Journal of Elementology ISSN 1644-2296

Adamczewska-Sowińska K., Turczuk J. 2016. *Yielding and biological value of garlic chives (Allium tuberosum* Rottl. *ex* Spreng.*) depending to the type of mulch*. J. Elem., 21(1): 7-19. DOI: 10.5601/jelem.2015.20.2.910

YIELDING AND BIOLOGICAL VALUE OF GARLIC CHIVES (*ALLIUM TUBEROSUM* ROTTL. EX SPRENG.) DEPENDING ON THE TYPE OF MULCH

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Abstract

Owing to their high nutritional value and medicinal properties, garlic chives, a representative of the genus *Allium*, are a valuable vegetable. The edible parts are green leaves and young stalks with flower buds and the bulbs. *Allium tuberosum*, known as garlic chives, Chinese chives or Oriental garlic, is a perennial species, adapted to a moderate climate. Of special concern is the fact that this species is readily infested by weeds, especially when grown on the same stand for many years. One possible measure to combat weed infestation is mulching. The aim of our study has been to make an assessment of the effect of mulching on yielding and biological value of Oriental garlic in the second and third year of its growth. The mulches used in the experiment were black and white polyethylene foil, black polypropylene agrotextile, black biodegradable foil and miscanthus chaff. The research results proved that the leaf yield significantly increased in the subsequent years of plant cultivation. The highest leaf yield from garlic chives was obtained on the plots mulched with black polypropylene agrotextile, black polyethylene foil and black biodegradable foil. Two-year-old plants contained significantly more dry matter, chlorophyll, carotenoids and potassium but less of nitrates. Mulching with white polyethylene foil considerably favoured the accumulation of dry matter, carotenoids, phosphorus, potassium and nitrates by garlic chives.

Keywords: garlic chives, macroelements, carotenoids, vitamin C, polyethylene foil, polypropylene agrotextile, biodegradable foil, miscanthus chaff.

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INTRODUCTION

Crop species from the genus *Allium* are common all over the world, especially in the Northern Hemisphere, and everywhere they have long been a source of valuable nutrients and medicinal ingredients for humans. These plants are rich in steroidal saponins, alkaloids, flavonoids, mineral compunds (mostly sulphur) and other substances (Hostettmann, Marston 1995, Zou et al. 1999, Miean, Mohamed 2000, Lanzotti 2006, Rodkiewicz 2013). However, the species called garlic chives (*Allium tuberosum* Rottler ex Spreng) is less known in Poland and therefore underrated. This is a perennial plant, resistant to pests and diseases, with a high content of mineral compounds and its edible parts are green leaves and young flowering shoots as well as bulbs (Biernat, Jeziorska-Domaradzka 2006, Brewster 2008, Żurawik, Jadczak 2008). A more delicate flavour can be obtained when leaves and shoots with undeveloped inflorescences are blanched (Rubatzky, Yamaguchi 1997). This species is grown on a large scale in China, Japan, Korea, in the countries of Southern Asia, Thailand, Nepal and on the Philippines, where it is justifiably appreciated both as a vegetable and as a medicinal plant (Rodkiewicz 1999, Sang et al. 2001, Setiawan et al. 2005, Guohua et al. 2006, 2009). Garlic chives can also be used in intercropping for the protection of other plant species against diseases and pests. Yu (1999) and Zhang et al. (2013) proved that volatile substances released by garlic chives reduce the incidence of diseases caused by fungi from the *Fusarium* species, and *Clavibacter michiganensis*.

Cultivation of garlic chives can be hindered by weed infestation, which becomes increasingly severe over the years. The application of synthetic and organic mulches (the latter on smaller areas) offers a good solution to this problem. However, the available literature lacks any data regarding mulch application to garlic chives fields. By contrast, there are numerous studies dealing with other species of vegetables, which seem to implicate that soil mulching is a very advantageous treatment (Greer, Dole 2003, Kwabiah 2004, Diaz-Perez et al. 2007, Moreno, Moreno 2008, Mirshekari et al. 2012). Mulching protects plantations against weeds (Buczkowska 1999) and, according to Greer and Dole (2003), Diaz-Perez et al. (2007) and Nyoike et al. (2008), against pests and some diseases. It also prevents soil erosion, excessive evaporation of water and leaching of nutrients around the rhizosphere of plants.

The aim of this research has been to assess the effect of a type of mulch on the yielding and biological value of two- and three-year-old garlic chives.

MATERIAL AND METHODS

In 2010-2014, a long-term field experiment was conducted at the Research Station belonging to the Department of Horticulture at Wrocław University of Environmental and Life Sciences. The trials were designed according to the method of randomized blocks in three replication. The yields and the biological value of garlic chives cultivated on synthetic mulches from black and white polyethylene foil (PE), black polypropylene agrotextile (PP) and biodegradable foil, and on miscanthus (*Miscanthus* x *giganteus* Greef at Deuter) chaff mulch (20 cm thick layer) were determined. In 2014, the experiment was treated as a two-factor one. The first factor was the age of the plantation and the second one comprised the aforementioned mulches. The plots without mulching served as the control. The size of a plot was 2.16 m^2 (1.8 x 1.2 m) and the harvested area made up 1.44 m^2 (1.2 x 1.2 m).

The experiment was conducted on Chernozem soil with a calcic horizon (FAO-WRB Gleyic Calcic Chernozems) lying on medium clay, which belonged to class III in the Polish soil taxnomy. The soil pH was 7.8 and its salinity equalled 113.1 µs cm^{-1}. The field was prepared by deep ploughing in the autumn followed by dragging and cultivating in the spring. Before planting garlic chives, the field was fertilised with ammonium nitrate in the amount of 100 kg N ha^{-1}, incorporated into the soil using a rotary cultivator. After 6 weeks, top dressing was performed at a dose of 50 kg N ha^{-1}. Nitrogen fertilisation was repeated every year, immediately after the onset of plant growing and after the second harvest. Garlic chives were cultivated at the 80 mg P dm^{-3} and 200 mg K dm^{-3} content in the soil. The fertilisation with triple superphosphate and potassium sulphate had been completed before the experiment was started, and then repeated in the spring of the second year of cultivation. While the plants were growing, the fertilisers were spread between the plots, onto the strips of land not covered with mulches.

Garlic chive seedlings were produced in the greenhouse, in multipot trays, with 72 plugs per tray, each 54 cm^3 in volume. 5 seeds in each plug were sown in the third decade of February. The seedlings grew on peat substrate until the phase of 2-3 permanent leaves, when (on 15th April) they were outplanted on a field, using nest planting (5 plants in each nest) and 30 x 20 cm spacing.

The cultivation measures applied during the experiment consisted of manual weeding around the plant clusters. Before the plant growing period, mulch made of biodegradable foil and the miscanthus mulch were spread over the ground. Miscanthus mulch was made on a plantation located at another research station of the Wrocław University of Environmental and Life Sciences. At the end of the experiment, synthetic mulches were recycled as plastic waste.

The leaves were harvested 4-5 times a year, from 11th May to 4th October in 2011, from 21st May to 18th October in 2012, from 15th May to 26th September in 2013, and from 13th May to 15th September in 2014. The leaf yields were determined. During the full growing period, chemical analyses were conducted on samples collected commencing from first decade of August (the third set), to assess the biological value of garlic chive leaves. The samples used for analyses were complete plant clusters, four from each plot (about 200 g). The content of the following parameters was determined: dry matter – using the gravimetric method, vitamin C – the titration method (PN-90/A-75101/11), reducing sugars – the Lane-Eynona method (PN--90/A-75101/07), chlorophyll and carotenoids – the colourimetric method, N-NO_3 – the potentiometric method. The concentrations of P and Mg were determined colourimetrically, in 2% acetic acid, with the use of a universal method developed by Nowosielski, whereas the levels of K and Ca were measured by flame photometry.

The results of the chemical analyses and those regarding plant yielding underwent statistical analysis using the Tukey test at significance $\alpha = 0.05$.

RESULTS AND DISCUSSION

The research showed significant influence of tillage conditions on the yield of garlic chives in the second year of cultivation (Tables 1, 2). The recorded data indicated that the yield of leaves in 2013 was on average 32.8% higher than the leaf yields in 2011 and 2012, which was probably a consequence of moderate temperatures and higher total rainfall in the first half of the plant growing period in 2013. A statistically significant effect of the type of mulch on the yield was observed only in 2011, when the highest leaf yield (17.99 t ha^{-1}) was harvested from the plots with black PE foil mulch. Statistically the same level of leaf yield was determined on plots mulched with PP agrotextile and on biodegradable foil. The use of white PE foil or miscanthus chaff as mulch decreased the leaf yield significantly: by 25.5% and 35.6%, respectively. Considering the mean yield produced by two-year-old chives, it was demonstrated that the yield of the plants cultivated on black mulches was on average 23.1% higher than that from the control variant or from chives grown on white foil, and 12.1% higher than on plots mulched with miscanthus chaff. The increased biomass and yield of the plants cultivated on black mulches from polyethylene foil or polypropylene agrotextile have often been reported. Such effects, for example, have been observed in the cultivation of pepper (Brown, Channell-Butcher 2001), zucchini (Kołota, Słociak 2003, Adamczewska-Sowińska, Kołota 2010), celery (Słodkowski, Rekowska 2008, Siwek, Ambroszczyk 2009), lettuce (Saleh et. al. 2009, Siwek, Ambroszczyk 2009), broccoli (Diaz-Perez 2009) and fennel (Błażewicz-Woźniak 2010).

A similar, statistically confirmed effect of the type of mulch was reported when the yielding of three-year-old chives was assessed. The highest yield of leaves (26.27-25.07 t ha^{-1}) was harvested from the chives grown with mulch

Table 1

Mean air temperature and rainfall sum during the growing period of garlic chives in 2010-2014

Month	Temperature (°C)					Rainfall (mm)				
	decade			mean monthly tempera-ture	devia-tion from mean monthly tempera-ture for many years	decade			sums of rainfall	deviation from monthly sums of rainfall for many years
	1st	2nd	3rd			1st	2nd	3rd		
2011										
April	12.5	11.1	15.9	13.2	5.0	17.6	1.5	4.9	24.0	-13.0
May	10.5	16.0	17.9	14.9	1.4	6.7	13.9	20.8	41.4	-15.6
Juni	20.4	18.7	18.3	19.1	2.8	3.9	4.5	13.5	21.9	-57.1
Juli	18.2	20.5	16.3	18.2	0.1	65.5	40.0	47.7	153.2	62.2
August	19.3	19.4	19.5	19.4	1.6	1.6	11.6	9.5	22.7	-41.3
September	17.3	16.1	14.5	15.9	2.3	20.9	0.9	-	21.8	-29.2
2012										
April	7.3	9.1	15.7	10.7	2.5	-	10.5	5.1	15.6	-21.4
May	16.4	13.3	17.8	15.9	2.4	10.5	2.5	7.5	20.5	-36.5
Juni	14.1	18.6	18.8	17.2	0.9	26.9	40.5	9.7	77.1	-1.9
Juli	22.4	17.3	20.6	20.1	2.0	31.8	19.0	20.0	70.8	-20.2
August	20.7	18.9	19.6	19.7	1.9	13.0	21.5	13.9	48.4	-15.6
September	16.8	14.3	13.5	14.8	1.2	13.2	31.8	-	45.0	-6.0
2013										
April	1.7	11.8	13.3	8.9	0.7	-	2.1	20	22.1	-14.9
May	14.9	15.4	12.7	14.3	0.8	57.5	-	-	57.5	0.5
Juni	14.9	20.4	16.0	17.1	0.8	26.5	-	60.9	87.4	8.4
Juli	20.0	18.1	21.9	20.0	1.9	-	12.0	16.3	28.3	-62.7
August	24.1	20.3	18.7	21.0	3.2	25.2	11.8	-	37.0	-27.0
September	17.4	13.1	10.7	13.7	0.1	6.8	71.9	19.7	98.4	47.4
2014										
April	11.3	10.1	15.5	12.3	4.1	1.8	21.5	23.3	46.6	9.6
May	11.4	12.2	17.3	13.8	0.3	30.3	33.6	42.8	106.7	49.7
Juni	18.4	16.6	15.7	16.9	0.6	8.2	0.3	15.4	23.9	-55.1
Juli	20.5	22.5	22.6	21.9	3.8	20.0	-	26.1	46.1	-44.9
August	21.7	17.4	15.9	18.2	0.4	17.5	13.1	35.0	65.6	1.6
September	17.2	18.0	14.0	16.6	3.0	24.1	21.6	14.3	60.0	9.0

made of PP agrotextile, black PE foil and biodegradable foil. A slightly lower yield (11.5% less on average), although on the same level of significance, was obtained from plants mulched with miscanthus chaff. In the plots which had white PE mulch or no mulch at all, the leaf yield decreased significantly (by

Table 2

The yield of garlic chives (t ha^{-1}) in subsequent years of cultivation, depending on a mulch type in 2010-2014

Type of mulch / Planting year	2010	2011	2012	Mean
The second year of cultivation (2011-2013)				
Black PE foil	17.99	16.64	18.87	17.83
White PE foil	13.41	11.67	18.52	14.53
Black PP agrotextile	15.42	16.37	22.66	18.15
Biodegradable foil	15.78	15.58	20.05	17.13
Miscanthus chaff mulch	11.59	13.96	21.83	15.79
Control, without mulches	13.77	13.91	15.00	14.23
Mean	14.66	14.69	19.49	16.28
$LSD_{\alpha = 0.05}$ for: year (I)				2.04
type of mulch (II)	3.31	n.s.	n.s.	n.s.
interaction (IxII)				n.s.
The third year of cultivation (2012 – 2014)				
Black PE foil	34.65	28.19	14.42	25.75
White PE foil	27.87	20.09	11.81	19.92
Black PP agrotextile	35.31	30.44	12.99	26.27
Biodegradable foil	38.38	24.33	12.50	25.07
Miscanthus chaff mulch	31.32	26.55	10.32	22.73
Control, without mulches	32.04	22.64	9.49	21.39
Mean	33.26	25.37	11.92	23.52
$LSD_{\alpha = 0.05}$ for: year (I)				3.63
type of mulch (II)	n.s.	n.s.	n.s.	3.92
interaction (IxII)				n.s.
Mean for type of mulch				
Black PE foil				21.79
White PE foil				17.23
Black PP agrotextile				22.21
Biodegradable foil				21.10
Miscanthus chaff mulch				19.26
Control, without mulches				17.81
$LSD_{\alpha = 0.05}$ for: age of plant (I)				1.27
type of mulch (II)				2.53
interaction (IxII)				n.s.

an average 19.6%). According to RUBATZKY and YAMAGUCHI (1997), the optimal temperature for the development of chive leaves is 20°C. Spells of high temperature, accompanied by either water deficit or excess in a soil profile, inhibit of the plant growth. Such unfavourable weather conditions occurred in 2014, hence a decrease in the yield of three-year-old chives by 64.2% compared to 2012 and by 53% compared to 2013.

The garlic chive biomass yields obtained in the consecutive years of cultivation were significantly varied. The leaf yield achieved in the third year was on average 44.5% higher than in the second year. ŻURAWIK and JADCZAK

(2008) found yields of two- and three-year-old plants to be similar and simultaneously nearly 18-fold higher than yields of one-year-old plants. As for the the effect of the different materials used for mulching garlic chive plots, it was possible to notice a significant influence of the mulches on chive yielding, regardless of the age of plants. The highest leaf yield was harvested from the plots mulched with black PP agrotextile, where it was 24.7% higher than the control yield. The yields of plants mulched with black PE foil and with biodegradable foil were on a comparable level of significance. Numerous studies have confirmed that biodegradable foil can be an alternative to polyethylene foil as plant mulch. For example, it has been proven that tomato yields were nearly identical when tomato plants were grown with either of the material used for mulching (MORENO, MORENO 2008). The use of white polyethylene foil mulch resulted in a significant decrease of the leaf yield (on average by 20.6% less than leaf yields from plots with the black mulches). Soil under black polyethylene foil attains higher temperature than soil covered with white foil or the one without any cover, and a higher temperature in a moderate climate ensures better conditions for the growth of vegetables (GREER, DOLE 2003, DIAZ-PEREZ et al. 2007). GORDON et al. (2008) emphasise the usefulness of white mulches in cultivation of plants with medium thermal requirements in warm climates.

In our experiment, the second and the third growing season of garlic chives can be perceived as the time when the plant achieves its full value. Accordingly, the biological value of chive leaves was assessed then. The data showed that chive leaves contained on average: 107.3% of dry matter, 11.37 g kg^{-1} of reducing sugars, 422.3 mg kg^{-1} f.m. of chlorophyll, 1.614 mg kg^{-1} f.m. of carotenoids and 540.9 mg kg^{-1} f.m. of vitamin C (Table 3). According to ŻURAWIK and JADCZAK (2008), the leaves of this species contain 12.1 - 14.1% d.m. and 43.0 - 56.1 mg 100 g^{-1} of L-ascorbic acid. The nutritive value of garlic chives is high and comparable to the quality of leaves originating from other *Allium genus* vegetables. DYDUCH and NAJDA (2000) report that the content of dry matter in young garlic leaves varied between 10.68 and 15.82%, total sugars constitute 19.68 - 22.04% and the amount of L-ascorbic acid equals 7.58 mg 100 g^{-1} f.m. The content determined in leaves of Japanese bunching onion corresponded to 10.67% d.m., 4.11% f.m. of total sugars and 37.75 mg 100 g^{-1} f.m. of vitamin C (KOŁOTA et al. 2013), while the following values were determined in leaves of tree onion: 9.64% d.m. and 63.61 mg 100 g^{-1} f.m. of vitamin C (JADCZAK 2003). CANTWELL et al. (1996) reported that the content of vitamin C in garlic chives equalled 55 mg 100 g^{-1} f.m., whereas RODKIEWICZ (2013) demonstrated an amount of vitamin C between 53 and 140 mg 100 g^{-1} f.m. In the described experiment, the amounts of macroelements in dry matter were estimated at 10.01 g P kg^{-1}, 59.49 g K kg^{-1}, 8.17 g Ca kg^{-1} and 2.08 g Mg kg^{-1}. ŻURAWIK et al. (2013) recorded the content of those components at 0.39% P, 4.77% K, 1.07% Ca and 0.21% Mg, while CANTWELL et al. (1996) reported 400 mg K, 20 mg Mg and 52 mg Ca in 100 g of edible parts, at approximately 10% content of dry matter. For comparison, KOŁOTA et al. (2013)

Table 3

Dry matter and selected organic compounds in garlic chive leaves depending on the type of mulch and age of plant (mean for 2011-2014)

Type of mulch	Dry matter (g kg^{-1})	Reducing sugars (g kg^{-1})	Chlorophyll (mg kg^{-1} f.m.)	Carotenoids (mg kg^{-1} f.m.)	Vitamin C (mg kg^{-1} f.m.)
The second year of cultivation (2011-2013)					
Black PE foil	110.2	10.13	443.3	1.620	563.6
White PE foil	120.2	11.82	466.3	1.661	608.4
Black PP agrotextile	111.8	12.43	481.4	1.661	576.0
Biodegradable foil	119.1	12.18	479.1	1.803	647.0
Miscanthus chaff mulch	115.0	12.67	465.6	1.649	600.7
Control, without mulches	107.9	13.78	476.2	1.723	515.5
Mean	114.0	12.17	468.7	1.686	585.2
$LSD_{\alpha = 0.05}$ for type of mulch	3.11	1.27	n.s.	n.s.	51.25
The third year of cultivation (2012-2014)					
Black PE foil	97.3	10.07	393.9	1.599	471.1
White PE foil	102.9	11.70	410.8	1.780	513.3
Black PP agrotextile	99.9	09.87	370.6	1.526	477.3
Biodegradable foil	102.1	09.67	390.7	1.559	484.8
Miscanthus chaff mulch	100.1	11.36	369.1	1.483	507.1
Control, without mulches	101.4	10.71	320.5	1.305	526.0
Mean	100.6	10.56	375.9	1.543	496.6
$LSD_{\alpha = 0.05}$ for type of mulch	n.s.	n.s.	n.s.	0.258	n.s.
Mean for type of mulch					
Black PE foil	103.7	10.10	418.6	1.610	517.4
White PE foil	111.5	11.76	438.5	1.722	560.8
Black PP agrotextile	105.9	11.15	426.0	1.593	526.6
Biodegradable foil	110.6	10.92	434.8	1.681	565.9
Miscanthus chaff mulch	107.5	12.01	417.3	1.566	553.9
Control, without mulches	104.6	12.25	398.4	1.514	520.7
Mean	107.3	11.37	422.3	1.614	540.9
$LSD_{\alpha = 0.05}$ for:					
age of plant (I)	4.29	n.s.	55.2	0.126	n.s.
type of mulch (II)	2.38	1.05	n.s.	0.122	n.s.
interaction (IxII)	5.28	2.94	n.s.	0.201	171.5

obtained the following data regarding mineral components in Japanese bunching onion: 0.19% P, 2.79% K, 1.32% Ca and 0.16% Mg.

The statistical analysis showed that mulched garlic chives in the second year of cultivation contained significantly more dry matter (by 6.9% on average) in comparison to control plants. In the cultivation treatments on mulches, except for black PE foil, the leaves contained significantly more vitamin C (by 17.9% on average), although the content of reducing sugars was smaller (except for miscanthus mulch). The content of macroelements in control plants was the highest of all treatments, which was statistically verified for P and K. No significant diversification in the amount of chlorophyll, carote-

Table 4

Macronutrients in garlic chive leaves, depending on the type of mulch and age of plant (mean for 2011-2014)

Type of mulch	NO_3-N (mg kg^{-1} f.m)	P (g kg^{-1} d.m.)	K (g kg^{-1} d.m.)	Mg (g kg^{-1} d.m.)	Ca (g kg^{-1} d.m.)
The second year of cultivation (2011-2013)					
Black PE foil	234.3	8.84	65.83	1.93	7.49
White PE foil	220.8	8.29	66.65	2.08	7.73
Black PP agrotextile	251.5	8.13	59.99	2.16	7.90
Biodegradable foil	246.7	9.91	62.98	2.09	8.19
Miscanthus chaff mulch	187.5	10.22	64.02	2.12	8.22
Control, without mulches	229.0	10.27	67.24	2.27	8.56
Mean	228.3	9.28	64.45	2.11	8.02
$LSD_{\alpha = 0.05}$ for type of mulch	n.s.	1.20	25.9	n.s.	n.s.
The third year of cultivation (2012-2014)					
Black PE foil	427.7	9.42	62.84	2.07	8.95
White PE foil	454.4	19.39	61.33	1.95	8.51
Black PP agrotextile	404.0	8.17	57.01	1.91	8.51
Biodegradable foil	597.5	8.60	58.70	2.05	8.88
Miscanthus chaff mulch	620.8	10.00	42.52	2.24	7.35
Control, without mulches	438.7	8.93	44.72	2.10	7.77
Mean	540.5	10.75	54.52	2.05	8.33
$LSD_{\alpha = 0.05}$ for type of mulch	224.9	n.s.	11.23	n.s.	0.42
Mean for type of mulch					
Black PE foil	331.0	9.13	64.33	2.00	8.22
White PE foil	487.1	13.84	63.99	2.01	8.12
Black PP agrotextile	327.7	8.15	58.50	2.04	8.21
Biodegradable foil	422.1	9.25	60.84	2.07	8.54
Miscanthus chaff mulch	404.1	10.11	53.27	2.18	7.78
Control, without mulches	333.8	9.60	55.98	2.18	8.17
Mean	384.3	10.01	59.49	2.08	8.17
$LSD_{\alpha = 0.05}$ for:					
age of plant (I)	153.1	n.s.	5.67	n.s.	n.s.
type of mulch (II)	80.69	3.23	4.19	n.s.	0.41
interaction (IxII)	184.0	4.69	7.83	n.s.	1.69

noids and nitrates with regard to the examined factor was recorded. It turned out that in the third year of growing, the leaves of chives cultivated on synthetic mulches and on the mulch from biodegradable foil contained more carotenoids (by 15.9%), as well as K and Ca than the control plants and the ones mulched with miscanthus. The content of the remaining components did not depend on the experimental factor.

Younger plants of garlic chives had a higher nutritive value. They contained significantly more dry matter, chlorophyll (by 24.7%), carotenoids (by 9.3%) and potassium. Also, the amount of reducing sugars and vitamin C they contained was higher than in three-year-old plants. However, that difference was not corroborated statistically. Two-year-old plants contained less than half nitrates found in three-year-old plants, but neither amount was high (228 and 541 mg N-NO_3^- kg $^{-1}$ f.m.). In the experiments conducted by Kołota et al. (2013), the content of nitrates in leaves of Japanese bunching onion was determined at 2089 mg NO_3^-N kg^{-1} f.m. Żurawik and Jadczak (2008), as well as Żurawik et al. (2013) reported higher contents of dry matter, vitamin C, potassium and magnesium in younger leaves of garlic chives, whereas Jadczak (2003) proved that more sugars were found in younger leaves of tree onion.

It was also evidenced that – regardless of the plant age – the type of material used for mulching affected the biological value of the cultivated plants. Mulching with white PE foil favoured the accumulation of dry matter, carotenoids, phosphorus and potassium by plants. Moreover, the plants contained the highest amount of chlorophyll and vitamin C, but the differences observed among the experimental variants regarding these two components were not significant statistically. There is a wealth of research evidence indicating that the effect of mulching on the chemical composition of vegetables depends on a cultivated species and the weather conditions (Kołota, Słociak 2003, Dyduch, Najda 2005, Siwek, Libik 2005, Diaz-Perez 2009).

CONCLUSIONS

1. The leaf yield of garlic chives depended on the type of mulch and on the weather conditions in each of the consecutive years of the experiment. The yield increased significantly over the years of cultivation.

2. The application of black mulches contributed to higher Oriental garlic yields (by 21.8% on average) than obtained from the control. The leaf yield of garlic chives growing on white polyethylene foil as well as on miscanthus chaff mulch remained on the same level of significance as the yield from the control plot.

3. The biological value of garlic chive leaves depended on the age of plants. Two-year-old plants had a higher nutritive value, as they contained significantly more dry matter, chlorophyll, carotenoids and potassium but less nitrates. They also had more reducing sugars and vitamin C, but these differences were not confirmed statistically.

4. Mulching with white PE foil significantly favoured the accumulation of dry matter, carotenoids, phosphorus, potassium and nitrates by garlic chives plants. The values regarding the content of chlorophyll and vitamin C achieved in that treatment were the highest.

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