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APPLICATION OF SYNTHETIC MULCHES AND FLAT COVERS WITH PERFORATED FOIL AND AGROTEXTILE IN ZUCCHINI

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Abstract. The improvement in zucchini growth in climatic conditions of Poland can be achieved by soil mulching and flat covering of plants. In the years 2009–2010, in Research – Horticulture Station belonging to Department of Horticulture at Wrocław University of Environmental and Life Sciences there was conducted two-factorial experiment with the use of synthetic mulches (polyethylene black and white foil, black polypropylene agrotextile), as well as flat covers (polypropylene agrotextile, perforated foil) in cultivation of Astra cultivar of zucchini. The experiment was established according to randomized split plot design, in three replications. Zucchini was planted on 12th May. There was not recorded any influence of mulches type on total and early yield of zucchini fruits. Additional application of flat covers made of PP agrotextile and perforated foil resulted in increase in total fruit yield in relation to control treatment by 26.7% and 44%, respectively and to the yield from plots which were only mulched – average by 47.3%. When using covers, early yield was average by 40.7% and by 47.9% higher. The highest total fruit yield (99.85 t ha^{-1}) was obtained in cultivation on PP agrotextile mulch with a perforated foil used as cover the plants. Fruits of 8–15 cm length accumulated the most considerable quantities of vitamin C, as well as phosphorus and potassium, while in fruits > 22 cm long there was recorded the highest amount of nitrates and carotenes.

Key words: *Cucurbita pepo* var. *giromontina* Alef., soil mulching, plant cover, yield, fruit composition

INTRODUCTION

Synthetic materials are commonly used in horticulture, among others, for mulching the soils and plant covering. Mulches, in the form of polyethylene foils which are impervious to the sun radiation or polypropylene textiles of different coloring, prevent weeds infestation; protect soil from water and air erosion, as well as mineral nutrients

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leaching from its surface layer [Kołota and Słociak 2003, Romic et al. 2003, Moreno and Moreno 2008]. They also affect soil temperature and moisture, as well as microbiological activity. Wien and Minotti [1987] reported that temperature increase in a roots zone of cultivated plants is the main advantage resulting from synthetic mulches application as the latter ones provide for plant growth and increase in their yielding. This phenomenon refers particularly to thermophilic species, such as tomato, pepper, melon and zucchini [Brown and Channell-Butcher 2001]. Research also proves their positive effect on reduction in pests occurrence and diseases infestation [Toscano et al. 1979], which, according to Diaz Perez et al. [2007], is caused by modification of light environment around plants. Flat covers from synthetic materials protect plants from frost, cold winds, intensive rainfall, as well as reduce water evaporation from the soil surface [Gordon et al. 2008]. A number of investigation, indicate that application of perforated foil or polypropylene textile contributes to acceleration of harvest time by several days, increase the yield and improvement of quality the vegetables, especially those which are cultivated for early harvest or warm season ones [Łabuda and Baran 2005, Siwek and Libik 2005, Biesiada 2008].

Zucchini belongs to vegetable species whose area of commercial cultivation in Poland has gradually been enlarged from year to year. This tendency results from a great interest in this species among consumers and food processing industry as well. Zucchini owes its popularity to dietary, biological and value of the flavor, a well as possibility of preparing different zucchini – based dishes. Kunachowicz et al. [2005] reports that in 100 g of edible parts vitamin C content equals 9 mg, β-carotene 205 μg, thiamine 0.07 mg, vitamin E 0.10 mg, potassium 250 mg, magnesium 22 mg, iron 0.4 mg. The content of vitamin C in the experiment by Kołota and Słociak [2003] ranged from 16.76 to 23.27 mg 100 g^{-1} f.m., in research by Osińska and Kołota [2003] it amounted, average, from 24.9 to 31.0 mg 100 g^{-1} f.m. An important useful feature of this vegetable is the fact that its fruits can be harvested in its different growth stages, although, according to commonly assessed its best value, the most advantageous fruits measure from 20–30 cm of length. Younger fruits characterize delicate, juicy, light–cream flesh, small seeds and such a thin skin that there is no need to remove it. According to Orłowski and Jadczak [2000] fruits 8–15 cm long, as compared to those of larger size, feature higher nutritive value. Their chemical composition also depends on harvest term, climatic – soil conditions and the type of cultivation. The aim of research undertaken was the assessment of yield size and quality of zucchini cultivated with introduction of synthetic mulches and flat foil and agrotextile covers.

MATERIAL AND METHODS

In the years 2009–2010, in Research – Horticulture Station owned by Department of Horticulture at Wrocław University of Environmental and Life Sciences, there was carried out two – factorial experiment with the use of different covers in cultivation of Astra cultivar of zucchini. The experiment was established following the randomized split-plot design. Factor first involved the type of synthetic mulch used: black polyethylene foil (BP), white polyethylene foil (WP), black non-woven polypropylene agrotex-

tile 50 g m^{-2} (BPP50). Within the factor second there were applied different flat covers on plants: non-woven polypropylene agrotextile weighing 17 g m^{-2} (PP17), perforated foil (PF) with 100 holes per 1 m^2, or cultivation without plants covering. All these treatments were additionally compared, using randomized plot method, to those where only a flat plant cover was applied or the ones without mulch and flat covers (control). The experiment was established in three replications and the area of one plot ranged 6.24 m^2 (2.6 × 2.4 m).

Field experiment was conducted on black degraded soil, formed from light loam, featuring low degree of sand in their composition. Zucchini was cultivated at optimal content of mineral nutrients in the soil, amounting 80 mg P dm^{-3}, 200 mg K dm^{-3} and pH 7.2. Field preparation for planting consisted of deep ploughing in the autumn and in the spring – by cultivator tillage and harrowing. Just before planting a rotary cultivator, was used in order to incorporate nitrogen fertilization in the dose of 150 kg ha^{-1} in the form of ammonium nitrate.

Zucchini seeds were sown on 15th April in a greenhouse into multipots of 56 cm^3 cell capacity, using one seed in each pot. Seedlings were produced in peat substrate. Before planting into the field the seedlings were subjected to hardening. The plants were planted on 12th May and covers were applied on selected plots. The covers were removed after 5 weeks. Zucchini was cultivated according to a strip – row system, in 100 × 80 × 130 cm spacing.

Fruit harvest, with separation into fractions, of the following length: 8–15 cm, 16–22 cm and above 22 cm took place every 5 days in the period between 25th June and 20th September. Assessment involved the yield of particular fruit fractions, as well as total and early yield. The latter one consisted of fruits harvested until the half of July (from the first four harvests). In the half of August there were collected fruit samples out of each fractions for chemical analyses. There were determined the following contents: vitamin C, using titration method [PN-90/A-75101/11], carotenes (colorimetric method)), nitrates (V) (potentiometric method), P (colorimetric method) and K (flame photometry). Research results were subjected to statistical analysis using Tukey test calculating confidence intervals for significance level $\alpha = 0.05$.

RESULTS AND DISCUSSION

On the basis of obtained results there were proved significant differences in zucchini yield between particular years. In 2009 favorite weather conditions, especially the temperatures recorded since the beginning of plant growth in the field, caused that early yield constituted 43.3% of total fruit yield (tab. 1). Although 2010 characterized by 32.1% higher total yield, yet the yield of fruits 8–15 cm and 16–20 cm long, as well as early yield was lower by 52.7%, 40.4% and 22.1% respectively. Majority, equal to 87% of total yield consisted of fruits of > 22 cm length. Gordon et al. [2008] also paid attention to high variability in growth and yielding of vegetables cultivated on mulches according to weather conditions prevailing in particular years of the experiment.

In 2009 it was proved that in cultivation with mulches, involving black foil and agrotextile, total zucchini yield was significantly higher, average by 16.9% than the one

obtained from cultivation on a white foil. Additional plants covering with perforated foil or polypropylene textile in mulched treatments resulted in increased yield values, average by 2.2- and 2 times in relation to the yield provided by not covered plants. Simultaneous application of black foil mulch and flat textile cover, or textile mulch and covers made of either textile or perforated foil brought about significant increase in total fruit yield as compared to the yield from plants cultivated without any covers. Zucchini cultivation on the soil mulched with a white foil caused statistically confirmed decrease the fruit yield in relation to control. In 2010 there were not recorded any significant differences in total yield of zucchini grown on different synthetic mulches. The only fact proved was elevated value of this yield, average by 33.6%, when additional plants covering with perforated foil was used. Introduction of flat covers, synthetic mulches or combined covers provided yield increase average by 16.8%, 8.2% or 25%, yet it has not been statistically proved.

Table 1. The effect of soil mulches and flat cover on early and total yield of zucchini fruits, mean for 2009–2010 (t ha^{-1})

Tabela 1. Wpływ rodzaju ściółki i płaskiej osłony na plon wczesny i ogólny owoców cukinii w latach 2009–2010 (t ha^{-1})

Kind of mulch Rodzaj ściółki	Flat cover Płaska osłona	Early yield – Plon wczesny			Total yield – Plon ogólny		
		2009	2010	mean średnio	2009	2010	mean średnio
	**PP17	45.37	13.09	29.23	93.34	61.35	77.35
*BP	PF	31.28	26.02	28.65	79.44	100.53	89.99
	0	22.89	24.09	23.49	44.02	88.27	66.15
Mean – Średnio		33.18	21.07	27.12	72.27	83.39	77.83
	PP17	35.22	20.01	27.61	84.23	83.53	83.88
BPP50	PF	40.27	28.63	34.45	83.06	116.64	99.85
	0	24.51	15.89	20.20	43.24	69.58	56.41
Mean – Średnio		33.33	21.51	27.42	70.17	89.92	80.05
	PP17	30.65	30.90	30.78	80.09	90.84	85.46
WP	PF	27.69	30.13	28.91	74.41	106.41	90.41
	0	11.31	22.71	17.01	28.32	84.26	56.29
Mean – Średnio		23.22	27.91	25.57	60.94	93.84	77.39
	PP17	37.08	21.33	29.21	85.89	78.57	82.23
Mean – Średnio	PF	33.08	28.26	30.67	78.97	107.86	93.41
	0	19.57	20.90	20.24	38.53	80.71	59.62
Without mulch	PP17	26.22	18.91	22.57	62.76	87.90	75.33
Bez ściółki	PF	23.89	19.71	21.80	66.83	86.27	76.55
Without mulch and ccovering (control) Bez ściółki i osłony (kontrola)		24.74	17.82	21.28	55.15	74.57	64.89
Mean – Średnio		28.67	22.33		66.24	87.51	
LSD α = 0.05 for: – NIR α = 0,05 dla:							
kind of mulch – rodzaju ściółki (I)		7.53	n.s.	n.s.	8.88	n.s.	n.s.
kind of flat cover – rodzaju płaskiej osłony (II)		8.65	5.90	4.96	19.05	22.42	13.93
interaction – interakcji (I × II)		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
kind of cover – rodzaju okrycia		12.58	10.33	8.76	26.82	n.s.	23.39
year – lat				3.57			9.55

*BP – black polyethylene foil – czarna folia polietylenowa, BPP50 – black non-woven polypropylene agrotextil, – włóknina polipropylenowa 50, WP – white polyethylene foil – biała folia polietylenowa

**PP17 – non-woven polypropylene agrotextil – włóknina PP, PF – perforated foil – folia perforowana, 0 – without covering – bez osłony

In the first year of investigation it was observed that early yield in zucchini cultivation only on mulches made of black foil or textile was comparable to the field obtained from plants covered with perforated foil or textile or those cultivated without any covers, while the only application of white foil mulch resulted in twice lower yield of fruits. In cultivation with soil mulches additional introduction of flat covers provided for increase in early yield average by 69% (perforated foil) and by 89.5% (agrotextile PP).The most favorable method of cultivation for achieving significantly higher yield was combined use of black foil mulch and PP textile cover (45.37 t ha^{-1}) or black textile mulch and perforated foil cover (40.27 t ha^{-1}). The share of the early yield in question in total fruits yield from these treatments amounted 48.6%. In 2010 percentage of early yield equaled 25.5%. The kind of synthetic mulches did not affect its size, while application of flat covers with perforated foil did considerably contribute to yield increase by 35.2%. It was also proved that the use of flat covers solely or mulching exclusively enables to obtain early yield of zucchini ranging similar to that in treatment without any covers and only their combined application can result in significant increase in zucchini yield.

In 2009 the share of fruits 8–15 cm and 16–22 cm long in total yield amounted 9.6% and 20.5% respectively (tab. 2). The type of mulch did not diversify its size. However, it was recorded that covering plants with a textile or perforated foil in mulched treatments resulted in significant increase of small fruits yield by 96.6% and 73.9% respectively and average, by 82.8% in the case of medium – size fruits. The results of statistical analysis showed that yield of fruits measuring 8–15 cm in length obtained from plants grown only with the use of synthetic mulches, was comparable to zucchini yield from plants covered with agrotextile only or with that of plants not covered at all. Medium – size fruits yield was significantly lower than the yield obtained from plants cultivated under flat PP textile covers. The yield of the largest fraction ranged 69.9% of total yield. It was found that the yield from plots mulched with a black foil or a black textile was significantly higher (average by 23.6%) than the one obtained from cultivation using white foil mulch. In these treatments zucchini grown under flat covers with perforated foil or PP textile provided for 1.9–3.3-times increased yield.

In the second year of experiment it was not recorded any significant influence of the examined factors on small and medium – sized zucchini fruits yield which amounted 2.24–4.27 t ha^{-1} and 5.82–12.78 t ha^{-1}. Yet yield of fruits > 22 cm long was significantly diversified as a result of flat covers used in the experiment. In mulched treatments plants covering with perforated foil brought about yield increase of this fraction by 34.5%. The highest yield of this grade (106.68 t ha^{-1}) was obtained from zucchini cultivated on black textile mulch with perforated foil cover.

Mean values for the years 2009–2010 proved that the type of synthetic mulch did not affect total yield of zucchini, which ranged from 77.39 t ha^{-1} (white foil) to 80.05 t ha^{-1} (black textile). These findings confirm research results obtained by Kołota and Słociak [2003]. Additional covering of zucchini with perforated foil or agrotextile PP caused its significant increase in average by 56.7% and 37.9%. It appeared out that the only use of flat covers or black foil mulch contributed to a slight increase in total yield of zucchini in relation to the control, average by 17.1% or by 2%. Similar phenomenon was reported by Błażewicz-Woźniak [2010] – slight increase, not proved

Table 2. The effect of soil mulches and flat cover on yield of zucchini fruits with length 8–15 cm, 16–22 cm and > 22 cm, mean for 2009–2010 (t ha^{-1})
Tabela 2. Wpływ rodzaju ściółki syntetycznej i płaskiej osłony na plon owoców cukinii o długości 8–15 cm, 16–22 cm i > 22 cm w latach 2009–2010 (t ha^{-1})

Kind of mulch Rodzaj ściółki	Flat cover Płaska osłona	Fruits length – Długość owoców								
		8–15 cm			16–22 cm			> 22 cm		
		2009	2010	mean średnio	2009	2010	mean średnio	2009	2010	mean średnio
	**PP17	7.37	3.85	5.61	16.38	7.80	12.09	69.59	49.70	59.64
*BP	PF	5.90	3.21	4.55	16.49	7.59	12.04	57.06	87.55	72.31
	0	4.72	2.46	3.59	9.91	7.10	8.51	29.39	79.14	54.26
Mean – Średnio		5.99	3.17	4.58	14.26	7.50	10.88	52.01	72.13	62.07
	PP17	7.89	2.24	5.07	15.47	8.01	11.74	60.87	75.46	68.17
BPP50	PF	7.70	3.58	5.64	15.14	6.38	10.76	60.21	106.68	83.44
	0	4.53	3.04	3.79	7.14	8.04	7.59	31.57	59.73	45.65
Mean – Średnio		6.71	2.6	4.83	12.58	7.48	10.03	50.88	80.62	65.75
	PP17	8.93	3.02	5.97	15.34	12.78	14.06	55.81	72.85	64.33
WP	PF	7.79	4.27	6.03	14.43	7.13	10.78	52.19	93.78	72.98
	0	3.04	2.88	2.96	8.44	7.85	8.15	16.84	75.29	46.06
Mean – Średnio		6.59	3.39	4.99	12.74	9.26	10.99	41.61	80.64	61.13
	PP17	8.06	3.04	5.55	15.73	9.53	12.63	62.09	66.00	64.05
Mean – Średnio	PF	7.13	3.69	5.41	15.35	7.03	11.19	56.48	96.00	76.24
	0	4.10	2.79	3.45	8.50	7.67	8.08	25.73	71.39	48.66
Without mulch	PP17	5.36	2.52	3.94	18.56	9.52	14.04	38.84	75.85	57.35
Bez ściółki	PF	7.25	2.67	4.96	12.99	5.82	9.41	46.59	77.78	62.18
Without mulch and covering (control) Bez ściółki i osłony (kontrola)		5.98	2.43	4.20	12.74	9.13	10.94	36.41	63.01	49.71
Mean – Średnio		6.37	3.01		13.59	8.10		46.28	76.40	
LSD α = 0.05 for: – NIR α = 0.05 dla:										
kind of mulch – ściółki (I)		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	8.31	n.s.	n.s.
kind of flat cover – rodzaju płaskiej osłony (II)		1.86	n.s.	1.04.	3.39	n.s	2..35	17.53	24.22	13.93
interaction – interakcji (I × II)		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
kind of cover – rodzaju okrycia		3.04	n.s.	1.80	5.26	n.s.	4.12	23.83	n.s.	22.42
year – lat				0.74			1.68			9.15

*BP – black polyethylene foil – czarna folia polietylenowa, BPP50 – black non-woven polypropylene agrotextil – włóknina polipropylenowa 50
WP – white polyethylene foil – biała folia polietylenowa
**PP17 – non-woven polypropylene agrotextil – włóknina PP, PF – perforated foil – folia perforowana, 0 – without covering – bez osłony

Table 3. The effect of soil mulches and flat cover on vitamin C, nitrates (V), P and K contents in zucchini fruits (mean for 2009–2010)
Tabela 3. Zawartość witaminy C, azotanów (V), P i K w owocach cukinii w zależności od rodzaju ściółki i płaskiej osłony (średnio z lat 2009–2010)

Kind of mulch Rodzaj ściółki	Flat cover Płaska osłona	Vitamin C (mg 100 g^{-1} f.w.) Witamina C (mg 100 g^{-1} ś.m.)			Nitrates (V) (mg kg^{-1} f.w.) Azotany (V) (mg kg^{-1} ś.m.)			P (%)			K (%)			Carotene (mg 100g^{-1} d.w.) Karoteny (mg 100g^{-1} s.m.)		
		***I	II	III	I	II	III	I	II	III	I	II	IIII	I	II	III
	**PP17	20.0	18.8	9.7	90	325	151	0.75	0.84	0.79	7.0	7.5	5.8	0.94	2.19	2.88
*BP	PF	21.6	20.2	8.8	147	94	165	0.90	0.88	0.63	6.8	6.1	6.5	1.60	4.25	2.60
	0	21.3	19.9	7.8	131	130	201	0.91	0.85	0.64	7.0	6.5	5.9	1.81	1.41	1.17
Mean – Średnio		21.0	19.6	8.8	123	183	172	0.85	0.86	0.69	6.9	6.7	6.1	1.45	2.62	2.22
	PP17	19.0	19.8	8.3	113	75	156	0.83	0.89	0.86	7.5	6.9	5.8	1.40	1.16	5.52
BPP50	PF	19.7	16.7	9.2	61	98	155	0.92	0.75	0.72	6.5	5.0	5.9	2.72	2.39	1.85
	0	21.4	16.6	11.6	101	95	119	1.12	0.82	0.82	7.5	5.5	5.8	3.60	4.00	1.70
Mean – Średnio		20.0	17.7	9.7	92	89	143	0.96	0.82	0.80	7.2	5.8	5.8	2.57	2.52	3.02
	PP17	20.0	20.8	12.1	74	68	210	0.90	1.02	0.57	7.1	6.4	4.8	2.03	2.94	2.96
WP	PF	22.5	18.3	8.1	51	105	98	0.89	0.78	0.89	6.4	5.5	6.1	2.63	3.32	6.07
	0	17.7	17.4	8.3	61	107	168	0.91	0.85	0.77	6.9	5.9	5.4	1.81	2.36	1.95
Mean – Średnio		20.1	18.8	9.5	62	93	159	0.90	0.88	0.74	6.8	5.9	5.4	2.16	2.87	3.66
	PP17	19.7	19.8	10.0	92	156	172	0.83	0.92	0.74	7.2	6.9	5.5	1.46	2.10	3.79
Mean – Średnio	PF	21.3	18.4	8.7	86	99	139	0.90	0.80	0.75	6.6	5.5	6.2	2.32	3.32	3.51
	0	20.1	18.0	9.2	98	111	163	0.98	0.84	0.74	7.1	6.0	5.7	2.41	2.59	1.61
Without mulch	PP17	22.2	22.3	7.6	98	83	150	0.93	0.91	0.72	7.3	6.4	5.6	1.85	1.20	1.71
Bez ściółki	PF	20.6	20.2	8.7	54	52	114	0.93	0.82	0.78	6.6	5.9	6.4	1.85	1.90	3.19
Without mulch and covering (control) Bez ściółki i osłony		21.7	19.6	8.9	73	97	163	0.97	0.82	0.88	7.3	6.5	6.5	2.06	4.49	3.66
Mean – Średnio		20.6	19.2	9.1	88	111	154	0.91	0.85	0.76	7.0	6.2	5.9	2.03	2.63	2.94
LSD α = 0.05 for: – NIR α = 0,05:																
kind of mulch – ściółki (I)		0.4	0.5	n.s.	25	30	n.s.	n.s.	n.s.	n.s.	n.s.	0.3	0.3	0.48	n.s.	0.50
kind of flat cover – rodzaju płaskiej osłony (II)		0.4	0..3	0.3	n.s.	17	10	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.23	0.37	n.s.
interaction – interakcji (I×II)		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
kind of cover rodzaju okrycia		0.5	0.5	0.1	50	30	32	n.s.	n.s.	n.s.	n.s.	0.2	n.s.	41	0.25	0.50

*BP – black polyethylene foil – czarna folia polietylenowa, BPP50 – black non-woven polypropylene agrotextil – włóknina polipropylenowa 50
WP – white polyethylene foil – biała folia polietylenowa
**PP17 – non-woven polypropylene agrotextil – włóknina PP, PF – perforated foil – folia perforowana, 0 – without covering – bez osłony
***length of fruits – długość owoców: I – 8–15 cm, II – 16–22 cm, III – > 22 cm

statistically, in the yield of fennel cultivated on black polyethylene foil mulch and polypropylene textile, in comparison to fennel grown without mulches. Kołota and Słociak [2003] recorded that zucchini cultivation on black textile mulch provided for significant increase of the yield in relation to that obtained from not mulched plots (by 16.7%). In other experiments, involving watermelon, there was confirmed yield increase and harvest acceleration when plants were cultivated on black foil mulch [Ibarra Jimenez and Flores Velasquez 1997], in the case of zucchini – cultivation on white foil [Toscano et al. 1979], or on synthetic foils of different colors Gordon et al. [2008]. Spiżewski et al. [2010] reported a slight, not statistically confirmed increase in total and marketable yield of cucumber cultivated on black polyethylene foil in relation to cultivation without covers.

In this experiment substantial and statistically significant increase in total yield (by 38.8–54%) was observed when combined usage of mulching and covering plants with perforated foil was introduced. The increment of yield of vegetables regarding cultivation under flat covers in comparison to that without covers was also reported by Wierzbicka et al. [2007] in cucumber cultivation, Łabuda and Baran [2005] – in the case of beans, Siwek and Libik [2005] in cultivation of celery.

In treatments where exclusive usage of mulching or flat covers was introduced, early fruits yield ranged the same level of significance as the one obtained without any covers applied. In the experiment conducted by Kołota and Słociak [2003] significantly higher early yield of fruits (by 26.6%) was harvested from plots mulched with a black foil. Gordon et al. [2008] confirmed positive effect of soil mulching on early yield of *Cucurbita pepo*. They also stated that the highest early yield was obtained from this species when cultivation took place on black, blue, and white foil mulch. Combined usage of mulches and flat covers proved favorable for faster growth of plants and earlier fruit setting. Early yield of fruits increased average by 47.9%. The larger yield characterized cultivation with the use of black textile mulch and flat cover from perforated foil (34.45 t ha^{-1}). In the experiment by Gordon et al. [2008] there was not recorded higher early fruit yield for treatments with combined application of mulching and plant covering.

On the basis of mean values of results involving two years of research it was possible to state that the type of synthetic mulch applied did not significantly affect fruits yield of particular fractions. Additional covering of plants in mulched treatments provided for significant increase in small fruits yield by 58.8%, medium – sized fruits by 47.4% and large fruits by 31.6% (agrotextile) and by 56.7% (perforated foil). Results of statistical calculations did not show significant increase in the yield of 8–15 cm and 16–22 cm long fruits under the influence of combined use of mulching and covering of plants as compared to yield obtained from plants cultivated without covers. The largest fruits yield was higher than control after combined application of mulching and perforated foil by 45.5%–67.9%.

Kołota and Słociak (2003) reported that soil mulching affects chemical composition of zucchini fruits only to a small degree, except for white foil which resulted in decrease in the contents of dry matter, vitamin C, sugars and total nitrogen. In this experiment significantly higher content of vitamin C and potassium was observed of zucchini cultivated on mulch with a black foil (tab. 3). However, the content of carotenoids was lower and nitrate concentration higher than in zucchini mulched with a white foil as well as

black agrotextile. Kosterna et al. [2010] reported a higher content of vitamin C, dry matter and soluble sugars of melon cultivated on black foil than on black agrotextile. In reported investigation correlations was founded between content of vitamin C, carotenes, phosphorus, potassium, nitrate and size fruits of zucchini. In comparison to the remaining fractions fruits of 8–15 cm length accumulated higher amounts of phosphorus and potassium. The content of vitamin C in small and medium – sized frutis was similar and it ranged about 20 mg 100 g^{-1}, while in the largest fruits it decreased average by 54.3%. Another finding referred to the fact that according to fruits ripening the amounts of carotenes increased average by 30% and 11.8% respectively and the content of nitrates (V) – by 26.1% and 38.7%. On mulching treatment, additional covering by agrotextile, in fruits which length higher then 15cm, increased content of vitamin C and nitrate on average by 9.7% and 28.1%.

CONCLUSIONS

1. There was not recorded any effect of the type of synthetic mulch used in zucchini cultivation on total and early yield of fruits.
2. Application of flat covers with perforated foil or polypropylene textile in soil mulched treatments provided for significant increase in total yield of zucchini fruits by 56.7% and by 37.9% in relation to cultivation with the only use of soil mulching.
3. To obtain earlier fruit setting in zucchini introduction of combined use of synthetic mulches and flat covers with perforated foil or polypropylene agrotextile proved to be advantageous. Early yield of zucchini fruits in these treatments increased average by 47.9%.
4. Black foil mulching increased content of vitamin C and potassium in zucchini fruits.
5. Fruits featuring the smallest size, 8–15 cm long characterized the highest content of vitamin C, phosphorus and potassium and, at the same time, the lowest level of nitrates (V) accumulation.

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WYKORZYSTANIE ŚCIÓŁEK SYNTETYCZNYCH ORAZ PŁASKICH OSŁON Z FOLII I WŁÓKNINY W UPRAWIE CUKINII

Streszczenie. Poprawę warunków wzrostu cukinii w klimacie Polski można uzyskać przez ściółkowanie gleby oraz płaskie osłanianie roślin. W latach 2009–2010, w Stacji Badawczo-Dydaktycznej Katedry Ogrodnictwa UP we Wrocławiu wykonano dwuczynnikowe doświadczenie z zastosowaniem ściółek syntetycznych (polietylenowa folia czarna i biała, włóknina polipropylenowa czarna) oraz płaskich osłon (włóknina polipropylenowa, folia perforowana) w uprawie cukinii odmiany Astra metodą losowanych podbloków w trzech powtórzeniach. Cukinię sadzono 12 maja. Nie wykazano istotnego wpływu rodzaju ściółki na wielkość plonu ogólnego i wczesnego. Dodatkowe zastosowanie płaskich osłon z włókniny PP i folii perforowanej spowodowało wzrost plonu ogólnego owoców w stosunku do kontroli, odpowiednio o 26,7% i 44%, oraz do plonu z poletek tylko ściółkowanych średnio o 47,3%. Plon wczesny przy użyciu osłon był średnio o 40,7% i o 47,9%

większy. Największy plon ogólny owoców (99,85 t ha^{-1}) zebrano w uprawie na ściółce z włókniny PP z osłoną z folii perforowanej. Owoce o długości 8–15 cm zgromadziły najwięcej witaminy C oraz fosforu i potasu, natomiast w owocach o długości > 22 cm stwierdzono więcej azotanów (V) i karotenów.

Słowa kluczowe: *Cucurbita pepo* var. *giromontina* Alef., ściółkowanie gleby, okrycie roślin, plon, skład chemiczny owoców

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