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DRY MATTER AND CARBOHYDRATES CONTENT IN THE TUBERS OF VERY EARLY POTATO VARIETIES CULTIVATED UNDER COVERAGE

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Abstract. The study were carried out in the years 1996–1998 on the soil characterized as a good rye complex. The experiment was set according to the method of randomized sub blocks at 3 replications. The four following factors were examined: 1) cultivation technologies: a) conventional technology – control, b) with polyethylene sheeting, c) with polypropylene sheeting, d) with double shield of polypropylene and polyethylene sheeting; 2) methods of weed control of potato: a) mechanical, b) with Afalon, c) with Racer, d) with herbicide mixture Afalon + Command; 3) potato cultivars: Aster and Drop; 4) harvest terms: a) 60 days after planting, b) 75 days after planting, c) harvest at full maturity. Coverage application at potato cultivation, as compared to traditional one, contributed to the decrease of dry mass and the increase of starch, total sugars, reducing sugars and sacharose in the potato tubers.

Keywords: potato, cover, herbicides, cultivars, dry matter, carbohydrates

INTRODUCTION

Tuber's quality of early potato cultivars depends mainly on a genotype, soil and weather conditions, as well as cultivation technology and methods of weed control [Pawłowski and Pomykalska 1988, Roztropowicz 1989, Sawicka 1994 1996, Ceglarek and Księżak 1992, Prośba-Białczyk and Mydlarski 1998, Zarzecka and Gąsiorowska 2001, Hamouz and Dvorak 2004]. For the purpose of quickly and profitable commercial yields of early potato cultivars, cultivation is carried out under such covers as: polyethylene foil, polypropylene sheeting or bio-foil. Perforated polyethylene foil well fulfils the requirement to protect plants, because it is permeable for sunbeams, and the heat radiation through the foil is relatively fast, thus plant may be normally grown [Friessle-

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ben 1984, Sawicka 1996]. Although polypropylene sheeting is a material that is characterized with worse permeability radiation, but good water vapor and air permeability, which eliminates the opportunity for plant's phytotoxic injuries [Roztropowicz and Lutomirska 1997, Pszczółkowski and Sawicka 2003]. However, application of flat covers in potato cultivation technology makes some difficulties, because weeds occur at high intensity and their total weight is often several times higher than without any cover [Hanousek and Dvorak 2004]. The issue of weed control in potatoes cultivated under coverage is extremely important, because it is directly associated with tuber's quality, particularly those harvested at an early date.

Therefore, studies aiming to evaluate the influence of various nursery operations to potatoes cultivated under cover on the content of dry matter and carbohydrates in tubers of two very early cultivars have been undertaken.

MATERIAL AND METHODS

Tuber samples for assessment were taken from the field experiment performed in 1996–1998. The experiment was set by means of randomized sub-blocks in 3 replications. Following factors were studied: 1) cultivation technologies: a) traditional as a control, b) using polyethylene sheeting, c) using polypropylene sheeting, d) cultivation under double cover consisting of sheeting and PE-folie; 2) methods of weed control: a) mechanical, b) using Afalon 50 WP at 2 kg · ha^{-1} rate, c) using Racer 25 EC at 2 l · ha^{-1} rate, d) using mixture of Afalon 50 WP and Command 480 EC at 1 kg + 0.2 l · ha^{-1} rate; 3) potato cultivars: a) Aster, b) Drop; 4) tuber harvest dates: a) 60 days after planting, b) 75 after planting, c) after maturation. Spring barley was a forecrop. Organic fertilization was applied in autumn in a form of manure at 25 t · ha^{-1} amount. Mineral fertilizers were applied in spring at following concentrations: 80 kg N, 35 kg P, and 100 kg K · ha^{-1}. Setting the pre-germinated tubers of elite class was performed on April 15–18 at 62.5 × 40 cm spacing. Area of each plot was 20 m^2. After planting, potatoes were ridged, and then harrowed using light harrow; in addition, spraying with proper preparation was made in objects with mechanical and chemical nursery. Subsequently, ridges were covered with shield and edged were banked with the soil. The covers were taken off when danger of near-ground frost, but no passed potato plants achieved them 15–20 cm of height. Harrowing using light harrow and double or triple soil banking was applied in objects with mechanical nursery. Spraying against potato beetle, Phytophthora infestans and Alternaria solani was made for all objects using commercially available preparations.

During harvest, samples of 50 tubers from 10 plants on each object were taken for chemical analyses. Dry matter content was determined by means of drier method, starch content – polarimetrically according to Ewers-Grossweld, total and reducing sugars – colorimetrically applying Miller's methods with 3,5-dinitrosalicyllic acid (DNS) [Baraniak et al. 1999]. The principle of the method is based on the reduction of 3,5-dinitrosalicyllic acid (DNS) to 3-amine-5-nitrosalicyllic acid in basic environment by aldehyde moieties of reducing sugars. The sucrose content was calculated from the formula:

$$\% \text{ sucrose} = (\% \text{ total sugars} - \% \text{ reducing sugars}) \cdot 0.95$$

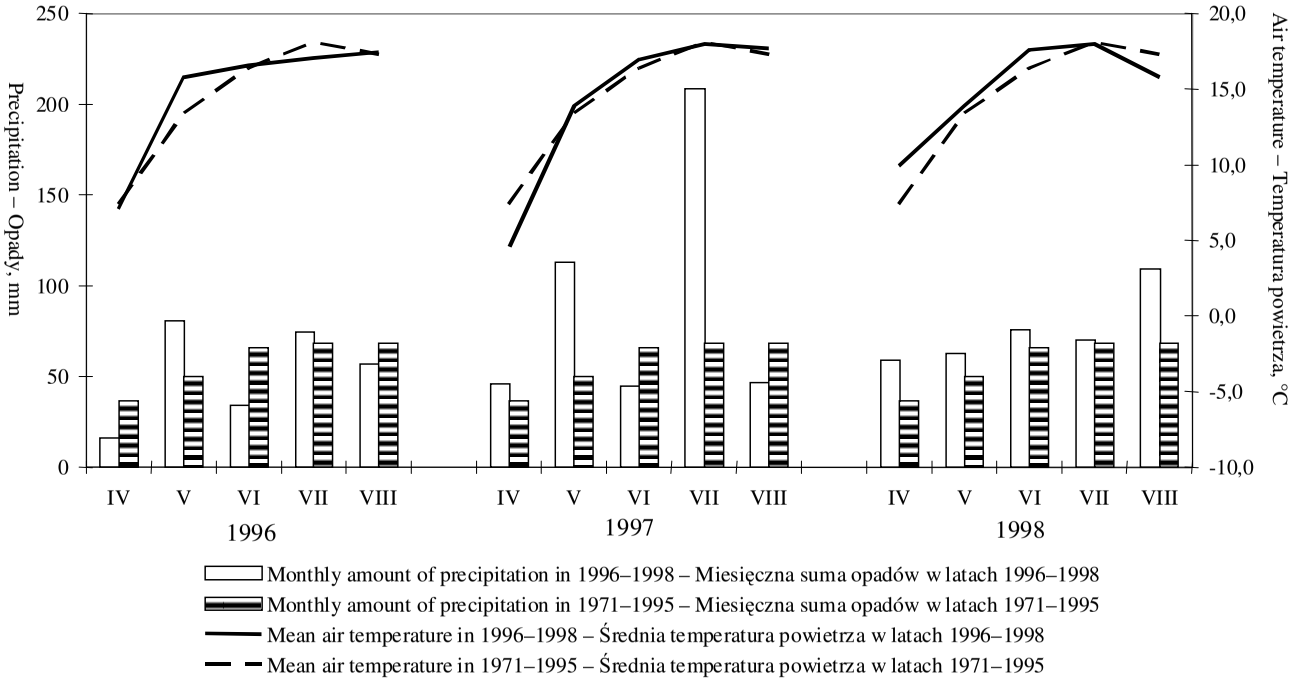

Fig. 1. Precipitation and air temperature in the potato vegetation period acc. to meteorological office Uhnin (1996–1998)
Rys. 1. Opady i temperatura powietrza w okresie wegetacji ziemniaka wg stacji meteorologicznej w Uhninie (1996–1998)

Analytical results were statistically worked out applying variance analysis for all experimental factors and 3 years of study. Significance of variability sources was tested using "F" Fischer-Snedecor's test and the evaluation of difference significance between compared mean values was carried out using multiple Tukey's intersections.

Description of meteorological conditions is presented in the figure 1.

RESULTS

The lowest content of dry matter and carbohydrates was found in the youngest tubers harvested 60 days after planting; gradual increase of these items was observed along with the maturation (tab. 1 and 2).

Table 1. Content of dry matter & starch in potato tubers, %
Tabela 1. Zawartość suchej masy i skrobi w bulwach ziemniaka, %

Experimental factors Czynniki eksperymentu		Dry matter – Sucha masa			Starch – Skrobia		
		harvest time – terminy zbioru *					
		I	II	III	I	II	III
Cultivation technology Technologia uprawy	A	18.19	20,19	22,26	8,90	12,37	12,82
	B	18.88	20,21	21,23	8,87	12,42	12,94
	C	18.04	19,86	22,14	9,04	12,62	13,15
	D	18.13	20,02	22,36	9,21	12,47	12,97
	LSD – NIR $\alpha \leq 0.05$		0.20			0,30	
Weed control systems Sposoby pielęgnacji	1	18.46	20,61	22,47	9,25	12,67	13,36
	2	18.66	20,09	22,25	9,10	12,67	13,06
	3	18.20	19,67	21,38	8,81	12,25	12,68
	4	17.93	19,92	21,88	8,86	12,29	12,76
	LSD – NIR $\alpha \leq 0.05$		0.20			0,30	
Cultivars Odmiany	Aster	18.56	20,34	22,45	8,84	12,40	12,85
	Drop	18.06	19,81	21,54	9,17	12,54	13,09
	LSD – NIR $\alpha \leq 0.05$		0.07			0,15	
Years Lata	1996	20.30	21,91	20,97	7,53	13,39	13,64
	1997	15.71	18,31	23,81	10,31	12,38	12,54
	1998	18.92	19,97	21,12	9,16	11,64	12,72
	LSD – NIR $\alpha \leq 0.05$		0.18			0,22	
Średnia – Mean		18,31	20.07	22,00	9,01	12,47	12,97
LSD – NIR $\alpha \leq 0.05$			0,06			0.09	

A – conventional technology – technologia tradycyjna; B – polyethylene sheeting – folia polietylenowa; C – polypropylene sheeting – agrowłóknina; D – polypropylene + polyethylene sheeting – agrowłóknina + folia
1 – mechanical weed control systems – mechaniczny; 2 – Afalon; 3 – Racer; 4 – Afalon + Command
*60 days following planting – po 60 dniach od sadzenia; II – 75 days following planting – po 75 dniach od sadzenia, III – harvest at full maturity – po dojrzeniu

Cultivation technologies significantly differentiated the content of dry mass, starch and saccharose (tab. 1 and 2). The influence of technology of tillage on chemical composition depended from harvest time of tubers. In the first and second harvest time tubers originating from polypropylene cover cultivation contained the lowest content of dry matter, the most meanwhile – in the tillage under PE-foil. In the harvest date of

tubers after maturity the most dry mass was affirmed was in cultivation under double sheeting from PE-foil and polypropylene sheeting, the least however – in tillage under PE-foil. The highest content of starch in the first harvest date be characterized the tubers cultivated under double sheeting from foil and polypropylene cover, the lowest meanwhile – cultivated under PE-foil. Tuber assembled two weeks later did not show in content essential changes this component under influence of cultivation technology, meanwhile assembled after maturity the most starch they contained in tillage under polypropylene sheeting, the least in traditional tillage. Potato cultivation under the foil did not differentiate the starch content in tubers as compared to the traditional one. Tubers from polypropylene and double-cover combinations were similar referring to the starch content; control and double-cover objects were similar as to dry matter. The content of sum of sugars and reducing sugars in all harvest dates did not depend from technology of tillage (tab. 2). The content of saccharose shaped the technology of tillage in the earliest date of harvest. The highest her content was observed in tillage under plot with double cover (polypropylene sheeting + polyethylene foil) meanwhile significant lower – in traditional tillage and under PE-foil.

Table 2. Content of total sugars, reducing sugars and saccharose, %
Tabela 2. Zawartość cukrów ogółem, cukrów redukujących i sacharozy, %

Experimental factors Czynniki eksperymentu		Total sugars Cukry ogółem			Reducing sugasrs Cukry redukujące			Saccharose Sacharoza		
		harvest time – terminy zbioru*								
		I	II	III	I	II	III	I	II	III
Cultivation technology Technologia uprawy	A	0.30	0.31	0,39	0,15	0,17	0,20	0,14	0,14	0,19
	B	0.30	0.33	0,42	0,15	0,17	0,20	0,14	0,15	0,21
	C	0.32	0.35	0,44	0,16	0,18	0,20	0,15	0,16	0,23
	D	0.32	0.36	0,45	0,17	0,19	0,21	0,19	0,17	0,23
	LSD – NIR $\alpha \leq 0.05$		n**			n			0,05	
Weed control systems Sposoby pielęgnacji	1	0.31	0.34	0,42	0,15	0,18	0,20	0,15	0,15	0,21
	2	0.30	0.34	0,42	0,16	0,17	0,20	0,14	0,15	0,21
	3	0.31	0.35	0,43	0,16	0,18	0,21	0,15	0,16	0,21
	4	0.31	0.35	0,44	0,16	0,18	0,20	0,15	0,15	0,22
	LSD – NIR $\alpha \leq 0.05$		n			n			n	
Cultivars Odmiany	Aster	0.31	0.34	0,42	0,16	0,18	0,20	0,14	0,15	0,21
	Drop	0.31	0.34	0,43	0,16	0,18	0,20	0,15	0,16	0,22
	LSD – NIR $\alpha \leq 0.05$		n			n			n	
Years Lata	1996	0.28	0.33	0,37	0,16	0,19	0,22	0,12	0,13	0,15
	1997	0.32	0.35	0,45	0,18	0,20	0,23	0,14	0,14	0,21
	1998	0.32	0.34	0,46	0,13	0,14	0,16	0,18	0,20	0,28
	LSD – NIR $\alpha \leq 0.05$		0.04			n			0,04	
Mean – Średnia		0,31	0.34	0.43	0,16	0,18	0,20	0,15	0,16	0,21
LSD – NIR $\alpha \leq 0.05$			0,02			0.01			0.02	

A – conventional technology – technologia tradycyjna; B – polyethylene sheeting – folia polietylenowa; C – polypropylene sheeting – agrowłóknina; D – polypropylene + polyethylene sheeting – agrowłóknina + folia
1 – mechanical weed control systems – mechaniczny; 2 – Afalon; 3 – Racer; 4 – Afalon + Command
*60 days following planting – po 60 dniach od sadzenia; II – 75 days following planting – po 75 dniach od sadzenia, III – harvest at full maturity – po dojrzeniu; **not significant at $\alpha \leq 0.05$ – nieistotne przy poziomie $\alpha \leq 0,05$

Weed control systems exerted significant influence on dry matter and starch contents in the tubers (tab. 1). All manners of weed control using herbicides contributed to significant reduction of these traits values as compared to mechanical way.

The impact of weed control system on dry matter and starch content depended on tuber's harvest date (tab. 1). The highest accumulation of dry matter in physiologically immatured tubers harvested 60 days after planting was found when Afalon 50 WP was applied, the lowest – when Afalon 50 WP + Command 480 EC mixture was used. In other harvest dates, the highest dry matter content was observed in tubers of plants nursed in traditional manner, the lowest – tubers in combinations with Racer 25 EC preparation. The content of starch, in all harvest times was the highest in objects with mechanical weed control system, the lowest meanwhile – after use of herbicide Racer 25 EC. It was one should was however add it that homologous objects in every harvest time were observed was. They in two the earliest harvest time with such objects turned out: the mechanical way and weed control system with use the herbicide Afalon 70 WP as well as nursery with use the preparation Racer 25 EC and mixture of herbicides Afalon 70 WP + Command 480 EC. In harvest time of tubers after maturity using the herbicide Afalon 70 WP as well as Racer 25 EC and mixture of herbicides Afalon 70 WP + Command 480 EC show oneself indeed worse than it applying mechanical way; near what they these two final combinations turned out homogeneous under in relation to value this feature.

Table 3. The influence of cultivation technology & weed control systems on the dry matter & starch content in the potato tubers

Tabela 3. Wpływ technologii uprawy i sposobów pielęgnacji na zawartość suchej masy i skrobi w bulwach ziemniaka

Cultivation technology Technologia uprawy	Weed control systems – Sposoby pielęgnacji			
	1	2	3	4
	Dry mass – Sucha masa			
A	20.59	20.50	19.73	20.04
B	20.57	20.28	19.45	20.13
C	20.40	20.25	20.29	19.13
D	20.50	20.30	19.54	20.34
LSD – NIR $\alpha \leq 0.05$		0.20		
	Starch – Skrobia			
A	11.62	11.52	11.18	11.14
B	11.91	11.49	11.06	11.16
C	11.78	11.80	11.36	11.44
D	11.74	11.64	11.37	11.46
LSD – NIR $\alpha \leq 0.05$		0,31		

Explanations see table 2 – Oznaczenia jak w tabeli 2

The cultivation technologies and weed control systems, in the all harvest times independently from years, significantly modified the dry mater and starch content in tubers (tab. 3). The highest dry matter content was found in tubers of plants cultivated in traditional technology and with mechanical weed control systems, the lowest – tubers of potatoes cultivated under PP-sheeting and with Racer 25 EC herbicide as weed control agents (tab. 3). In traditional cultivation, the lowest starch level was recorded at me-

chanical and chemical nursery with Afalon 50 WP + Command 480 EC application; in cultivation under covers – when nursery using Racer 25 EC was made. The highest starch contents in traditional technology, under PE-sheeting and under double cover (PP-sheeting and PE-folie) were observed in tubers of plants where weed control was regulated with mechanical weed control system; in polypropylene sheeting cultivation – using Afalon 70 WP herbicide (tab. 3).

The varietal factor significantly differentiated the dry matter and starch levels in tubers (tab. 1). Cv. Aster was characterized with higher dry matter, in all harvest times and cv. Drop with higher starch contents in the first and final harvest times. Concentrations of total and reducing sugars and saccharose were at the same level in tubers of both cultivars (tab. 2).

Tested cultivars showed differentiated reaction towards cultivation technologies, independently from harvest times and years (tab. 4). Cv. Aster accumulated the highest dry matter level in cultivation under polyethylene-foil cover, the most starch – in objects with polypropylene sheeting. Drop cv. accumulated the highest content of both components in double-cover cultivation. It probably resulted from different mechanisms of storage substances transfer from green above ground parts of plant to tubers.

Table 4. The influence of cultivation technology & cultivars on dry matter & starch content in the potato tubers

Tabela 4. Wpływ technologii uprawy i odmian na zawartość suchej masy i skrobi w bulwach ziemniaka

Cultivars Odmiany	Cultivation technology – Technologia uprawy			
	A	B	C	D
	Sucha masa – Dry matter			
Aster	20.55	20.56	20.43	20.26
Drop	19.89	19.65	19.60	20.08
LSD – NIR $\alpha \leq 0.05$	0.11			
	Skrobia – Starch			
Aster	11.24	11.40	11.48	11.34
Drop	11.49	11.41	11.73	11.76
LSD – NIR $\alpha \leq 0.05$	0,20			

Explanations see table 2 – Oznaczenia jak w tabeli 2

Meteorological conditions during vegetation periods also influenced on dry matter accumulation in tubers, as well as carbohydrates levels (tab. 1 and 2). The highest dry matter amount was accumulated by tubers in 1996 – year with the lowest level of precipitation sum during vegetation. Tubers were characterized with the highest contents of total and reducing sugars in 1997 – year with the heaviest rainfalls and the most intensive insolation. Tubers contained the most sucrose in 1998. It was the year with advantageous precipitation distribution during vegetation period.

DISCUSSION

Presented results of indicate that the content of dry matter, starch and sucrose in tubers was influenced by the cultivation technology and harvest date. Decrease of dry matter content in young potatoes cultivated under polypropylene sheeting cover is confirmed by Prośba-Białczyk and Mydlarski [1998]. Wierzbicka [1995], Sawicka [1996] as well as Sawicka and Mikos-Bielak [1998] have opposite opinion. The increase of starch level in tubers of potatoes cultivated under covers was confirmed in studies by Wierzbicka [1995], Sawicka [1996] as well as Sawicka and Mikos-Bielak [2000]. The authors also proved that application of polyethylene foil in cultivation of very early potato cultivars decreased the reducing sugars concentration in the maturity tubers, but it increased the sucrose level. No such dependence was found in own studies. It probably results from the fact that high air (up to 45°C) as well as soil temperature is produced under double cover (polypropylene sheeting + polyethylene foil) and it raises considerably oneself the temperature of soil, and the same tubers [Friessleben 1984, Hamouz and Dvorak 2004]. In opinion of Friessleben [1984], the air temperature in cultivation under perforated polyethylene foil may be higher, depending on the hour of the day, even by 6.2–11.8°C as compared to the traditional cultivation with no cover. Roztropowicz and Lutomierska [1997] stated that the temperature differences between open area and covered with a foil amounted (depending on the insolation) to 1–15°C. It means that at noon of a sunny day, thin air layer over the soil is warmed even up to 45°C. Such temperature may be a stress for a crop and, according to Midmose [1984], the plant's burn may occur, which is sometimes considered as herbicide injury. The strongest injuries and temperature stress may occur under double cover consisting of polypropylene sheeting and polyethylene foil, but own studies did not confirm such dependence. Higher air and soil temperatures where potato tubers are formed, causes changes of enzymatic activities [Kacperska 1998]. In opinion of Grzesiuk and Górecki [1994], it may lead to the damage of respiratory enzymes and decrease of respiration intensity. It is a result of oxygen deficiency and carbon dioxide excess inside tubers [Starck et al. 1995]. Perhaps anaerobic conditions are formed there due to intensified respiration, thus biological membranes are damaged and polyphenol oxidases get the access to substrates, tyrosine among others. Grzesiuk and Górecki [1994] as well as Kacperska [1998] reported that specific stress proteins are formed in tuber's cells due to elevated temperatures, and plasmolemma, cyto-frame and cellular nucleus are extremely susceptible. In consequence, increasing the tuber's temperature may lead to excessive tissue dehydration when water intake is slower than transpiration (dehydration may be a main cause of structural damages and cell function disturbances under conditions of excessive environmental temperature). Kacperska [1998] proved that high air temperature may also cause reversible changes of membrane structure, e.g. change of its phase. This, in turn, may be a reason for catalytic disturbances of enzyme properties. After stress disappearance, those disturbances may be reversed or lead to great deficits of energy carriers (e.g. ATP or NAD[P]H) or mediate metabolism products, which results in inhibition of some metabolites or over-production of another ones (e.g. reducing sugars). Therefore, monitoring of air and soil temperature at various layers under covers is essential, and removing them when the temperatures are too high.

Differentiated reaction of studied potato cultivars towards cover application might have resulted from different mechanisms of storage substances transport from above ground parts of plants to tubers. As Kopcewicz [1998] reports, changes in ultra-structure of maturing tuber cells are accompanied by changes in chemical composition and biochemical reactions course.

Herbicides applied in the experiment with potato cultivars also differentiated the tuber's chemical composition. They contributed to the increase of reducing sugars and the decrease of dry matter and starch levels. Negative influence of mechanical and chemical nursery on dry matter of tubers were confirmed by Leszczyński and Lisińska [1985], Zarzecka [1997], Zarzecka and Gąsiorowska [2002]; opposite opinion was expressed by Kłosińska-Rycerska [1971], Gruczek [1980] as well as Ceglarek and Zarzecka [1992]. Reports of Leszczyński and Lisińska [1985], Ceglarek and Księżak [1992], Zarzecka [1997], Prośba-Białczyk and Mydlarski [1998], Leszczyński [2002] as well as Zarzecka and Gąsiorowska [2000, 2002] confirmed the decrease of starch content in tubers due to herbicide application. However, Pawłowski and Pomykalska [1988] reported that application of herbicide did not significantly change the starch level in tubers. The increase of total and reducing sugars in tubers as a result of herbicide action is contradictory to study of Kłosińska-Rycerska [1971], who found that herbicides did not cause significant changes of reducing sugars and sucrose contents. Zarzecka [1997] stated that herbicide application in potato cultivation may elevate or reduce the total and reducing sugars level. These transformations, in her opinion, depend on the herbicide type. Such different opinions on chemical composition of potato tubers of various authors may result from their selective action, different penetration into the cells of various cultivars and different distribution of root system in the soil (intake selectivity) [Starck et al. 1995]. Kacperska [1998] found that localization of herbicides in cells and tissues also plays a major role. At plants resistant to the herbicide, it is not transported at all, or it is transported in small amounts towards apical tops that are very sensitive to toxic substances. Some of applied herbicides block the bio-synthesis of amino acids, carotenoids, or lipids. For instance, Afalon 50 WP that is urea-derived (linurone – 3-(3,4-dichlorocyclo)--1-methylurea is its active form) and applied both in scientific experiments and in agricultural practice, is the inhibitor of photosynthesis and electron transport systems. It blocks the electron transport between photosystems PS II and PS I at electron carrier Q_A bonded to a specific protein. In turn, Racer 25 EC, whose biologically active form is flurochloridone (3-chloro-4-chloromethyl-1-(trifluoro-m-tollilo)-2-pyrolidone) is the inhibitor of carotenoids synthesis and when used in improper date, it often causes leaf nerve discolorations as well as chlorotic spots on leaves. Chlomazone (2-(2-chlorobenzylo)-4,4-dimethyl-oxasolidin-5-one) is the biologically active substance of Command 480 EC preparation applied in own experiments. There are no data on Command 480 EC application in potato cultivation in available literature. Only Rola et al. [1999] report that the herbicide (both Command 480 EC and Command 360 CS (new formula in a form of droplets suspended in liquid) is often applied in EU countries making no negative effects on yielding and quality of crops. Combined application of Command and Afalon preparations in own studies was one of the elements to search for less energy-consuming and more economic cultivation technology as well as opportunity for better work organization in a farm, for reducing the number of visits in a field, and thus

reducing the losses caused by soil squeezing and mechanical plant damage. However, the qualitative effect of combined application of those preparations appeared to be unsatisfactory. At present, new herbicides, so-called photodynamic, that can selectively induce the accumulation of tetrapyrole-derived compounds invoking great light susceptibility at various species and even cultivars in the dark, are introduced on markets. These substances act selectively towards weeds with no damage for the crop at properly selected concentrations [Kacperska 1998].

Varietal properties determined the dry matter and starch contents in tubers. Cv. Aster was characterized with higher concentration of dry matter, Drop cv. – higher starch level. The varietal variability was confirmed by studies of Prośba-Białczyk and Mydlarski [1998], Mikos-Bielak and Sawicka [1998], Kamasa [2001] and Zarzecka and Gąsiorowska [2002].

Our own studies confirmed the dependence of tuber's chemical composition on meteorological conditions course during potato's vegetation period. Higher accumulation of dry matter, and lower – of total sugars and sucrose than in wetter years was observed in warmer summers and periodically dry. It was confirmed by studies of Somorowska [1971], Roztropowicz [1989], Zgórska and Frydecka-Mazurczyk [1985] as well as Pytlarz-Kozicka [2002].

Tuber harvest date determined their quality as well. The increase of dry matter, starch, total and reducing sugars contents was observed during tuber's maturation. Somorowska [1971] observed different course of total and reducing sugars accumulation during vegetation period. Their highest level was found before flowering followed by the decrease. According to Kopcewicz [1998], when plants get older, activities of such enzymes as arabinase, xylanase, α and β-galactosidase as well as xylulolase that decomposing polysaccharides damage the structure of cellular walls, leading to separation of the cutting zone cells, decrease in time.

CONCLUSIONS

1. Cultivation of early potato cultivars under cover may contribute not only to the increase of starch accumulation in tubers, but also total and reducing sugars as well as sucrose.

2. Cultivation technologies applying polypropylene sheeting or polyethylene foil as a cover appeared to be safer for tuber's quality than technology utilizing double cover consisting of polypropylene sheeting plus polyethylene foil.

3. The content of dry mass, starch and saccharose in the tubers depended from cultivation technology and harvest time:

a) the most dry mass young tubers contained in the tillage under PE-foil, meanwhile mature tubers – in tillage under double sheeting from PE- and PP-sheeting;

b) young tubers, assembled after 60 days from planting, accumulated the most starch in the tillage under double cover from PE-foil and PP-sheeting, tuber assembled two weeks later did not show in content essential changes this component under influence of cultivation technology, meanwhile assembled after maturity the most starch they contained in tillage under polypropylene sheeting;

c) tubers with the earliest harvest time accumulated indeed more sacharose in tillage under double cover (PE-foil and PP-sheeting).

4. The best tuber quality both in traditional cultivation and under covers was ensured by mechanical nursery and Afalon 50 WP among all tested herbicides. Application of Racer 25 EC exerted the strongest negative influence on tuber quality. Strict fulfilling the dates and rates of its application as well as thorough selection of following crops should be taken into account when making a decision of introducing the preparation, because its retention time in the soil is very long.

5. The harvest date also determined the tuber quality. The increase of dry matter, starch, sucrose as well as total and reducing sugars contents was observed during tuber's maturation; the latter determine the potato's usefulness for foodstuff processing.

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ZAWARTOŚĆ SUCHEJ MASY I WĘGLOWODANÓW W BULWACH BARDZO WCZESNYCH ODMIAN ZIEMNIAKA UPRAWIANYCH POD OSŁONAMI

Streszczenie. Badania przeprowadzono w latach 1996–1998 na glebach kompleksu dobrego żytniego. Eksperyment założono metodą losowanych podbloków w 3 powtórzeniach. Badano 4 następujące czynniki: 1) technologie uprawy: a) technologia tradycyjna jako obiekt kontrolny, b) z folią polietylenową, c) z agrowłókniną polipropylenową, d) z podwójną osłoną z folii i włókniny polipropylenowej; 2) sposoby pielęgnacji ziemniaka: a) mechaniczna, b) z zastosowaniem Afalonu, c) z użyciem Raceru, d) z zastosowaniem mieszaniny herbicydów Afalon + Command; 3) odmiany ziemniaka: Aster i Drop; 4) terminy zbioru: a) 60 dni po sadzeniu, b) 75 dni po sadzeniu, c) po dojrzeniu. Stosowanie osłon w uprawie ziemniaka, w porównaniu z uprawą tradycyjną spowodowało wzrost zawartości w bulwach skrobi, cukrów ogółem, cukrów redukujących i sacharozy, a spadek koncentracji suchej masy.

Słowa kluczowe: ziemniak, osłony, herbicydy, odmiany, sucha masa, węglowodany

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