ACTA Acta Sci. Pol., Hortorum Cultus 9(2) 2010, 3-12

THE EFFECT OF NITROGEN FERTILIZATION AND IRRIGATION ON YIELDING AND NUTRITIONAL STATUS OF SWEET BASIL (*Ocimum basilicum* L.)

Anita Biesiada, Anna Kuś

Wroclaw University of Environmental and Life Sciences

Abstract. Sweet basil (*Ocimum basilicum* L.) is an annual plant belonging to the plant family *Lamiaceae.* There are many varieties of basil, with leaves of colour from green to purple and with small white or pink flower. In field experiment conducted in the years 2007–2008 there was investigated the effect of nitrogen fertilization in the doses of 50, 150 and 250 kg N·ha^{-1}and irrigation on yielding and nutritional status of basil of 'Red Rubin' cultivar grown from transplants. Basil positively responded to irrigation and the increase in its yield under the influence of irrigation amounted from 97.37% to 25.36% in subsequent years of cultivation. Also the dose of nitrogen did advantageously affect basil herb yield. The highest yields were recorded at the dose of 150–250 kg N·ha^{-1}. The highest amount of nitrates ranged from 697.00 to 938.00 mg·kg^{-1} f.m. was determined in plants fertilized with nitrogen dose of 250 kg N·ha^{-1}. The level of macroelements depended both on irrigation and on nitrogen doses. Irrigation caused decreased amounts of phosphorus, potassium and calcium, while content of magnesium increased. The highest quantities of phosphorus and magnesium were obtained at nitrogen dose of 150 kg N·ha^{-1}, while for the highest values of potassium and calcium nitrogen dose was 250 kg N·ha^{-1}.

Key words: sweet basil, nitrogen dose, yield, nitrates, macronutrients

INTRODUCTION

Sweet basil (*Ocimum basilicum* L.) is a well-known and appreciated spice and medicinal plant [Omer et al. 2008]. Apart from biologically active compounds, such as volatile oils, tannins, terpenes, flavonoids or glycosides, it is also a valuable source of macro- and micro- elements [Kohlmünzer 2003].

Rich chemical composition, as well as unique taste and flavor have recently gained basil its considerable position and wide-range use in Polish cuisine. Basil`s leaves are used as spices both when fresh and after being frozen or dried.

Corresponding author – Adres do korespondencji: Anita Biesiada, Department of Horticulture, Wroclaw University of Environmental and Life Sciences, pl. Grunwaldzki 24a, 50-363 Wrocław, e-mail: anita.biesiada@up.wroc.pl

For cultivation purposes there is utilized basil featuring large, intensive green or purple leaves containing anthocyanins [Echeverry 1990]. The degree of plant supply with nitrogen is a major factor regarding yielding and affects the quantity and composition of volatile oils [Daneshian et al. 2009, Politycka and Golcz 2004]. Anthocyanins level depends, among others, on nitrogen content and its deficit usually leads to accumulation of those compounds [Taiz and Zeiger 1998]. The content of macroelements in basil is also related to climatic conditions and cultivation treatments, including irrigation and the terms of harvest [Daneshian et al. 2009]. However, so far there have not been elaborated precise data regarding standard contents of mineral components in basil governing plant appropriate growth and high yield of good quality herb.

The aim of research conducted in the years 2007–2008 in Department of Horticulture at Wroclaw University of Environmental and Life Sciences was the assessment of the effect of nitrogen fertilization and irrigation on yielding and the nutritional state of field grown basil.

MATERIALS AND METHODS

Field experiment was carried out in Research Station in Psary near Wroclaw, on a clay soil of pH = 6.9, containting 1.8% humus, 40 mg P, 150 mg K, 90 mg Mg in 1 dm^3. In two factorial experiments the first factor were nitrogen doses: 50, 150 and 250 kg $N \cdot ha^{-1}$. The source of nitrogen was ammonium nitrate. The second factor involved irrigation, applied weekly, to the part of plants, each time using 20 mm precipitation and the remaining part of plants constituting control treatment with no irrigation introduced. Field experiment followed a split-plot pattern, with three replications consisting of 12 plots, each of 4.05 m^2 area.

Basil seeds of 'Red Rubin' cultivar were sown on 14^{th} April in a greenhouse to multipots filled with peat substrate. After a month plants were placed under a foil tunnel, which contributed to seedlings hardening. Six-week old ready transplants were planted at the end of May in 45 × 22.5 cm spacing, to the plots entirely fertilized before plant growing period.

Herb harvest took place twice when inflorescence shoots occurred-for the first time in the half of July and, again, on 9^{th} September. Each time all the above ground plant parts were cut at the height 6–7 cm, leaving lower, lignified shoot parts. When harvesting, there were determined yield of herb and there were also collected plant material samples to be subjected to laboratory analyses. In basil leaves originating from the medium part of shoots there was assayed nitrates content using an ion-selective electrode, while after drying at the temperature of 40^oC in the extract with 2% acetic acid there was determined potassium and calcium content according to flame photometry method, as well as magnesium content with the use of colorimetric method.

The results were verified statistically. The significance of differences between mean values was estimated by Tukey's test at the significance level of $\alpha = 0.05$.

RESULTS AND DISCIUSSION

The weather conditions varied in the years of study (tab. 1). During the plant growing period mean air temperatures were favorable and relatively higher in both years of experiment than long-term average temperatures. Mean precipitation levels in May and June 2007 were higher than long-term average ones but in 2008 there was noticed a strong drought. Rainfalls in July and August of both years were sufficient for basil growth but in September there was observed low level of soil humidity.

Table 1. Mean temperatures and precipitation totals during the experimental period
Tabela 1. Średnie temperatury i sumy opadów podczas trwania doświadczenia

Month Miesiąc	Average monthly temperature Średnia temperatura miesiąca °C		Total monthly precipitation Miesięczna suma opadów mm		Average sum of monthly precipitation in the years 1981–2000 Średnia wieloletnia temperatura miesięczna 1981–2000	Deviation from average sum of monthly precipitation in the years 1981–2000 of examination Średnia wieloletnia miesięczna suma opadów 1981–2000
	2007	2008	2007	2008	mm	mm
May Maj	15.90	16.00	53.40	1.40	14.2	57.1
June Czerwiec	19.70	20.70	101.10	23.50	16.9	78.7
July Lipiec	20.30	21.70	108.30	285.70	18.8	90.8
August Sierpień	19.70	20.30	60.60	96.60	18.0	64.0
September Wrzesień	13.80	14.60	19.88	27.80	13.6	50.6

Both nitrogen dose and diversified moisture level did affect yield size of basil herb (tab. 2). Total yield obtained from irrigated treatments was significantly higher than that coming from not irrigated ones and it amounted 6.02 $kg \cdot m^{-2}$ in 2007 and 2.57 $kg \cdot m^{-2}$ in 2008, while the data dealing with not irrigated treatment amounted 3.05 and 2.05 $kg \cdot m^{-2}$ respectively. Yield increase as a result of irrigation ranged from 97.37% to 25.36% in the years of the experiment. Also Yassen et al. [2003] recorded advantageous reaction regarding plant yielding under the influence of irrigation.

Nitrogen dose did affect basil herb yield in both years of the experiment as well. In 2007, in the first cut, the increase in nitrogen dose from 50 to 150 kg $N \cdot ha^{-1}$ provided for yield increase even by 63.90%, while further increase in nitrogen dose to 250 kg $N \cdot ha^{-1}$ resulted in yield increase by 11.46%. Similarly, in the second cut in the treatment fertilized with nitrogen dose of 150 kg $N \cdot ha^{-1}$ herb yield was higher by 54.02% in comparison to that obtained at nitrogen dose of 50 kg $N \cdot ha^{-1}$, while further increase in N level brought about yield decrease by 8.94%. In 2008 the highest yield of basil herb was obtained due to plant fertilization in the dose of 150 kg $N \cdot ha^{-1,}$ and ranging from 1.34 $kg \cdot m^{-2}$ in the first cut to 1.79 $kg \cdot m^{-2}$ in the second cut. In treatments with most intensive irrigation basil gave the best yield at nitrogen dose of w 250 kg $N \cdot ha^{-1}$. Positive response of basil to nitrogen fertilization was also reported by other authors

Table 2. Effect of nitrogen dose and irrigation on sweet basil yielding, $kg \cdot m^{-2}$
Tabela 2. Wpływ nawożenia azotem i nawadniania na plonowanie bazylii pospolitej, $kg \cdot m^{-2}$

Factors Czynniki		I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia	Total yield Plon całkowity $kg \cdot m^{-2}$		Mean Średnia
		2007	2008		2007	2008		2007	2008	
I – dose of nitrogen, kg N ha^{-1} I – dawka azotu, kg N ha^{-1}	50	1.33	0.87	1.10	1.69	1.41	1.55	3.02	2.28	2.65
	150	2.18	1.34	1.76	2.80	1.79	2.29	4.98	3.13	4.05
	250	2.43	1.23	1.83	3.66	1.68	2.67	6.09	2.59	4.34
LSD α = 0.05 NIR α = 0,05		0.25	0.37		0.49	0.28		0.57	0.84	
II – irrigation II – nawadnianie	irrigation nawadnianie	2.40	1.46	1.93	3.35	1.59	2.47	6.02	2.57	4.29
	without irrigation bez nawadniania	1.42	0.97	0.89	1.67	1.32	1.50	3.05	2.05	2.55
LSD α = 0.05 NIR α = 0,05		0.32	0.49		0.27	0.34		0.62	0.88	

[Santos et al. 1998, Golcz et al. 2006, Sifola and Barbieri 2006]. Similarly, Sifola and Barbieri [2006] proved that basil reacts advantageously to intensive nitrogen fertilization. According to their results, under the influence of gradually increasing N doses up to 300 kg $N \cdot ha^{-1}$, in the conditions of drip irrigation, there was obtained significant increase in fresh matter yield of above ground plant parts and leaves-up to 43.1 $t \cdot ha^{-1}$. Yassen et al. [2003] reported the highest basil herb yield (23.2 $t \cdot ha^{-1}$) in treatments fertilized with the highest nitrogen dose amounting 120 kg $N \cdot ha^{-1}$. In climatic conditions of Poland better production effects are provided by basil cultivation from transplants. Plants obtained in this way characterize higher number of inflorescences and larger leaf blades, as well as they provide higher herb yield [Jadczak et al. 2006]. In research by Seidler-Łożykowska et al. [2009] basil cultivated from seeds yielded, depending on its stand, within the range 0.37–3.47 $kg \cdot m^{-2}$, while in our research at different weather conditions, when cultivated from transplants at two herb cuts there was obtained total yield amounting on average 2.65–4.34 $kg \cdot m^{-2}$.

The increase in nitrogen dose resulted in higher nitrates content. The lowest values regarding these compounds were determined at nitrogen fertilization dose 50 kg $N \cdot ha^{-1}$ (284–619 $mg \cdot kg^{-1}$ f.m.) and the highest ones were recorded for 250 kg $N \cdot ha^{-1}$ (661–1047 $mg \cdot kg^{-1}$ f.m.). The results of the experiment point out to the fact that basil is a plant of moderate tendency to nitrates accumulation, lower than dill and lettuce [Dziennik Ustaw, 2003]. In pot experiments conducted by Hochmuth et al. [2003] nitrates level in basil fertilized with N P K ranging from 0 to 600 $g \cdot pot^{-1}$ it amounted from 290 to 2500 ppm, and when cultivated in standard medium solution it equaled 1900 ppm. According to the results by Seidler-Łożykowska et al. [2009], basil coming from different stands contained highly diversified nitrates level within the range 487–5250 $mg \cdot kg^{-1}$ d.m. The results of experiments by Majkowska-Gadomska et al. [2009] showed that nitrate content of edible parts of basil was affected also by planting time.

In the experiment there was recorded considerable effect of diversified soil moisture on nitrates content in basil herb (tab. 3). Higher amounts of those compounds were accumulated by plants originating from not irrigated plots. Nitrates level in the first-cut – herb in regularly irrigated treatment amounted average 454.3 $mg \cdot kg^{-1}$ f.m., while in the conditions of reduced moisture it increased to 599.6 $mg \cdot kg^{-1}$ f.m. In the second cut for treatments without irrigation those values ranged from 665.00 $mg \cdot kg^{-1}$ f.m. in 2007 to 902.00 $mg \cdot kg^{-1}$ f.m. in 2008, while in the irrigated ones those values equaled 435.33 and 712.33 $mg \cdot kg^{-1}$ f.m respectively. According to Majkowska-Gadomska et al. [2009] red basil had higher level of nitrates in leaves in comparison to green basil.

There could be also noticed some effect of diversified soil moisture on phosphorus content in basil herb (tab. 4). In irrigated treatments there was usually recorded decrease in this component content. The lowest amount of phosphorus, ranging 0.43% in 2007 and 0.37% in 2008, featured herb from the first cut. More considerable effect on phosphorus content belonged to nitrogen fertilization. The highest amount of phosphorus was accumulated by plants fertilized with nitrogen in the dose of 150 kg $N \cdot ha^{-1}$.

Potassium content was affected both by diversified soil moisture and by the dose of nitrogen. In basil herb grown on irrigated plots potassium level showed lower values. In 2007 the increase in nitrogen dose caused increased contents of this element both in the first and in the second cut. The highest amount of potassium (5.48%) was recorded in plants harvested on 15th July at nitrogen dose 250 kg N·ha^{-1}. In 2008, in the second cut, the highest potassium content was found at fertilization with 150 kg N·ha^{-1}, while in the first cut there was not recorded any directed tendency.

Table 3. Effect of nitrogen dose and irrigation on nitrates content in sweet basil herb, mg·kg^{-1} f.m.
Tabela 3. Wpływ nawożenia azotem i nawadniania na zawartość azotanów w zielu bazylii pospolitej, mg·kg^{-1} ś.m.

Factors Czynniki			I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia
			2007	2008		2007	2008	
I – dose of nitrogen, kg N ·ha^{-1} I – dawka azotu, kg N ·ha^{-1}		50	284.00	314.00	299.00	411.50	619.00	515.25
		150	416.50	473.00	444.75	558.50	755.50	657.00
		250	661.00	733.00	697.00	830.50	1047.00	938.75
LSD α = 0.05 NIR α = 0,05			13.6	16.9		11.6	12.7	
II – irrigation II – nawadnianie	irrigation nawadnianie		373.33	435.33	404.33	535.33	712.33	623.83
	without irrigation bez nawadniania		534.33	578.00	556.17	665.00	902.00	783.50
LSD α = 0.05 NIR α = 0,05			21.3	17.2		24.7	19.7	

Except for plants harvested on 15th July 2008, there was observed the increase in Ca content in plants originating from not irrigated plots. The term of herb harvesting did also influence on calcium level (tab. 5). Higher amounts of calcium were found in plants from the second cut. There was also proved significant effect of nitrogen fertilization on calcium accumulation by basil plants. The increase in nitrogen doses caused Ca enhancement from 1.81% to 1.97% in 2007 and from 1.82% to 2.00% in 2008, which apparently confirms the statement quoted above. There was observed a slight effect of irrigation on magnesium content in red basil herb, in 2008. In irrigated treatments the mentioned content marked increased, but in 2007 there were found negligible difference. In not irrigated plots the content of Mg was slightly higher in 2007, while in 2008 no significant differences were found. Similarly, nitrogen dose affected magnesium content only to a low degree. In the literature there cannot be found detailed information about the effect of the examined factors on plants nutrition regarding such elements as P, K, Ca and Mg.

In the case of all the elements there was observed the effect of harvest term on their content in basil herb. In leaves from the second cut, harvested on 9th September, the level of potassium and magnesium decreased, while the content of calcium and phosphorus increased. Similar correlation was noticed by Szewczuk and Mazur [2004] in nettle. They reported that delayed harvesting resulted in decreased contents of phosphorus, potassium and magnesium. The level of macroelements also depends on other factors, e.g. the age of plants affects their chemical composition, which was confirmed, among others, by Rumińska [1983] and Sanda et al. [2001]. In research by Jadczak et al. [2006] the use of covers caused the decrease in nitrogen, potassium and magnesium contents in basil.

Table 4. The effect of nitrogen dose and irrigation on phosphorus and potassium content in sweet basil herb, % d.m.
Tabela 4. Wpływ nawożenia azotem i nawadniania na zawartość fosforu i potasu w zielu bazylii pospolitej, % s.m.

Factors Czynniki		P						K					
		I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia	I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia
		2007	2008		2007	2008		2007	2008		2007	2008	
I – dose of nitrogen	50	0.39	0.33	0.36	0.43	0.37	0.40	4.59	5.26	4.93	4.11	4.69	4.40
I – dawka azotu	150	0.53	0.43	0.48	0.55	0.45	0.50	4.98	4.38	4.68	4.67	4.94	4.81
kg N ·ha^{-1}	250	0.45	0.40	0.43	0.53	0.45	0.49	5.48	5.26	5.37	5.02	4.75	4.89
LSD α = 0.05 NIR α = 0,05		0.03	0.05		0.04	0.04		0.32	0.40		0.50	0.40	
II – irrigation II – nawadnianie	irrigation nawadnianie	0.43	0.37	0.40	0.46	0.42	0.44	4.58	4.84	4.71	4.33	4.38	4.36
	without irrigation bez nawadniania	0.48	0.40	0.44	0.54	0.42	0.48	5.45	5.09	5.27	4.87	5.21	5.04
LSD α = 0.05 NIR α = 0,05		0.04	n.s.		0.03	n.s		0.30	0.40		0.30	0.50	

Table 5. The effect of nitrogen dose and irrigation on calcium and magnesium content in sweet basil herb, % d.m.
Tabela 5. Wpływ nawożenia azotem i nawadniania na zawartość wapnia i magnezu w zielu bazylii pospolitej, % s.m.

Factors Czynniki		Ca						Mg					
		I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia	I cut I pokos		Mean Średnia	II cut II pokos		Mean Średnia
		2007	2008		2007	2008		2007	2008		2007	2008	
I – dose of nitrogen	50	1.42	1.63	1.53	1.81	1.82	1.82	0.21	0.21	0.21	0.19	0.20	0.20
I – dawka azotu	150	1.60	1.44	1.52	1.93	1.98	1.96	0.22	0.28	0.25	0.21	0.20	0.21
kg N ·ha^{-1}	250	1.62	1.44	1.53	1.97	2.00	1.99	0.24	0.20	0.22	0.21	0.21	0.21
LSD α = 0.05 NIR α = 0,05		0.05	0.05		0.07	0.11		0.02	0.03		0.01	n.s	
II – irrigation II – nawadnianie	irrigation nawadnianie	1.48	1.54	1.51	1.72	1.90	1.81	0.23	0.26	0.25	0.21	0.20	0.21
	without irrigation bez nawadniania	1.61	1.46	1.54	2.08	1.96	2.02	0.21	0.19	0.20	0.19	0.20	0.20
LSD α = 0.05 NIR α = 0,05		0.09	n.s.		0.12	n.s		n.s.	0.02		n.s.	n.s.	

In investigation conducted by Seidler-Łożykowska et al. [2008] basil was cultivated in the first year after manure application and the plant featured only higher potassium content as compared to control not fertilized organically. However, the level of Ca, Mg and P was higher in cultivated plants herb in the second year after introduction of manure fertilization. In the mentioned experiment P content ranged 0.55–0.57% d.m., K 3.56–4.47%, Ca 3.02–3.28% and Mg 0.52–0.77%. In our own research phosphorus content was similar and ranged from 0.39 to 0.54%, potassium level was higher and amounted 4.5–5.4% and calcium and magnesium content were lower almost by half: 1.6–2.08% and 0.20–0.28% respectively. According to the data by USDA [2009], Zengin et al. [2007], Jadczak et al. [2006] average level of calcium in basil dry herb amounts 2.0–3.36%, and that of magnesium 0.15–0.31% which can be compared to the results obtained in our experiment.

CONCLUSIONS

1. Basil of 'Red Rubin' cultivar positively response to irrigation. Yield increase as a result of irrigation ranged from 97.37% to 25.36%, depending on weather condition in particular years. Irrigated plants contained lower amounts of nitrates, phosphorus and potassium.

2. Basil is a plant featuring moderate tendency to nitrates accumulation. At nitrogen dose of 250 kg $N \cdot ha^{-1}$ nitrates content ranged from 830 to 1047 $mg \cdot kg^{-1}$ f.m.

3. Optimum nitrogen dose proved to be 150 kg $N \cdot ha^{-1}$. In the conditions of irrigation, plants advantageously reacted to intensive fertilization with nitrogen up to the dose of 250 kg $N \cdot ha^{-1}$. The highest quantities of phosphorus and magnesium were obtained at nitrogen dose of 150 kg $N \cdot ha^{-1}$ while the highest values of potassium and calcium at 250 kg $N \cdot ha^{-1}$.

REFERENCES

Daneshian A., Gurbuz B., Cosge B., Ipek A., 2009. Chemical components of essential oils from basil (*Ocimum basilicum* L.) grown at different nitrogen levels. IJNES. 3 (3), 8–12.

Dziennik Ustaw nr 37 poz. 326 z 4 lipca 2003 roku w sprawie maksymalnych poziomów zanieczyszczeń w żywności.

Echeverry O., 1990. Studies on the growth and fenology of *Ocimum basilicum*, *Ocimum minimum*, *Ocimum gratissimum*. Universidad Nacional de Colombia.

Golcz A., Politycka B., Seidler-Łożykowska K., 2006. The effect of nitrogen fertilization and stage of plant development on the mass and quality of sweet basil leaves (*Ocimum basilicum* L.). Herba Pol. 52, 1/2, 22–30.

Hochmuth R., Davis L.L., Laughlin W.L., Simonne G.H., 2003. Evaluation of Organic Nutrient Sources in the Production of Greenhouse Hydroponic Basil. North Florida Research and Education Center Research Report 2003-08: 7pp.

Jadczak D., Błaszczuk A., Rekowska E., 2006. Effect of covering on the content of macroelements in basil (*Ocimum basilicum* L.) cultivates for a bunch harvest. J. Elementol. 11 (2), 135–141.

Kohlmünzer S., 2003. Farmakognozja. Wyd. Lekarskie PZWL. Warszawa, wyd. 5.
Majkowska-Gadomska J., Arcichowska K., Wierzbicka B., 2009. Nitrate content of the edible parts of vegetables and spice plants. Acta Sci. Pol., Hortorum Cultus 8(3), 25–35.
Omer E. A., Elsayed Abdel-Ghafor A., El-Lathy A., Khattab M.E., Sabra A.S., 2008. Effect of the nitrogen fertilizer forms and time of their application on the yield of herb and essential oil of *Ocimum americanum* L. Herba Pol. 54, 1, 34–46.
Politycka B., Golcz A., 2004. Content of chloroplast pigments and anthocyanins in the leaves of *Ocimum basilicum* L. depending on nitrogen doses. Folia Hortic. Ann. 16/1, 23–29.
Rumińska A., 1983. Rośliny lecznicze. PWN. Warszawa.
Sanda K., Koba K., Akpagana K., Tchepan T., 2001. Content and chemical composition of the essential oil of *Ocimum basilicum* L. and *Ocimum gratissimum* L. at different harvesting dates after planting. Rivista Ital EPPOS (31), 3–7.
Santos B., Morales-Payan J., Stall W.M., Dusky J., 1998. Effects of nitrogen and gibberelic acid combinations on basil growth. Soil. Crop Sci. Soc. Florida Proc. 57, 99–101.
Seidler-Łożykowska K., Golcz A., Wójcik J., 2008. Yield and quality of sweet basil, savory, marjoram and thyme raw materials from organic cultivation on the composted manure. J. Res. Applic. Agric. Eng. 53, (4), 63–66.
Seidler-Łożykowska K., Mordalski R., Kucharski W., Golcz A, Kozik E., Wójcik J., 2009. Economic and qualitative value of the raw material of chosen species of medicinal plants from organic farming part II. Yield and quality of sweet basil herb (*Ocimum basilicum* L.). Acta Sci. Pol., Agricultura 8(3) 2009, 29–35.
Sifola M.I., Barbieri G., 2006. Growth, yield and essential oil content of three cultivars of basil grown under different levels of nitrogen in the field. Sci. Hort. 108, 408–413.
Szewczuk Cz., Mazur M., 2004. Wpływ zróżnicowania dawek nawozów azotowych na skład chemiczny pokrzywy zwyczajnej (*Urtica dioica* L.) zbieranej w trzech fazach rozwojowych. Cz. I. Zawartość składników mineralnych. Acta Sci. Pol. Agricultura 3, (1), 239–248.
Taiz L., Zeiger E., 1998. Mineral nutrition. Plant Physiology. Sinauer Associates, Inc., Sunderland, 103–124.
USDA National Nutrient Database for Standard Reference, Release 19. 2006. http://www.nal.usda.gov/fnic/foodcomp.
Yassen M., Ram P., Anju Yadav, Singh K., 2003. Response of Indian basil (*Ocimum basilicum*) to irrigation and nitrogen schedule in Central Uttar Pradesh. Central Institute of Medicinal and Aromatic Plants. Annals of Plant Physiology. CAB abstracts.
Zengin M., Özcan M. M., Cetin Ü., Gezgin S., 2007. Mineral contents of some aromatic plants, their growth soils and infusions. J. Sci. Food Agric. 88 (4), 581–589.

WPŁYW NAWOŻENIA AZOTEM I NAWADNIANIA NA PLONOWANIE I STAN ODŻYWIENIA BAZYLII POSPOLITEJ (*Ocimum basilicum* L.)

Streszczenie. Bazylia pospolita jest rośliną jednoroczną należącą do rodziny jasnotowatych (*Lamiaceae*). Istnieje wiele odmian bazylii, które charakteryzują się różnym zabarwieniem liści (zielone, fioletowe) i kwiatów (białe, różowe) W doświadczeniu przeprowadzonym w latach 2007–2008 badano wpływ nawożenia azotem, w dawkach 50, 150 i 250 kg $N \cdot ha^{-1}$ oraz nawadniania na plonowanie i stan odżywienia bazylii o czerwonych liściach uprawianej z rozsady. Bazylia dodatnio reagowała na nawadnianie, zwyżka plonu pod wpływem nawadniania wynosiła od 97.37% do 25.36% w kolejnych latach uprawy.

Również dawka azotu wpływała korzystnie na plon ziela bazylii. Największy plon odnotowano przy dawce 150–250 kg N·ha^{-1}. Największą ilość azotanów odnotowano u roślin nawożonych dawką 250 kg N·ha^{-1}. Ich zawartość wahała się od 697do 938 mg·kg^{-1} ś.m. Poziom makroelementów zależał zarówno od nawadniania, jak i dawek azotu. Nawadnianie powodowało zmniejszenie ilości fosforu, potasu i wapnia, natomiast zwiększenie zawartości magnezu. Największe wartości fosforu i magnezu uzyskano przy dawce 150 kg N·ha^{-1}, natomiast potasu i wapnia przy dawce 250 kg N·ha^{-1}.

Słowa kluczowe: bazylia pospolita, dawka azotu, plon, azotany, makroelementy

Accepted for print – Zaakceptowano do druku: 6.05.2010