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EVALUATION OF CONTENT OF SELECTED MACRO- AND MICRONUTRIENTS IN EDIBLE PARTS IN WINTERING ONION CULTIVATED FOR BUNCHES

OCENA ZAWARTOŚCI WYBRANYCH MAKRO- I MIKROSKŁADNIKÓW W CZĘŚCIACH JADALNYCH ZIMUJĄCEJ CEBULI ZWYCZAJNEJ UPRAWIANEJ NA PĘCZKI

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Streszczenie. Zaletą metody uprawy cebuli z zimowaniem na polu jest wcześniejsze zaopatrzenie rynku w świeżą cebulę pochodzącą z upraw polowych. Tak wczesna cebula z zielonym szczypiorem jest warzywem bardziej atrakcyjnym, ponadto ma większą wartość biologiczną niż cebula długo przechowywana. Bogactwo związków, jakie zawiera cebula, powoduje, że odgrywa ona bardzo ważną rolę w żywieniu człowieka. Celem pracy było określenie zawartości makroskładników: azotu ogólnego, fosforu, potasu, wapnia, magnezu i siarki oraz wybranych mikroskładników (manganu, żelaza, miedzi i cynku) w częściach jadalnych cebuli zimującej odmiany 'Amigo F_1', w zależności od stosowanych metod uprawy (z okrywaniem roślin przed zimą włókniną polipropylenową oraz bez okrywania – obiekt kontrolny). Na podstawie uzyskanych wyników stwierdzono zróżnicowaną zawartość składników mineralnych w badanych częściach cebuli. W szczypiorze stwierdzono istotnie większą zawartość azotu ogólnego (średnio 28,73 g · ka^{-1} s.m.), potasu (średnio 42,22 g · kg^{-1} s.m.), wapnia (8,77 g · kg^{-1} s.m.), magnezu (średnio 2,21 g · kg^{-1} s.m.) i siarki (3,37 g · kg^{-1} s.m.), w porównaniu z zawartością tych składników w niedojrzałej cebuli. W szczypiorze wykazano również istotnie większe zawartości manganu (średnio 28,97 mg · kg^{-1} s.m.), żelaza (459,85 mg · kg^{-1} s.m.) oraz miedzi (średnio 6,67 mg · kg^{-1} s.m.). Uprawa cebuli ozimej z zastosowaniem okrywania roślin przed zimą włókniną polipropylenową PP 17 przyczyniła się do wzrostu zawartości magnezu, siarki, manganu, żelaza, miedzi, w odnniesieniu do metody uprawy bez okrywania osłonami.

Key words: wintering onion, polypropylene cover, macro- and micronutrients.
Słowa kluczowe: cebula zimująca, włóknina polipropylenowa, makro- i mikroskładniki.

INTRODUCTION

Bulb vegetables are grown and eaten all over the world. Within this group of vegetables, the common onion is of great economic importance. It is harvested as spring onions (green-topped) or as full-size onions for curing. Given its valuable nutritional and medicinal properties, this species has a broad range of applications in human life. (Wang et al. 2012). Attempts have been made to grow onions over winter. Agreat advantage of this method of cultivation is the possibility of early supplying the market with fresh onions from field

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cultivation. Early onion with green chives is a very attractive and sought-after vegetable. Its nutritional value is greater than the onion from long-term storage yield caused by frost damage, flat covers are used (perforated plastic film, polypropylene non-woven fabric). Proper selection of the cultivar is an important aspect of such a crop, which guarantees good winter hardiness of the plants and, as a result, high good quality yields in the spring. The aim of conducted experiments was to evaluate content of selected chemical components in edible parts of wintering onion of Amigo F_1 cultivar.

MATERIAL AND METHODS

Experiment was conducted in two vegetation periods (2008/2009 and 2009/2010) in Vegetable Experimental Station in Dołuje, near Szczecin. In the studies an overwintering cultivar Amigo F_1, tolerant to frost, with a rapid pace of weight gain of bulb in the spring was used.

Experiment was carried out in randomized block design, in three replications. Plants were grown in objects with polypropylene non-woven covering and in control plots (without covering). Area of each experimental plot amounted to 1.2 m^2 (1.2 m ·1.0 m). Bean was a forecrop for onion. Rates of NPK fertilization were determined on the basis of current content of nutritional components in soil (Table 1) and soil was supplemented with NPK to standard content recommended for onion (Sady 2006). A single dose of phosphorus and potassium fertilizers was applied a week before sowing the seeds. The dose of nitrogen was divided into three parts. The first was applied before sowing (as nitro-chalk) and the other two in the form of top dressing (as ammonium nitrate) were applied in the spring, just after beginning of the vegetation and two weeks later.

Table 1. Mineral composition of the soil collected from the experimental plot in the consecutive years of the study
Tabela 1. Zawartość składników mineralnych w glebie pola doświadczalnego w kolejnych latach badań

Year of study Rok badań	pH in H_2O pH w H_2O	$N\text{-}NO_3$	P	K	Ca	Mg	Cl	Salinity Zasolenie [g NaCl · dm^{-3}]
		mg · dm^{-3}						
2007	7.1	49	120	153	3574	106	21	0.38
2008	7.8	66	96	98	3088	79	15	0.30
2009	7.7	17	118	143	2333	119	15	0.16

Seeds of onion were sown each year on 10th August, at a rate of 6 kg · ha^{-1}, in rows spaced every 30 cm. Before the winter plants were covered with thin polypropylene non-woven fabric PP 17 (1 m^2 of this cover weighs 17 g). It was removed in the early spring, at the beginning of the plant vegetation. Harvest of plant wintering onion was performed when the leaves were approximately 50 cm long.

There has been significant differences in the weather conditions noted for the years of the study. The least positive course of the atmospheric characteristic for the plant growth was observed in the first onion growing season (2007/2008). Over 0°C temperature from December to February together with the lack of snow cover had a negative effect on the plant emergence and their over-wintering, and also on the quantity and quality of the yield. Content of:

- total nitrogen (by the Kjeldahl method),
- magnesium, copper, iron, zinc and manganese (by flame spectrophotometry absorption ASA),
- phosphorus (by the colorimetric method),
- potassium and calcium (by flame photometry),
- sulphur (by the turbidimetric method) were estimated in fresh plant material (leaves foliage and bulb) (Krełowska-Kułas 1993).

The results were evaluated by the Tukey's test and the assumed significance level was $\alpha = 0.05$.

RESULTS AND DISCUSSION

One of the major factors determining successful overwintering and high quality and abundant yield of onion is appropriate fertilization with phosphorus-based fertilizers. The doses of mineral fertilizers need to precisely match current nutritional composition of the soil. Correct doses and times of their application in the cultivation of overwintering onion is particularly important in the case of nitrogen (Felczyński 2008).The influence of weather conditions on the field cultivation of vegetables in Poland is very significant (Siwek et al. 2013). According to Brewster et al. (1977) and Brewster and Salter (1980), sowing common onion seeds in autumn allows earlier harvest and reduces the risk of disease. Onions should not be harvested too early nor too late. Richwine (1990) showed that a delay in sowing has a negative influence on the yield. According to the author, sowing seeds on 11 October resulted in a decrease in the yield by 86% as compared to an earlier sowing time of 19 September. Sowing seeds after 15 September contributed to poor over wintering of young plants. Felczyński (2006) demonstrated that sowing onion seeds in the beginning of August resulted in the smallest yield but delaying sowing until the end of August considerably improved the yield. In the present author's own research, seeds were sown in late summer, on 10 August. The yield obtained on 10 June was of good quality without discoloration or signs of disease.

In each year of the study a significant differences in content of evaluated macronutrients depending on kind of edible part of onion were found (Tables 2, 3). Significantly higher content of total nitrogen, potassium, calcium, magnesium and sulphur was found in leaves foliage. However, bulbs were characterized by higher content of phosphorus than leaves foliage. A similar phenomenon as regards the content of phosphorus was observed in research carried out by Żurawik and Żurawik (2015), who showed that the phosphorus content in garlic chive leaves increases when the plants are covered with black non-woven fabric, with a simultaneous decrease in the amount of potassium, calcium, copper and manganese as compared to blanched plants.

Significant influence of method of wintering onion cultivation on content of total nitrogen (in the year 2009) and phosphorus, magnesium and sulphur (in both years of the experiment) was found. In cultivation of onion with non-woven PP 17 polypropylene covering the increase of content of total nitrogen, magnesium and sulphur was found in comparison with plants grown in the fields without covers (control object). Besides content of macronutrients also content of micronutrients in onion differed significantly depending on factors evaluated in the experiment (Table 4).

Table 2. Content of total nitrogen, phosphorus and potassium depending on kind of eatable part of plant and method of cultivation of winter onion
Tabela 2. Zawartość azotu całkowitego, fosforu i potasu w zależności od rodzaju części jadalnej rośliny oraz metody uprawy cebuli ozimej

Part of plant Część rośliny	Method of cultivation Metoda uprawy	Total nitrogen Azot całkowity			Phosphorus Fosfor			Potassium Potas		
		g · kg^{-1} d.m. – s.m.								
		2009	2010	mean średnia	2009	2010	mean średnia	2009	2010	mean średnia
Leaves foliage Liście	polypropylene cover włóknina polipropylenowa	23.41	35.63	29.52	2.22	3.11	2.67	44.19	43.56	43,88
	without cover (control) bez osłony (kontrola)	20.04	35.84	27.94	2.94	3.42	3.18	40.64	40.45	40.55
Mean Średnia		21.73	35.74	28.73	2.58	3.27	2.93	42.42	42.01	42.22
Bulb Cebula	polypropylene cover włóknina polipropylenowa	17.52	22.47	20.00	3.19	3.59	3.39	13.13	13.67	13.40
	without cover (control) bez osłony (kontrola)	16.97	20.19	18.58	3.59	3.87	3.73	16.76	16.53	16.65
Mean Średnia		17.25	21.33	19.29	3.39	3.73	3.56	14.95	15.10	15.03
Mean for methods of cultivation Średnia dla metod uprawy	polypropylene cover włóknina polipropylenowa	20.47	29.05	24.76	2.71	3.35	3.03	28.66	28.62	28.64
	without cover (control) bez osłony (kontrola)	18.51	28.01	23.26	3.27	3.65	3.46	28.70	28.49	28.60
LSDα = 0.05 for part of plant – dla części rośliny		0.19	1.97	0.80	0.19	0.28	0.33	0.18	1.49	0.81
Method of cultivation Metoda uprawy		0.63	n.s.	n.s.	0.23	0.29	0.18	n.s.	n.s.	n.s.
Interaction Interakcja		0.88	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

n.s. – non significant differences – różnica nieistotna.

Table 3. Content of calcium, magnesium and sulphur in eatable parts of winter onion depending on method of its cultivation
Tabela 3. Zawartość wapnia, magnezu i siarki w jadalnych części cebuli ozimej, w zależności od sposobu jej uprawy

Part of plant Część rośliny	Method of cultivation Metoda uprawy	Calcium Wapń			Magnesium Magnez			Sulphur Siarka		
		g · kg^{-1} d.m. – s.m.								
		2009	2010	mean średnia	2009	2010	mean średnia	2009	2010	mean średnia
Leaves foliage Liście	polypropylene cover włóknina polipropylenowa	8.80	8.69	8.75	2.10	3.09	2.60	3.82	3.50	3.66
	without cover (control) bez osłony (kontrola)	8.71	8.87	8.79	1.60	2.04	1.82	3.36	2.78	3.07
Mean Średnia		8.76	8.78	8.77	1.85	2.56	2.21	3.59	3.14	3.37
Bulb Cebula	polypropylene cover włóknina polipropylenowa	1.28	0.70	0.99	0.65	0.77	0.71	0.97	1.09	1.03
	without cover (control) bez osłony (kontrola)	1.31	0.71	1.01	0.61	0.71	0.66	0.98	1.12	1.05
Mean Średnia		1.30	0.71	1.00	0.63	0.74	0.69	0.98	1.11	1.04
Mean for methods of cultivation Średnia dla metod uprawy	polypropylene cover włóknina polipropylenowa	5.04	4.70	4.87	1.38	1.93	1.66	2.40	2.30	2.35
	without cover (control) bez osłony (kontrola)	5.01	4.79	4.90	1.11	1.38	1.24	2.17	1.95	2.06
LSDα = 0.05 for part of plant – dla części rośliny		0.32	0.21	2.28	0.01	0.09	0.06	0.57	0.13	0.38
Method of cultivation Metoda uprawy		n.s.	n.s.	n.s.	0.03	0.03	0.02	0.05	0.09	0.08
Interaction Interakcja		n.s.	n.s.	n.s.	0.04	0.05	0.02	0.07	0.12	0.09

n.s. – non significant differences – różnica nieistotna.

Table 4. Evaluation of content selected micronutrients depending on kind of eatable part of plant and method of cultivation of winter onion
Tabela 4. Ocena zawartości wybranych mikroskładników w zależności od rodzaju jadalnej części rośliny oraz metody uprawy cebuli ozimej

Part of plant Część rośliny	Method of cultivation Metoda uprawy	Manganese Magnez			Iron Żelazo			Copper Miedź			Zinc Cynk		
		mg · kg^{-1} d.m. – s.m.											
		2009	2010	mean średnia	2009	2010	mean średnia	2009	2010	mean średnia	2009	2010	mean średnia
Leaves foliage Liście	polypropylene cover włóknina polipropylenowa	32.40	38.44	35.42	496.20	539.39	517.80	7.09	7.85	7.47	18.99	22.86	20.93
	without cover (control) bez osłony (kontrola)	20.60	24.41	22.51	467.60	336.16	401.88	5.52	6.20	5.86	13.28	16.32	14.80
Mean Średnia		26.50	31.43	28.97	481.90	437.80	459.85	6.31	7.03	6.67	16.14	19.59	17.87
Bulb Cebula	polypropylene cover włóknina polipropylenowa	7.98	9.97	8.98	35.36	88.80	62.08	3.89	2.70	3.30	16.68	26.10	21.39
	without cover (control) bez osłony (kontrola)	7.02	8.76	7.89	30.56	80.01	55.29	3.92	2.88	3.40	20.49	34.22	27.36
Mean Średnia		7.50	9.37	8.44	32.96	84.41	58.69	3.91	2.79	3.35	18.59	30.16	24.38
Mean for methods of cultivation Średnia dla metod uprawy	polypropylene cover włóknina polipropylenowa	20.19	24.21	22.20	265.78	314.10	289.94	5.49	5.28	5.39	17.84	24.48	21.16
	without cover (control) bez osłony (kontrola)	13.81	16.59	15.20	249.08	208.09	228.59	4.72	4.54	4.63	16.89	25.27	21.08
LSDα = 0.05 for part of plant – dla części rośliny		1.87	5.37	2.88	29.09	49.97	37.23	0.51	0.13	0.30	n.s.	0.83	0.12
Method of cultivation Metoda uprawy		0.97	0.63	2.42	3.84	4.92	1.86	0.68	0.10	0.19	n.s.	0.39	n.s.
Interaction Interakcja		1.38	0.88	0.80	1.97	6.96	1.72	0.96	0.14	0.18	2.52	0.55	0.14

n.s. – non significant differences – różnica nieistotna.

In each year of the research, significantly higher content of magnesium, iron and copper was found in leaves foliage in comparison with bulb. Zinc was an exception because in the year 2009 no significant differences in content of that component, regardless of edible part of plant were found. However, in the year 2010 (what was confirmed by average results of the years of experiment) edible bulb was characterized by higher content of zinc than leaves foliage.

Tendaj and Gruszecki (2002) claimed that covering onion crops with non-vowen polypropylene or perforated film just before frost was one of the most important treatments considerably enhancing their overwintering performance. Statistical analysis on obtained results of the experiment showed that covering of onion with polypropylene non-woven PP 17 affected the significant increase content of manganese, iron and copper in comparison with cultivation of onion without covers. Results obtained by Michalik (2010) are confirmable with that opinion. Author showed that covering of plants of sweet pepper with non-woven polypropylene had affected the increase of content of dry matter and mineral components in fruits of evaluated cultivars.

Similarly, Wadas et al. (2008) showed that content of magnesium in tubers of early potato of *Tagetes* L. cultivar increased when plants were grown under non-woven polypropylene. However, no significant differences in content of potassium and zinc between onion grown in the fields without covers (control object) and cultivated with non-woven PP 17 polypropylene covering were found. Orłowski et al. (2005) obtained similar results. In that case no significant influence of the use of flat covers on content of dry matter, L-ascorbic acid and macronutriends was found. Similarly, in research conducted by Jadczak and Wójcik-Stopczyńska (2007) no significant influence of covering of plants with perforated foil and non-woven polypropylene on content of dry matter was found.

Also results of experiments conducted by Biesiada (2008) did not confirm those advantageous effects of the use of covers. Author evaluated the influence of the use of covers in cultivation of kohlrabi for early harvest. Non-woven and perforated foil used in the experiment affected the decrease of content of dry matter, total sugars including reducing sugars in hypocotyle of kohlrabi. Majkowska-Gadomska (2010) in the research concerning chemical composition of fruits of selected cultivars of melon showed that kind of plants cover and soil covering had differentiated significantly content of dry matter in eatable parts of melon however, did not affect significant changes in content of the other organic components. Also experiments conducted by Błażewicz-Woźniak (2009) confirm those results. Used covers did not affect significantly nutritive value of thickened stems of fennel in comparison with its growing without covers. A significantly higher total yield and a greater share of commercial yield in the total yield were found in research carried out by Francke (2011). Also Rekowska (2007) and Rekowska and Skupień (2009) emphasize the benefits resulting from the use of flat covers in garlic cultivation on the yield of onions to be sold in bunches.

This has also been confirmed by the results of the research done by Siwek and Libik (2005), which deals with the influence of the use of the PP 30 non-woven fabric and biodegradable fibre on the size and quality of ribbed celery. They proved that covering ribbed celery with a perforated plastic film for 4 weeks contributed to a significant increase in the yield as compared to cultivation in an uncovered field. This cover was also good protection against the formation of the so-called bolters. Błażewicz-Woźniak et al. (2014) also carried out research analysing the chemical composition of romaine lettuce under the influence of

covering plants with flat covers. The authors proved a significant influence of the covers used on the content of P and Mg in the leaves. Lettuce grown under the PP 17 and PP 50 non--woven fabric collected less P, but more Mg than lettuce grown without any covers. No significant influence of the use of dry covers was found on the dry matter content, total N as well as P and Ca (Adamczewska-Sowińska and Kołota 2011). However, a different opinion is held by Siwek et al. (2013), who covered onions from the Glacier cultivar with Bionolle 59 g · m^{-2} and 100 g · m^{-2} covers and standard PP 50 non-woven fabric. In the assessment of the yield, he did not find an influence of the covers used on the chemical ingredient content in bulbs as compared to the cultivation without covers. Błażewicz-Woźniak et al. (2014), in turn based on the research aimed at defining the influence of the use of flat covering of plants with PP 17 and PP 50 covers and intercropping on the macronutrient content in romaine lettuce leaves, found that covering plants with non-woven fabric did not have a significant influence on the dry matter content, total N, P and Ca in romaine lettuce. They showed that lettuce under covers accumulated less K but more Mg than lettuce cultivated without covers.

CONCLUSIONS

1. Significant differences in content of selected chemical components depending on examined eatable part of plants were found. Significantly higher content of total nitrogen, potassium, calcium, magnesium and sulphur was found in chive however, bulb was characterized by higher content of phosphorus and zinc.
2. Cultivation of onion with the use of non-woven PP 17 polypropylene covering affected the increase of content of magnesium (on the average by 33.5%) and sulphur (on the average by 14%) in comparison with plants grown in the fields without covers (control object).
3. Cultivation of onion with the use of non-woven polypropylene covering affected also the significant increase of content of manganese (on the average by 46%), iron (on the average by 27%) and copper (on the average by 16%) in edible parts of plants in comparison with control object (growing in the field without covers).

REFERENCES

Adamczewska-Sowińska K., Kołota E. 2011. Using synthetic mulches and flat plastic film and non-woven fabric covers in courgette cultivation. Acta Sci. Pol., Hortorum Cultus 10(7), 179–189.

Biesiada A. 2008. Effect of covers and plant density on yielding and quality of kohlrabi. J. Elem. 13(2), 167–173.

Błażewicz-Woźniak M. 2009. The influence of soil and plant covering and the date of sowing on the emergence and growth of two fennel cultivars in field cultivation. Ann. UMCS, Sec. EEE 19(2), 1–10.

Błażewicz-Woźniak M., Krzysiak A., Najda A., Baltyn M. 2014. The influence of flat covering and intercropping on the chemical composition of romaine lettuce leaves. Hortic. Ann. UMCS Lub. 24(1), Sec. EEE, 9–15.

Brewster J.L., Salter P.J, Darby R.J. 1977. Analysis-of the growth and yield of overwintered onions. J. Hort. Sci. 52, 335–346.

Brewster J.L., Salter P.J. 1980. The effect of plant spacing on the yield and bolting of two cultivars of overwintered bulb onions. J. Hort. Sci. 55(2), 97–102.

Felczyński K. 2006. Nowe elementy w uprawie cebuli ozimej [New growing elements of wintering onion]. Now. Warz. 43, 45–58. [in Polish]

Felczyński K. 2008. Wpływ terminu siewu i przedzimowego nawożenia azotem na zimotrwałość i plonowanie cebuli ozimej [Effects of sowing time and pre-winter nitrogen fertilization on overwintering and yield of winter onion]. Zesz. Probl. Post. Nauk Rol. 527, 97–107. [in Polish]

Francke A. 2011. Assessing the effectiveness of flat cover use on the size and quality of rocket yield. Acta Sci. Pol., Hortorum Cultus 10(4), 3–14.

Jadczak D., Wójcik-Stopczyńska B. 2007. Influence of plant covering on some organic compound content and pungency of shallot grown for bunching harvest. Veg. Crops Res. Bull. 66, 25–30.

Krełowska-Kułas M. 1993. Badanie jakości produktów spożywczych. Warszawa, PWE. [in Polish]

Majkowska-Gadomska J. 2010. The chemical composition of fruit in selected melon cultivars grown under flat covers with soil mulching. Acta Sci. Pol., Hortorum Cultus 9(2), 39–52.

Michalik Ł. 2010. The effect of non-woven pp fabric covers on the yielding and the fruit quality of field-grown sweet peppers. Acta Sci. Pol., Hortorum Cultus 9(4), 25–32.

Orłowski M., Jadczak D., Żurawik A. 2005. The influence of the cover and the diameter of planted bulbs on the size and quality of shallot cultivated for bunches. Zesz. Nauk. AR Wroc. 515(86), 387–393.

Rekowska E. 2007. The influence of covers and methods of clove planting on the yields of garlic in the cultivation on harvesting for bunches. Rocz. AR Pozn., Ogrodnictwo 43, 585–593.

Rekowska E., Skupień K. 2009. The influence of selected agronomic practices on the yield and chemical composition of winter garlic. Veg. Crops Res. Bull. 70, 173–182.

Richwine P.A. 1990. Effect of fall planting date on bulb yield of 'Sweet Winter' onion in the rolling plains of Texas. Hort. Sci. 25(8), 981.

Sady Wł. 2006. Nawożenie warzyw polowych. Kraków, Wydaw. Plantpress. [in Polish]

Siwek P., Libik A. 2005. Wpływ osłon z folii i włókniny w uprawie wczesnej selera naciowego na wielkość i jakość plonu [Effects of covering early leaf celery crops with plastic film and non-vowen on the quantity and quality of its yield] Zesz. Nauk. AR Wroc. 515(86), 483–490. [in Polish]

Siwek P., Libik A., Zawiska I. 2013. The influence of biodegradable non-woven fabric covers on the yield and quality of overwintering onion. Acta Sci. Pol., Hortorum Cultus 12(6), 3–11.

Tendaj M., Gruszecki R. 2002. Wpływ terminu sadzenia dymki i stosowania płaskich osłon na plon wczesnej cebuli z zielonym szczypiorem [Effects of planting time and flat covers on the yield of spring onion with green leaves] Ann. UMCS Lubl., Sec. EEE 9, 61–68. [in Polish]

Wadas W., Kosterna E., Sawicki M. 2008. Effect of perforated film and polypropylene nonwoven covering on the marketable value of early potato yield. Veget. Crops Res. Bull. 69, 51–61.

Wang Y., Tian W.X., Ma X.F. 2012. Inhibitory effects of onion (*Allium cepa* L.) extract on proliferation of cancer cells and adipocytes via inhibiting fatty acid synthase. Asian Pac J. Cancer Prev. 13(11), 5573–9.

Żurawik A., Żurawik P. 2015. Content of macro- and micronutrients in green and blanched leaves of garlic chives (*Allium tuberosum* Rottler ex Sprengel). J. Elem. 20(4), 1053–1060. DOI: 10.5601.jelem.2014.19.4.815.

Abstract. An advantage of overwintering onion in the field is the possibility of earlier supply of fresh, field-cultivated onion to the market. Many experiments with onion wintering in the fields have been conducted in Poland recently. Earlier market supply of fresh onion grown in the field is an undoubted advantage of that method. Early onions with green leaves foliage is an attractive vegetable and is characterized by greater biological value than onion stored for a long time. It is a very rich source of components important in human nutrition. The aim of the research was to evaluate content of macronutrients: total nitrogen, phosphorus, potassium, calcium, magnesium and sulphur as well as selected micronutrients (manganese, iron, copper and zinc) in edible parts (leaves foliage and bulb) of wintering onion cultivar Amigo F_1 depending on the method of cultivation (growing under polypropylene non-woven covering and without covers – control object). On the basis of obtained results, different content of mineral components depending on kind of eatable part of plant was found. Significantly higher content of total nitrogen (on the

average 28.73 g · ka^{-1} d.m.), potassium (on the average 42.22 g · kg^{-1} d.m.), calcium (8.77 g · kg^{-1} d.m.), magnesium (on the average 2.21 g · kg^{-1} d.m.) and sulphur (3.37 g · kg^{-1} d.m.) was found in leaves foliage in comparison with unripe bulbs. Also significantly higher content of manganese (on the average 28.97 mg · kg^{-1} d.m.), iron (459.85 mg · kg^{-1} d.m.) and copper (on the average 6.67 mg · kg^{-1} d.m.) was found in leaves foliage than in bulbs. Method of winter onion cultivation with plants covering with non-woven PP 17 affected the increase of content of magnesium, sulphur, manganese, iron and copper in comparison with method of cultivation without covers.