57
		3.0 / 1 pc.	31.63
		3.0 / 4 pcs.	26.30
	Mean		27.17
Cinnamon basil		0.7 / 1 pc.	26.40
		3.0 / 1 pc.	29.57
		3.0 / 4 pcs.	30.40
	Mean		28.79
Mean for pot volume (dm^3) / number of plants in pot		0.7 / 1 pc.	24.81
		3.0 / 1 pc.	30.03
		3.0 / 4 pcs.	29.96
	LSD $\alpha = 0.05$ for:		
varieties of basil (a)			2.88
pot volume (b)			2.81
interaction (axb)			1.70

An interaction between the experimental factors also had a significant effect on leaf greenness index which was the highest in purple basil and the lowest in Greek 'Minette' basil (significant difference of 34.7%). Basil grown in 3.0 dm^3 containers with one plant per pot had the highest leaf greenness index, and slightly lower

SPAD values were noted in basil grown in 3.0 dm^3 containers with four plants per pot. The value of leaf greenness index was lower by 18.12% in basil grown in 0.7 dm^3 containers. The best variant was growing purple basil in 3.0 dm^3 containers with four plants per pot, and the worst – growing Greek 'Minette' basil in 0.7 dm^3 containers. Cinnamon and Greek 'Minette' basils were characterised by the highest fresh herbage yields (Tab. 2).

Table 2. The effect of basil ecotype, container size and the number of plants per pot on fresh herbage yield (kg m^{-2})

Varieties of basil		Pot volume (dm^3) / number of plants in pot	Marketable yield of herb	
			fresh	air-dry
Sweet basil		0.7 / 1 pc.	1.49	0.16
		3.0 / 1 pc.	1.44	0.24
		3.0 / 4 pcs.	0.95	0.15
	Mean		1.29	0.18
Thai 'Siam Queen' basil		0.7 / 1 pc.	1.39	0.14
		3.0 / 1 pc.	1.94	0.19
		3.0 / 4 pcs.	0.93	0.12
	Mean		1.42	0.15
Greek 'Minette' basil		0.7 / 1 pc.	2.00	0.20
		3.0 / 1 pc.	1.91	0.23
		3.0 / 4 pcs.	1.35	0.14
	Mean		1.75	0.19
Purple basil		0.7 / 1 pc.	0.87	0.09
		3.0 / 1 pc.	1.19	0.12
		3.0 / 4 pcs.	0.92	0.09
	Mean		1.00	0.10
Lemon basil		0.7 / 1 pc.	1.29	0.17
		3.0 / 1 pc.	1.29	0.19
		3.0 / 4 pcs.	0.60	0.09
	Mean		1.06	0.15
Cinnamon basil		0.7 / 1 pc.	1.89	0.21
		3.0 / 1 pc.	2.09	0.23
		3.0 / 4 pcs.	1.31	0.14
	Mean		1.76	0.19
Mean for pot volume (dm^3) / number of plants in pot		0.7 / 1 pc.	1.49	0.16
		3.0 / 1 pc.	1.64	0.20
		3.0 / 4 pcs.	1.01	0.12
LSD α = 0.05 for:				
varieties of basil (a)			0.32	0.04
pot volume (b)			0.23	0.03
interaction (axb)			0.10	0.03

The yields of Thai and sweet basils were lower by 19.3 and 26.7%, respectively. Purple and lemon basils had the lowest fresh herbage yields. The amount of substrate in a container had a significant effect on basil yield. A significant decrease in fresh herbage yield was noted when four basil plants were grown in 3.0 dm^3 containers. The highest fresh herbage yield was achieved when cinnamon basil was grown in 3.0 dm^3 containers with one plant per pot, and when Greek 'Minette' basil was grown in 0.7 dm^3 with one plant per pot. These treatments contributed to a 71% increase in yield relative to lemon basil grown in 3.0 dm^3 containers with four plants per pot. The dry herbage yields of five botanical varieties of basil were comparable, only purple basil was characterised by lower dry herbage yield. Analysis of the interaction between the experimental factors revealed that sweet basil grown in 3.0 dm^3 containers with one plant per pot had the highest dry herbage yield. Purple and lemon basils grown in 0.7 dm^3 containers with one plant per pot and in 3.0 dm^3 containers with four plants per pot were characterised by the lowest dry herbage yields (62.5%). Our results are consistent with the findings of other authors (Nurzyńska-Wierdak *et al.* 2012) who reported that larger containers contributed to higher yields of culinary herbs and spices. The dry herbage yields of the analysed basil varieties were lower than those reported by Nurzyńska-Wierdak *et al.* (2011a), but higher than those achieved under field conditions in warmer regions of Poland (Biesiada and Kuś 2010, Rosłon *et al.* 2011).

Spice plants have desirable chemical composition and deliver numerous health benefits: they enhance the appetite, stimulate digestion and facilitate nutrient absorption (Jadczak and Grzeszczuk 2008, Kudełka and Kosowska 2008). Dry matter content is an important indicator of the biological value of basil (Tab. 3). The average dry matter content of basil herbage, determined for three years of the study, was the highest in cinnamon basil grown in 3.0 dm^3 containers with one plant per pot, and the lowest in Greek 'Minette' basil grown in 0.7 dm^3 containers (30.0% decrease). A similar dry matter content of basil was reported by Dzida (2010b), at 28.42 to 29.15% on average, whereas lower values were noted by Nurzyńska-Wierdak *et al.* (2011b) at 10.50 to 17.48%.

Carbohydrates are a source of energy, but plant foods low in carbohydrates are a part of healthy and low-calorie diet, which is an important consideration for regulating blood glucose levels in patients with type 2 diabetes. According to Szostak and Cichocka (2008), and Dzida (2010a), basil is one of such plants. A statistical analysis of total sugar content of basil herbage revealed that it was affected by both experimental factors. Lemon and Thai 'Siam Queen' basils had significantly the highest concentrations of total sugars, whereas cinnamon basil had the lowest total sugar content. An analysis of the effect of container size on total sugar content of basil herbage indicated that it was the highest in basil grown in 3.0 dm^3 containers with one plant per pot, but no significant differences were found relative to basil grown in 0.7 dm^3 containers. Basil grown in 3.0 dm^3 containers with four plants per pot had significantly the lowest concentration of total sugars (8.0%). Growing lemon basil in 0.7 dm^3 containers with one plant per pot contributed to the accumulation of total sugars, whereas cinnamon basil grown in 3.0 dm^3 containers with four plants per pot had the lowest total sugar content. Similar results were reported by Majkowska-Gadomska *et al.* (2015) for greenhouse-grown basil fertilised with Florovit. Field-grown basil analysed by Borowy and Matela (2012) had lower total sugar content.

Table 3. The effect of basil ecotype, container size and the number of plants per pot on dry matter, total sugar and L-ascorbic acid content

Varieties of basil	Pot volume (dm^3) / number of plants in pot	Dry matter %	Total sugar g 100 g^{-1} f.m.	L-ascorbic acid mg 100 g^{-1} f.m.
Sweet basil	0.7 / 1 pc.	16.99	8.6	12.47
	3.0 / 1 pc.	17.00	9.3	10.05
	3.0 / 4 pcs.	17.78	8.9	10.53
Mean		17.26	8.9	11.02
Thai 'Siam Queen' basil	0.7 / 1 pc.	16.59	10.2	14.72
	3.0 / 1 pc.	19.18	10.9	13.75
	3.0 / 4 pcs.	18.08	9.7	12.55
Mean		17.95	10.3	13.67
Greek 'Minette' basil	0.7 / 1 pc.	15.33	9.7	14.11
	3.0 / 1 pc.	19.05	10.7	12.03
	3.0 / 4 pcs.	20.39	9.7	13.16
Mean		18.26	10.1	13.10
Purple basil	0.7 / 1 pc.	15.60	10.3	11.70
	3.0 / 1 pc.	16.89	10.6	11.99
	3.0 / 4 pcs.	16.40	8.5	13.14
Mean		16.60	9.8	12.28
Lemon basil	0.7 / 1 pc.	19.17	11.4	12.08
	3.0 / 1 pc.	20.79	10.3	15.17
	3.0 / 4 pcs.	20.10	10.5	13.81
Mean		20.02	10.7	13.69
Cinnamon basil	0.7 / 1 pc.	20.50	9.5	14.92
	3.0 / 1 pc.	21.91	8.8	15.29
	3.0 / 4 pcs.	20.83	7.7	10.26
Mean		21.08	8.7	14.06
Mean for pot volume (dm^3) / number of plants in pot	0.7 / 1 pc.	17.36	10.0	13.30
	3.0 / 1 pc.	19.14	10.1	13.05
	3.0 / 4 pcs.	18.93	9.2	12.24
LSD α = 0.05 for:				
varieties of basil (a)		1.05	1.5	n.i.
pot volume (b)		1.19	0.8	1.03
interaction(axb)		1.31	0.2	0.09

Spice plants are a rich source of natural antioxidants capable of neutralising free radicals that have adverse health effects. This group includes organic acids, vitamin C (L-ascorbic acid), provitamin A (ß-carotene), phenolic compounds and anthocyanins (Szajdek and Borowska 2004). L-ascorbic acid, which is a major dietary antioxidant, exerts its antioxidant effects through conversion of the reduced form to the oxidised form (Capecka *et al.* 2005). The results of studies investigating the L-ascorbic acid content of basil herbage are inconclusive. In a study by Borowy and Matela (2012), the concentrations of L-ascorbic acid in field-grown basil ranged from 44.9 to 75.8 mg 100 g^{-1} fresh weight. Sweet basil grown in containers had lower L-ascorbic acid content which varied from 22.0 to 25.0 mg 100 g^{-1} fresh weight on average, depending on the rate of $CaCO_3$ (Dzida 2010a). In another experiment conducted by the cited author (Dzida 2011), the average vitamin C content of purple basil fertilised with nitrogen ranged from 15 to 19 mg 100 g^{-1} fresh weight.

In the present study, the content of L-ascorbic acid in basil herbage was affected by container size, the number of plants per pot, and its interaction with basil varieties. Growing basil in 3.0 dm^3 containers with four plants per pot led to a 6-8% decrease in L-ascorbic acid concentrations. In a previous experiment performed by Majkowska-Gadomska *et al.* (2015), which investigated sweet basil, Thai 'Siam Queen' basil, Greek 'Minette' basil and cinnamon basil, L-ascorbic acid content was lower, from 9.5 mg 100g^{-1} fresh weight in Greek 'Minette' basil to 11.27 mg 100 g^{-1} fresh weight in sweet basil. The concentration of L-ascorbic acid was the highest in cinnamon basil – 15.29 mg 100g^{-1} fresh weight when cultivating a single plant in 3 dm^3 of substrate, the smallest for single sweet basil cultivation in a pot of 3 dm^3 – 10.05 mg 100g^{-1} fresh weight.

CONCLUSIONS

1. Cinnamon basil and Greek 'Minette' basil were characterised by significantly higher marketable yield of fresh herbage.

2. Basil ecotype had a significant effect on leaf greenness index, fresh herbage yield, dry herbage yield, and on the content of dry matter and total sugars.

3. Growing basil plants in 3.0 dm^3 containers, with four plants per pot, contributed to a significant decrease in fresh and dry herbage yields, in comparison with the remaining treatments.

REFERENCES

Biesiada A., Kuś A., 2010. The effect of nitrogen fertilization and irrigation on yielding and nutritional status of sweet basil (*Ocimum basilicum* L.). Acta Sci Pol-Hortoru, 9(2), 3-12.

Borowy A., Matela M., 2012. Effect of mycorrhization on growth and yield of Basil. Ann. UMCS, Sectio EEE. Horticultura, Lublin, 22(2), 12-22.

Capecka E., Mareczek A., Leja M., 2005. Antioxidant activity of fresh and dry herb of some Lamiaceae species. Food Chem., 93(2), 223-226.

Dzida K., 2010a. Nutrients contents in sweet basil (*Ocimum basilicum* L.) herb depending on calcium carbonate dose and cultivar. Acta Sci Pol-Hortoru, 9(4), 143-151.

Dzida K., 2010b. Biological value and essential oil content in sweet basil (*Ocimum basilicum* L.) depending on calcium fertilization and cultivar. Acta Sci Pol-Hortoru, 9(4), 153-161.

Dzida K., 2011. Influence of nitrogen nutrition and cultivar on quality of sweet basil herbs. Ann. UMCS Sectio DDD, Lublin, 24(3), 125-132.
Frąszczak B., Gąsecka M., Golcz A., Zawirska-Wojtasiak R., 2015. The chemical composition of lemon balm and basil plants grown under different light conditions. Acta Sci. Pol-Hortoru., 14(4), 93-104.
Frąszczak B., Knaflewski M. 2009. Effect of light conditions and temperature on fresh yield of some spice plants grown in containers. Vegetable Crop Research Bulletin, 71, 59-67.
Jadczak D., Błaszczuk A., Rekowska E., 2006. Effect of covering on the content of macroelements in yield of Basil (*Ocimum basilicum* L.) cultivated for bunch harvest. J. Elem., 11(2), 135-141.
Jadczak D., Grzeszczuk M., 2008. Spice herbs – biological value of selected species (in Polish). Panacea, 2(23), 15-17.
Kacperska A., 2002. Responses of plants to abiotic stress factors (In Polish). In: Fizjologia roślin (Eds J. Kopcewicz, S. Lewak). PWN, Warszawa.
Khalil S.E., Abd El-Aziz N.G., Abou Leila B.H., 2010. Effect of water stress, ascorbic acid and spraying time on some morphological and biochemical composition of *Ocimum basilicum* plant. J. Am. Sci., 6(12), 33-44.
Kopsell D.A., Kopsel D.E., Curran-Celentano J., 2005. Carotenoid and chlorophyll pigments in sweet basil grown in the field and greenhouse. HortSci., 40(5), 1230-1233.
Kołodziej B., 2010. Cultivation of herbs: guide for planters (in Polish). PWRiL, Poznań.
Kudełka W., Kosowska A., 2008. Components of spices and spice herbs determining their functional properties and their role in human nutrition and disease prophylaxis (in Polish). Zesz. Nauk., UE w Krakowie, Kraków, 781, 83-111.
Majkowska-Gadomska J., Dziedzic A., Dobrowolski A., Mikulewicz E. 2015. The effect of sowing time on the yield and nutritional value of Basil (*Ocimum basilcum* L.) herbage. Acta Agroph., 22(2), 165-172.
Majkowska-Gadomska J., Mikulewicz E., Dobrowolski A., Dziedzic A., 2015. Ecotype and foliar fertilization with Florovit affect herbage yield and quality of greenhouse-grown basil (*Ocimum basilicum* L.). JAS, 7(4), 195-200.
Nurzyńska-Wierdak R., 2012. *Ocimum basilicum* L. – a valuable spice, medicinal and oil bearing plant (in Polish). Ann. UMCS, Sectio EEE. Horticultura, Lublin, 22(1), 20-30.
Nurzyńska-Wierdak R., Borowski B., Dzida K., 2011a. Yield and chemical composition of basil herb depending on cultivar and foliar feeding with nitrogen. Acta Sci. Pol-Hortoru., 10(1), 207-219.
Nurzyńska-Wierdak R., Rożek E., Bolanowska K., 2012. Yield and quality of herbage of lemon balm, marjoram and thyme in relation to the method of cultivation in containers (in Polish). Ann. UMCS, Sectio EEE. Horticultura, Lublin, 22(2), 1-11.
Nurzyńska-Wierdak R., Rożek E., Borowski B., 2011b. Response of different basil cultivars to nitrogen and potassium fertilization: total and mineral nitrogen content in herb. Acta Sci. Pol-Hortoru., 10(4), 217-232.
Politycka B., Golcz A., 2004. Content of chloroplast pigments and anthocyanins in the leaves of *Ocimum basilicum* L. depending on nitrogen doses. Folia Hort., 16(1), 23-29.
Rosłon W., Osińska E., Bączek K., Węglarz Z., 2011.The influence of organic-mineral fertilizers on yield and raw materials quality of chosen plants of the Lamiaceae family from organic cultivation. Acta Sci. Pol-Hortoru., 10(1), 147-158.
Szajdek A., Borowska J., 2004. Antioxidant properties of food of plant origin (in Polish). Żywn-Nauk Technol Ja. 4(41)S, 5-28.
Szostak W.B., Cichocka A., 2008. Dietotherapy of adult patients with diabetes (in Polish). Diabet. Prakt., 9, 18-27.

Vrbnicanin S., Kresovic M., Bozic D., Simic A., Maletic R., Uludag A., 2012. The effect of ryegrass (*Lolium italicum* L.) stand densities on its competitive interaction with cleavers (*Galium aparine* L.). Turk. J. Agric. For., 36, 121-131.

Wu J., Wang D., Rosen C.J., Bauer M.E., 2007. Comparison of petiole nitrate concentrations, SPAD chlorophyll readings, and Quick Bird satellite imagery in detecting nitrogen status of potato canopies. Field Crops Res., 101, 96-103.

PLON I WARTOŚĆ ODŻYWCZA BAZYLII UPRAWIANEJ W SZKLARNI

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Streszczenie. Doświadczenie dwuczynnikowe przeprowadzono w latach 2012-2014 w szklarni Katedry Ogrodnictwa Uniwersytetu Warmińsko-Mazurskiego w Olsztynie. Pierwszym czynnikiem badawczym było sześć odmian botanicznych bazylii pospolitej: bazylia zielonolistna, tajska 'Siam Queen', grecka (drobnolistna) 'Minette', czerwonolistna, cytrynowa oraz cynamonowa. Drugim czynnikiem doświadczenia była uprawa roślin w doniczkach o zróżnicowanej pojemności oraz liczbie roślin: 0,7 dm^3 z jedną rośliną w pojemniku; 3,0 dm^3 z jedną rośliną w pojemniku; 3,0 dm^3 z czterema roślinami w pojemniku. W kolejnych latach trzyletniego cyklu doświadczenia, między 22 a 24 lutego w szklarni na stołach przesuwnych w zależności od objętości doniczek (0,7 i 3,0 dm^3) ustawiono pojemniki wypełnione podłożem organicznym, w którego skład wchodził torf sfagnowy. Jednorazowy zbiór ziela przeprowadzono między 17.04 a 07.05. Rośliny ścinano w doniczce, na wysokości 5 cm od podłoża w doniczce. Nie zanotowano uszkodzeń mechanicznych oraz chorób ziela, dlatego plon ogółem był taki sam jak plon handlowy. W bazylii określono zawartość suchej masy, cukrów ogółem i kwasu L-askorbinowego. Ekotyp bazylii pospolitej miał istotny wpływ na indeks zazielenienia liści bazylii, plonu świeżego i powietrznie suchego ziela oraz suchej masy i cukrów ogółem. Uprawa czterech roślin w pojemnikach 3 dm^3 istotnie wpływała na zmniejszenie ich plonu świeżego i powietrznie suchego ziela w odniesieniu do pozostałych obiektów badawczych.

Słowa kluczowe: *Ocimum basilcum* L., plon świeżego ziela, plon suchego ziela, sucha masa, skład chemiczny