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Growth characteristic of Welsh onion (*Allium fistulosum* L.) grown from seeds and transplants

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ABSTRACT

The characteristic growth features of four Welsh onion cultivars ('Parade', 'Performer', 'Siedmiolatka Zielona', and 'Siedmiolatka Czerwona') dependant on growing method (seeds sown directly in the field and from transplants) were evaluated during the three-year study (2007-2009). The following traits were determined: plant height, number of leaves on a single plant, tendency to produce laterals, plant weight, as well as length and diameter of the pseudostem. Plants of the 'Parade' cultivar were the highest (76.0 cm, on average), while those of 'Siedmiolatka Czerwona' were the shortest (mean 68.6 cm). Pseudostem length was found to be the main factor determining the height of the Welsh onion. The longest pseudostems were observed for the 'Parade' and 'Performer' cultivars, while the 'Siedmiolatka Czerwona' had the shortest.

In each of the tested cultivars, those grown from a transplant resulted in larger pseudostems and a larger number of leaves. Amongst the studied cultivars, 'Siedmiolatka Czerwona' had the most numerous leaves and laterals (45.2 leaves and 14.3 laterals, on average), while 'Performer' and 'Parade' had the least (mean 11.7 and 14.8 leaves and 2.4 and 2.6 laterals, respectively). The weight of a single plant with laterals significantly differed depending on the cultivar and growing method. At the end of the vegetation period (mid-October), the 'Parade' and 'Performer' cultivars grown from transplants were characterised by the highest weights (mean 518.2 g and 631.7 g), while 'Siedmiolatka Czerwona' and 'Siedmiolatka Zielona' grown from seeds had the lowest (222 g, on average).

Key words: growing method, cultivars, growth features

INTRODUCTION

Welsh onion (*Allium fistulosum* L.) is a commonly grown and consumed vegetable in many Eastern countries − namely Japan, China, Vietnam, the Philippines, Malaysia, and in Europe and America as well. In Poland, a local population named 'Siedmiolatka', the plants of which are characterised by their intensive growth rate, resistance to low temperatures, and are suitable for forcing, is grown on an amateur scale (Tendaj et al. 2006, Tendaj and Mysiak 2007). The first Polish cultivar has already been bred ('Kroll', PlantiCo, Zielonki) − its plants produce many laterals with abundant foliage and they are slightly susceptible to produce seed stalks.

Under Polish conditions, cultivars from the breeder Bejo Zaden − 'Parade' and 'Performer' − are recommended for growing. Several Japanese cultivars − 'Ishikura Long White' and 'Koshigaya Long White' – have also shown positive effects on yield quality resulting from ridging and deep setting (Kotlińska et al. 2005).

In China, despite the moderate climate conditions, Welsh onion is most often grown in low foil tunnels (Su et al. 2007). Growing Welsh onion from summer sowings in unheated foil tunnels is

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also recommended in Serbia. Therefore, there is a possibility of growing young plants from December until the spring months (Lazić et al. 2002).

The main advantage of growing Welsh onion from transplants is the possibility of obtaining earlier yields. Earlier research conducted in Poland showed that onion grown from seeds ripened four weeks later as compared to the onion grown from sets, and two weeks later than the onion grown from transplants (Gruszecki and Tendaj 2001).

The intensive growth of some Welsh onion cultivars that do not produce many laterals, but do produce large pseudostems, encourages the undertaking of growing procedures aimed at generating crops with great nutritional and health value (Leong 2001, Lazić et al. 2002, Stajner et al. 2006). Another positive feature of the Welsh onion is its long durability after the harvest, which distinguishes it amongst many other *Allium* vegetables grown for bunching (Ibaraki et al. 1999).

The present research aimed at characterising the growth of four Welsh onion cultivars dependant on the growing method (from seeds and transplants). The verified poor winter hardiness of the tested cultivars meant that we could only use results from the first growing year, despite the fact that Welsh onion is considered a perennial species.

MATERIAL AND METHODS

The experiment with Welsh onion growing was conducted in 2007-2009 at the Felin Experimental Farm (University of Life Sciences, Lublin). The range of the study comprised measurements of Welsh onion plants grown from seeds directly into the soil and from transplants. The study also encompassed the cultivars and the sowing material that is accessible in Polish markets. Due to the very poor winter hardiness recorded for the examined cultivars under local weather conditions in the first and second years of experiment, the paper presents only the results referring to the Welsh onion plants grown during the first year.

The field experiment was set up by means of randomised blocks with three replications. These were the variable factors: cultivar ('Parade', 'Performer', 'Siedmiolatka Czerwona' and 'Siedmiolatka Zielona') and growing method (from seeds sown directly into the field and from transplant setting). Each experimental plot had an area of 8 m^2 (100 plants at 30 × 40 cm spacing). The transplants were produced in an unheated greenhouse from seeds sown into plastic boxes filled with peat substrate. Seed sowing for the transplants was conducted on 16-17 March. The dates of seed sowing directly into the field and transplant setting were the following: 20 April 2007, 18 April 2008 and 22 April 2009 . At the setting time, the Welsh onion transplant had 2-3 leaves with mean length of about 10-15 cm. Basil, broad bean, and root parsley were the forecrops for Welsh onion in subsequent years of the experiment.

At the end of the vegetation period (mid-October), the whole plant weight, particular lateral weight, and length and diameter of the pseudostem were evaluated for 30 randomly selected plants per plot. The measurement results were subjected to statistical analysis, with the least significant differences calculated by the Tukey test at $p = 0.05$.

RESULTS AND DISCUSSION

The Welsh onion plants reached from 64.3 cm (2009) to 78.7 cm (2007) in height at the end of the vegetation period (mid-October). The growing method exerted a significant influence on plant height in subsequent years. The plants produced from transplants were significantly higher. The plants from studied cultivars differed in height, but statistically significant differences were confirmed only for the 2007 and 2009 growing periods. 'Parade' was the highest (mean 76.0 cm), while 'Siedmiolatka Czerwona' the shortest (mean 68.6 cm). That trait was quite apparently associated with the number of leaves produced (Tab. 1). Considerably more leaves were recorded for 'Siedmiolatka Czerwona' plants (45.2, on average), while 'Parade' had significantly the least (11.7, on average). Due to the utility value of the Welsh onion, not just plant height but the number of produced leaves that are utilisable are important. According to Lazić et al. (2002), plants of cultivars that form numerous laterals have a higher utility value, because of their greater leaf weight, allowing for a more intensive utilisation of the Welsh onion. From a physiological point of view, the number of leaves on Welsh onion plants, along with low temperatures, may determine the earliness of generative shoot formation (Yamasaki and Miura 1995). That trait can be crucial for crop quality when using the plant at different growth stages.

For Welsh onion, usable parts include not only the tubular chives, but also the pseudostem, formed from the leaf sheath like in leeks. Therefore, Welsh onion is often called Japanese leek or Japanese bunching onion (Leong 2001, Fritsch and Friesen 2002). In the present study, the 'Parade' and

Table 1. Effect of growing method on plant height and leaf number in Welsh onion

Cultivar	Growing method	Height of plant (cm)				Number of leaves in single plant			
		2007	2008	2009	mean	2007	2008	2009	mean
'Parade'	from seeds	69.8	80.3	68.0	72.6	11.1	7.5	9.6	9.4
	from transplants	83.6	80.0	74.7	79.4	13.7	14.0	14.3	14.0
	mean	76.7	80.1	71.3	76.0	12.4	10.7	12.0	11.7
'Performer'	from seeds	67.6	71.0	64.0	67.5	13.4	8.9	14.3	12.2
	from transplants	72.6	76.6	66.7	71.9	14.7	19.2	18.6	17.5
	mean	70.1	73.8	65.3	69.7	14.0	14.0	16.5	14.8
'Siedmiolatka Zielona'	from seeds	88.6	72.3	51.3	70.7	14.7	8.7	18.3	13.9
	from transplants	89.1	78.8	72.0	79.9	14.8	16.0	26.3	19.0
	mean	88.9	75.5	61.6	75.3	14.7	12.3	22.3	16.4
'Siedmiolatka Czerwona'	from seeds	76.1	56.0	59.7	63.9	30.3	30.5	57.6	39.4
	from transplants	82.6	78.6	58.8	73.3	33.9	40.7	78.6	51.1
	mean	79.4	67.3	59.2	68.6	32.1	35.6	68.1	45.2
Mean	from seeds	75.5	69.9	60.7	68.7	17.3	13.9	24.9	18.7
	from transplants	82.0	78.3	68.0	76.1	19.3	22.5	34.4	25.4
	mean	78.7	74.2	64.3	72.4	18.3	18.2	29.7	22.0
$LSD_{0.05}$									
cultivar		7.90	n.s.	6.23	n.s.	12.11	10.23	19.66	17.61
growing method		4.14	7.79	7.01	n.s.	n.s.	5.03	n.s.	n.s.
interaction		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 2. Effect of growing method on length and diameter of pseudostem

Cultivar	Growing method	Length and diameter of pseudostem (cm)							
		2007		2008		2009		mean	
		length	diam.	length	diam.	length	diam.	length	diam.
'Parade'	from seeds	17.0	3.3	19.6	2.3	15.7	2.6	17.5	2.7
	from transplants	19.0	2.9	21.0	3.2	18.7	4.6	19.5	3.6
	mean	18.0	3.1	20.3	2.7	17.2	3.6	18.5	3.1
'Performer'	from seeds	16.6	3.2	16.3	2.7	15.2	2.8	16.0	2.9
	from transplants	16.7	3.4	20.1	3.7	18.3	3.2	18.3	3.4
	mean	16.6	3.3	18.2	3.2	16.7	3.0	17.2	3.1
'Siedmiolatka Zielona'	from seeds	20.0	3.0	20.3	2.7	11.5	1.9	17.2	2.5
	from transplants	24.1	3.7	19.0	3.1	18.0	2.8	20.3	3.2
	mean	22.0	3.3	19.6	2.9	14.7	2.4	18.7	2.8
'Siedmiolatka Czerwona'	from seeds	14.1	1.4	13.0	0.8	13.0	1.4	13.4	1.2
	from transplants	21.3	1.6	19.5	0.8	16.7	2.1	19.1	1.5
	mean	17.7	1.5	16.2	0.8	14.8	1.7	16.2	1.3
Mean	from seeds	16.9	2.7	17.3	2.1	13.8	2.2	16.0	2.3
	from transplants	20.2	2.9	19.9	2.7	17.9	3.1	19.3	2.9
	mean	18.5	2.9	18.6	2.4	15.8	2.6	17.6	2.6
$LSD_{0.05}$									
cultivar		3.96	0.66	2.06	0.37	2.18	0.47	n.s.	0.88
growing method		2.07	n.s.	1.08	0.19	2.33	0.95	2.17	0.46
interaction		n.s.	n.s.	3.53	0.63	n.s.	n.s.	n.s.	n.s.

Table 3. Effect of growing method on number and weight of laterals of a single Welsh onion

Cultivar	Growing method	Number of laterals				Weight of single lateral (g)		
		2007	2008	2009	mean	2007	2008	mean
'Parade'	from seeds	4.0	1.0	3.0	2.6	88.7	73.9	81.3
	from transplants	5.0	1.0	2.0	2.6	128.8	161.9	145.3
	mean	4.5	1.0	2.5	2.6	108.7	117.9	113.3
'Performer'	from seeds	4.0	1.0	1.6	2.2	107.0	124.3	115.6
	from transplants	4.0	1.6	2.6	2.7	130.1	151.3	140.7
	mean	4.0	1.3	2.1	2.4	118.5	137.8	128.1
'Siedmiolatka Zielona'	from seeds	8.0	1.3	3.6	4.3	42.7	63.3	53.0
	from transplants	9.0	2.0	6.0	5.6	60.1	134.3	97.2
	mean	8.5	1.6	4.8	4.9	51.4	98.8	75.1
'Siedmiolatka Czerwona'	from seeds	17.0	6.6	8.0	10.5	15.1	23.8	19.4
	from transplants	30.0	10.0	14.6	18.2	19.9	32.1	26.0
	mean	23.5	8.3	11.3	14.3	17.5	27.9	22.7
Mean	from seeds	18.2	2.5	4.1	4.9	63.4	71.3	67.3
	from transplants	12.0	3.6	6.3	7.3	84.7	119.9	102.3
	mean	10.1	3.1	5.2	6.1	74.0	95.6	84.8
$LSD_{0.05}$								
cultivar		6.12	0.62	4.36	7.75	7.08	9.56	52.33
growing method		n.s.	0.32	n.s.	n.s.	n.s.	5.01	26.12
interaction		n.s.	1.07	n.s.	n.s.	n.s.	16.36	n.s.

Table 4. Effect of growing method on weight of a single plant

Cultivar	Growing method	Weight of plant (g)			
		2007	2008	2009	mean
'Parade'	from seeds	344.7	204.8	376.0	308.5
	from transplants	563.4	408.0	583.3	518.2
	mean	454.0	306.4	479.7	413.3
'Performer'	from seeds	376.4	340.5	357.3	558.1
	from transplants	544.5	670.5	680.3	631.7
	mean	460.4	505.5	518.8	494.9
'Siedmiolatka Zielona'	from seeds	308.3	187.5	171.3	222.3
	from transplants	421.7	497.2	594.0	504.3
	mean	356.0	342.3	382.6	363.3
'Siedmiolatka Czerwona'	from seeds	199.7	143.1	325.3	222.7
	from transplants	409.7	324.5	443.6	392.6
	mean	304.7	233.8	384.5	307.6
Mean	from seeds	307.2	218.9	307.5	277.9
	from transplants	484.8	475.0	575.3	511.7
	mean	396.0	346.9	441.4	394.8
$LSD_{0.05}$					
cultivar		n.s.	50.14	82.11	129.54
growing method		96.67	26.26	33.06	67.85
interaction		n.s.	85.80	n.s.	n.s.

'Siedmiolatka Zielona' cultivars formed the longest pseudostems (18.5 cm and 18.7 cm on average, respectively). In the two other cultivars, the pseudostem was significantly shorter, especially in 'Siedmiolatka Czerwona' at 16.2 cm (mean). The pseudostem diameter of the plants of the studied cultivars was from 1.3 cm to 3.1 cm. Significantly, the smallest pseudostem diameter was found in 'Siedmiolatka Czerwona' (mean 1.3 cm), while the largest was in 'Parade' and 'Performer' (3.1 cm, on average).

It was found that the susceptibility to lateral production greatly determines the weight of the utilisable parts of the Welsh onion. The more laterals produced by plants (side plants), the shorter the pseudostems and smaller their diameter (Tabs 2 and 3).

Amongst the examined cultivars, 'Siedmiolatka Czerwona' was considerably distinguished by the largest number of laterals and the smallest pseudostem diameter. Regardless of the cultivar, growing from transplants significantly affected the length of the pseudostem and its larger diameter.

The weight of the utilisable parts of a single plant along with its laterals differed significantly depending on the cultivar and growing method. For every studied cultivar, plants produced from transplants were considerably heavier as compared to those achieved from seed sowing directly into the field (Tab. 4). At the end of the vegetation period, the 'Parade' and 'Performer' plants had the heaviest amounts of usable matter (413.3 g and 494.9 g on average, respectively), while 'Siedmiolatka Czerwona' had the lowest weight (mean 307.6 g). Kotlińska et al. (2005) reported that Welsh onion varietal features and growing methods greatly influence the weight of the utilisable parts, whereas their effects on plant height are weaker.

The present experiment revealed that the weight of single laterals was higher when their number on a given plant was smaller. The 'Parade' and 'Performer' cultivars were characterized by a slight susceptibility to produce laterals (mean 2.4-2.6 laterals), although their weight was significantly higher as compared to 'Siedmiolatka Zielona' or 'Siedmiolatka Czerwona'. Regardless of the cultivar, the growing method had no significant influence on the number of produced laterals, while it did on their weight. Laterals produced by plants grown from transplants were almost twice as heavy than those from seed sowing directly into the field (Tab. 3).

CONCLUSIONS

1. Welsh onion appeared to be a plant with very intensive growth, regardless of the growing method. However, growing from transplants at the end of April resulted in a higher likelihood of plants with significantly larger leaf numbers and almost twice the weight as compared to seeds sown directly into the field.
2. The Welsh onion pseudostems, a very important utilisable part, achieved considerable length and diameter at the end of the vegetation period (mid-October). The growing method and cultivar determined this feature. The 'Parade' and 'Siedmiolatka Zielona' cultivars produced the largest pseudostems, while 'Siedmiolatka Czerwona' had the smallest. The growing from transplants resulted in longer and wider-diameter pseudostems for each of the cultivars in the study.
3. Amongst the examined cultivars, there were two with poor lateral production, which are very useful for growing at denser spacing ('Parade' and 'Performer'). 'Siedmiolatka Czerwona', whose plants had the lowest weight but great usefulness for bunching, appeared to be the cultivar with considerable susceptibility to forming numerous laterals.

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CHARAKTERYSTYKA WZROSTU CEBULI SIEDMIOLATKI (*ALLIUM FISTULOSUM* L.) UPRAWIANEJ Z SIEWU I ROZSADY

Streszczenie: W trzyletnim cyklu badań (2007-2009) oceniono charakterystyczne cechy wzrostu roślin czterech odmian siedmiolatki (‘Parade’, ‘Performer’, ‘Siedmiolatka Zielona’, ‘Siedmiolatka Czerwona’) w zależności od metody uprawy (z siewu nasion wprost do gleby i z sadzenia rozsady). Określono wysokość roślin, liczbę liści jednej rośliny, skłonność do wytwarzania odrostów bocznych, masę jednej rośliny, długość i średnicę łodygi rzekomej. Największą wysokość osiągnęły rośliny odmiany ‘Parade’ (średnio 76,0 cm) a najmniejszą ‘Siedmiolatki Czerwonej’ (średnio 68,6 cm). Stwierdzono, że o wysokości roślin tej cebuli decydowała przede wszystkim długość łodygi rzekomej. Najdłuższe łodygi rzekome miały rośliny odmiany ‘Parade’ i ‘Performer’, a najkrótsze odmiany ‘Siedmiolatka Czerwona’.

U każdej odmiany uprawa z rozsady zapewniła wytworzenie większej łodygi rzekomej oraz większej liczby liści. Spośród badanych odmian najwięcej liści i odrostów wytworzyły rośliny odmiany ‘Siedmiolatka Czerwona’ (średnio 45,2 liści i 14,3 odrostów), a najmniej rośliny odmiany ‘Performer’ i ‘Parade’ (średnio 11,7 i 14,8 liści oraz 2,4 i 2,6 odrostów). Masa jednej rośliny z odrostami różniła się istotnie w zależności od odmiany i metody uprawy. Pod koniec wegetacji (druga dekada października) największą masę miały rośliny odmiany ‘Parade’ i ‘Performer’ z sadzenia rozsady (średnio 518,2 g i 631,7 g), a istotnie najmniejszą rośliny odmiany ‘Siedmiolatka Czerwona’ i ‘Siedmiolatka Zielona’ z siewu nasion (średnio 222 g).

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