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THE INFLUENCE OF SELECTED AGRICULTURAL FACTORS ON YIELD AND CONTENT OF SOME COMPONENTS OF WELSH ONION (*Allium fistulosum* L.) 'SPRINT'

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Abstract

The influence of three factors: sowing date (l0th April, 25th April, 10th May), sowing rate (4, 6, and 8 kg × ha^{-1}), and row spacing (20, 25, and 30 cm), on the quantity and quality of yield of Welsh onion 'Sprint' was examined in the experiment. The highest total and marketable yield were obtained when seeds were sown on 25th April. An increase in sowing rates resulted in a significant increase of yield. The highest total and marketable yield were obtained at a sowing rate of 8 kg × ha^{-1}. However, significantly greater total and marketable yield were obtained at a row distance of 20 cm. Dry matter content in Welsh onion yield depended significantly on the sowing date and the part of the plant. Plants obtained from seeds sown on 10th May contained the highest content of dry matter. Significantly more dry matter was in the pseudostems than in the leaves of Welsh onion. However, higher L-ascorbic acid content was estimated in the leaves. Welsh onion obtained from the earliest sowing date (10th April) contained significantly the most reducing sugars. Welsh onion obtained from seeds sown on 25th April was characterized by the highest content of pyruvic acid.

Key words: *Allium fistulosum*, sowing date, yield, nutritive value

INTRODUCTION

Welsh onion *(Allium fistulosum* L.*)* belongs to the genus *Allium* and to the family Alliaceae. It is one of the oldest cultivated vegetable plants (Y o o and P i k e, 1998; K o t l i ń s k a et al. 2005). It is also called Japanese bunching onion. 'Sprint', an annual variety of Welsh onion, is one of taxa cultivated on a large scale in the Far East countries, but it is not widely known in Poland (W o j t a s z e k et al. 2005). Bulbous vegetables are commonly cultivated and consumed on account of their medicinal, nutritional, and spicy value (O r ł o w s k i et al. 2005). They play a part in human nutrition as an important source of vitamins, mineral components (Ca, K, P, Mg and Fe, especially), aromatic substances, and organic acids (K o t l i ń s k a, 1994; F r a n c z u k, 2000). Whole plants are perfect additives to different dishes on account of their mild consistency and taste (K o t l i ń s k a and K o j i m a, 2000; L e o n g and A r m s t r o n g, 2001; K o t l i ń s k a et al. 2005). Welsh onion has appeared more often on our market in the last years as whole plants tied up in bunches.

The investigations were carried out in connection with the fast growing interest in this species and due to a lack of sufficient reports in the literature about its cultivation and nutritive value. The aim of these investigations was to improve agronomic practices and to determine the influence of sowing date, sowing rate, and row distance on the quantity of Welsh onion 'Sprint' yield. However, yield quality was assessed according to the date of seed sowing.

MATERIALS AND METHODS

In the years 2002–2004 in the Vegetable Research Station in Dołuje belonging to the Department of Horticulture of the West Pomeranian University of Technology in Szczecin, a field experiment was carried out to examine the influence of the sowing date, sowing rate and row distance on the quantity and quality of 'Sprint' – an annual variety of Welsh onion grown for bunches.

The experiment was carried out in randomized split-plot design with four replications. The area of a single harvest plot was 1.44 m^2 (1.2 × 1.2 m).

Sowing date (10th April, 25th April and 10th May), sowing rate (4, 6, and 8 kg × ha^{-1}), and row distance (20, 25, and 30 cm) were the experimental factors.

The soil of the experimental field belongs to soil class III b, classified it as post-bog soil, Chernozem type, proper Chernozem subtype. In each year of the experiment, before sowing the field was prepared according to the agronomic requirements recommended for the cultivation of bulbous vegetables. Ploughing was carried out in November and soil tillage was done in spring. Soil samples were taken and their analysis was carried out in the Regional Chemical-Agricultural Laboratory in Szczecin. On the basis of the obtained results, mineral fertilization was applied and mineral nutrients were supplied at a level of 150 mg N-NO_3, 75 mg P, and 175 mg K × dm^{-3} soil. Before sowing, seeds were treated with a mixture of fungicides (carbendazim, tiuram, and metalaxyl).

Plant protection against diseases and pests was carried out according to the current recommended vegetable protection programme developed by the Research Institute of Vegetable Crops in Skierniewice. Plants were sprayed with chlorothalonil, metalaxyl, and mancozeb in order to protect them against fungal diseases, mainly from downy mildew *(Peronospora destructor* Casp.). In 2003 plants were also sprayed with deltametrine against *Thrips tabaci communis* Uzel.

Whole plants were harvested once at the date dependent on the sowing date.

Table 1
Harvest date of Japanese bunching onion in accordance with the sowing date in each year of the study

Sowing date	Harvest date		
	2002	2003	2004
10. 04	12.07	14.07	19.07
25. 04	22.07	28.07	28.07
10. 05	28.07	01.08	30.07

Harvest was carried out by hand after plants had been earlier dug up. Immediately after the harvest, plants were put in plastic boxes and then sorted according to quality standards.

Healthy plants with pseudostem diameter above 1 cm as well as without pests and mechanical damage were selected as marketable yield.

In the years 2003 and 2004, collective samples were taken for each date of sowing after finishing the harvest for the purpose of chemical analysis. The material for investigation was taken from the middle part of a leaf and pseudostem. Dry matter was estimated by drying to constant weight at 105°C, L-ascorbic acid content – by Tillmans' method, pyruvic acid content – according to the Schwimmer and Weston method (1961) with several modifications (Horbowicz, 1998). The content of reducing sugars in dry matter was estimated according to the Luff-Schoorl method and the content of total sugars – by sucrose hydrolysis (Krełowska-Kułas, 1993).

The obtained experimental results were statistically verified by Tukey's test at a confidence level of 5%.

The data on weather conditions during the two years when plant material was collected for chemical analysis, including temperature, precipitation and sunlight hours, are presented in Table 2. In 2003 the temperature from April to July was slightly higher than the long-term mean (mostly in May by 2.5°C). The whole growing period of the studied plants, from April to July, was very sunny; in all the months sunlight hours were longer compared to the long-term mean. The year 2003 was exceptionally dry. In all the months, except July, there was less precipitation in comparison to the long-term mean and therefore it was necessary to water the plants. Weather conditions were favourable for tobacco thrips (*Thrips tabaci communis* Uzel) to appear.

The weather conditions in 2004 were favourable for Welsh onion cultivation. Higher temperatures were recorded in April in comparison to the previous year. The average temperature of May was similar to the long-term average temperature in this month. In comparing the temperatures in June and July, it was found out that they were slightly lower than the long-term mean for that period (by 1.3 and 0.4°C, respectively). In May, June, and July, thus during the intensive growth of the plants, there were relatively few sunlight hours, less than the annual mean. Heavy rains in July were unfavourable, with rainfall higher by 25.8mm than the long-term mean, and they contributed to the development of downy mildew (*Peronospora destructor* Casp.).

Table 2
Climatic conditions – mean temperature, total precipitation, and total sunlight hours in 2002–2004

Year	10-day period	Climatic conditions											
		mean temperature [°C]				total precipitation [mm]				total sunlight hours [h]			
		IV	V	VI	VII	IV	V	VI	VII	IV	V	VI	VII
2002	I	4.2	13.5	17.5	19.4	0.0	8.9	10.2	9.9	86.0	72.0	83.0	77.0
	II	9.2	14.8	18.5	19.8	14.1	3.8	17.4	7.3	26.0	64.0	76,.0	55.0
	III	9.7	15.9	16.5	19.7	20.8	59.7	25.0	16.9	53.0	79.0	73.0	78.0
Mean		7.7	14.7	17.5	19.6	34.9	72.4	52.6	34.1	165.0	215.0	232.0	210.0
Deviation from long-term mean		0.5	2.3	1.0	2.0	-0.1	21.4	-3.4	-34.9	-14.0	-14.0	1.0	-10.0
2003	I	3.2	15.0	20.9	16.9	8.5	1.9	2.4	22.7	45.9	84.2	135.0	35.4
	II	8.9	13.0	17.6	20.4	0.1	19.8	25.9	19.1	89.6	74.1	96.8	105.7
	III	12.7	16.8	17.3	20.9	6.8	3.6	10.0	49.2	84.7	123.3	68.0	84.9
Mean		8.3	14.9	18.6	19.4	15.4	25.3	38.3	91.0	220.2	281.6	299.8	226.0
Deviation from long-term mean		1.1	2.5	2.1	1.8	-19.6	-25.7	-17.7	22.0	69.2	52.6	68.8	6.0
2004	I	6.6	14.7	16.1	16.2	20.8	19.6	6.9	40.5	57.4	53.4	60.6	77.7
	II	9.7	11.9	14.6	17.2	1.6	6.2	27.0	39.5	84.2	52.2	54.4	50.3
	III	11.4	11.2	14.9	18.1	9.3	6.0	17.1	14.8	67.0	106.0	65.9	81.1
Mean		9.2	12.6	15.2	17.2	31.7	31.8	51.0	94.8	208.6	211.6	180.9	209.1
Deviation from long-term mean		2.0	0.2	-1.3	-0.4	-3.3	-19.2	-5.0	25.8	57.6	-17.4	-50.1	-10.9

RESULTS AND DISCUSSION

The three-year results showed that marketable yield of Welsh onion significantly depended on all the experiment factors (Table 3). The highest marketable yield was obtained when seeds were sown on 25th April, and it was higher by 9.20 t × ha^{-1} than marketable yield obtained when seeds were sown on 10th April. An increase in sowing rates resulted in an increase of marketable yield. The highest yield was obtained at a sowing rate of 8 kg × ha^{-1}. It was higher by 9.80 t × ha^{-1} than the yield obtained at a sowing rate of 4 kg × ha^{-1}. The present experiments confirmed the reports of R u m p e l and F e l c z y ń s k i (1997) that increased plant density results in an increase of marketable yield. Significantly higher yield was observed when plants were grown in rows 20 cm apart in comparison to their cultivation in rows 30 cm apart. An interaction was also found between sowing date and sowing rate. When seeds were sown on 10th April, significantly higher marketable yield was obtained at a sowing rate of 6 and 8 kg × ha^{-1} (25.8 and 26.7 t × ha^{-1}, respectively). However, the highest marketable yield of Welsh onion for the later sowing dates was obtained at a sowing rate of 8 kg × ha^{-1}.

When Welsh onion was grown from seeds sown on 10th April, higher marketable yield was obtained at a row spacing of 20 cm (26.6 t × ha^{-1}). When seeds were sown on 25th April and plants were grown in rows 20 cm apart, the highest marketable yield was obtained. It was higher by 7.5 txha^{-1} than the yield obtained at a row spacing of 30 cm. When Welsh onion seeds were sown on 10th May, significantly greater marketable yield was at a row distance of 20 cm and 25 cm (28.6 t × ha^{-1} and 28.3 t × ha^{-1}, respectively). When plants were grown in rows 30 cm apart, higher yield was obtained at a sowing rate of 6 and 8 kg × ha^{-1}. However, when seeds were sown in rows every 20 cm and 25 cm, the highest marketable yield was at a sowing rate of 8 kg × ha^{-1}.

According to O r ł o w s k i and K o ł o t a (1999), Welsh onion leaf yield is about 20 t × ha^{-1}. The three-year results of the present experiment revelead that marketable Welsh onion yield was higher (on average by 41.0 t × ha^{-1}) when seeds were sown on 25th April in rows 20 cm apart and at sowing rates 6 and 8 kg × ha^{-1}. Welsh onion plants produced the lowest yield (18.9 t × ha^{-1}) when seeds were sown on 10th April, in rows 30 cm apart and at a sowing rate of 4 kg × ha^{-1}.

The three-year results demonstrated that total yield of Welsh onion depended significantly on the examined factors (Table 4). Similarly to marketable yield, the highest total yield was found when plants were grown from seeds sown on 25th April. It was higher by 8.7 t × ha^{-1} than the yield obtained from seeds sown on l0th April. The highest total yield was recorded at a sowing rate of 8 kg × ha^{-1}, while the lowest one at a sowing rate of 4 kg × ha^{-1} (the difference in yield was 10.7 t × ha^{-1}). The highest total yield was recorded at a row distance of 20 cm and the lowest one when plants were grown in rows 30 cm apart. The present experiment confirmed the reports of Mehla et al. (1993) stating that when Welsh onion is planted in rows 10, 15, 20 or 25 cm apart, its yield decreases. It also confirmed the reports of Wojtaszek et al. (1992) that an increase in row distance results in an increase of pseudostem size, but also in a decrease of total yield.

When seeds were sown on 10th April, significantly higher total yield was obtained at a sowing rate of 6 and 8 kg × ha^{-1}. When seeds were sown on 25th April and on 10th May, the highest total yield was found at a sowing rate of 8 kg × ha^{-1}. It was higher (by 13.7 and 11.5 $txha^{-1}$, respectively) than the total yield obtained at a sowing rate of 4 kg × ha^{-1}.

A decrease in row distance resulted in an increase of total Welsh onion yield, regardless of sowing date. No significant interaction between the row distance and sowing rate was found.

Bulbous vegetables are commonly grown and consumed on account of their medicinal, nutritive and seasoning value (Orłowski et al. 2005). In 2003 a significant effect of the sowing date and edible part of Welsh onion on dry matter content was found (Table 5). Plants obtained from the last sowing date contained the highest amount of dry matter (12.4%), while plants from the second sowing date (25th April) contained the least dry matter – 8.98%. Pseudostems were characterized by significantly higher dry matter content (13.3%) in comparison to green shoots (8.04%). The analysis of the results also found a significant interaction between the sowing date and edible part of Welsh onion. Significantly more dry matter was found in pseudostems (12.8, 11.5 and 15.5%, respectively) than in green shoots (8.43, 6.47, and 9.22%, respectively), regardless of sowing date.

In 2004 plants obtained from the last sowing date contained significantly the highest dry matter content (14.2%) in comparison to plants obtained from the earliest date (8.60%). It was found that among the edible parts of Welsh onion pseudostems were characterized by significantly higher dry matter content (15.5%) than green shoots (8.41%). A significant interaction between the examined factors was noted. More dry matter was estimated in pseudostems than in green shoots, regardless of sowing date.

The two-year results of the experiment showed that plants grown from seeds sown on 10th May contained significantly more dry matter (13.3%) than plants obtained from the earliest date (9.11%). Significantly more dry matter was estimated in pseudostems than in green shoots. The present experiment confirmed the reports of Kotlińska et al. (2005) that Welsh onion leaves contain 5–13% of dry matter. Pseudostems included more dry matter than green shoots, regardless of sowing date.

Kotlińska et al. (2005) state that both leaves and pseudostem of Welsh onion are a rich source of vitamin C and contain 76–95 mg × 100 g^{-1} f.m. of vitamin C. In the present experiment, 38.4 mg (on average) was estimated in the leaves and 17.2 mg × 100 g^{-1} f.m. of vitamin C (as L-ascorbic acid) was estimated in the stem of Welsh onion.

A significant effect of the part of Welsh onion on its L-ascorbic acid content was also found (Table 4). In 2003 more L-ascorbic acid (by 21.2 mg × 100 g^{-1} f.m., on average) was estimated in green shoots than in pseudostems. A significant interaction between the examined factors was noted. The leaves contained more L-ascorbic acid than pseudostems, regardless of sowing date.

In 2004 a significant influence of both examined factors on L-ascorbic acid content in Welsh onion yield was found. More L-ascorbic acid was estimated in plants grown from seeds sown on 10th and 25th April than in plants obtained from seeds sown on 10th May. Significantly more L-ascorbic acid content in Welsh onion leaves (38.6 mg × 100 g^{-1} f.m., on average) than in pseudostems (17.4 mg × 100 g^{-1} f.m., on average) was found. The statistical analysis of the results also showed a significant interaction between the examined factors. Green shoots of Welsh onion included more L-ascorbic acid than pseudostems, regardless of sowing date.

The two-year results of chemical analysis showed a significant influence of the examined factors on L-ascorbic acid content in yield. Welsh onion grown from seeds sown on 10th and 25th April contained more L-ascorbic acid than those obtained from seeds sown on 10th of May. Significantly more L-ascorbic acid content was estimated in green shoots. A significant interaction between the examined factors on L-ascorbic acid content was also noted. Green shoots contained more L-ascorbic acid than pseudostems, regardless of sowing date.

Tendaj and Mysiak (2007) note that total sugar content in Welsh onion is 1.51% f.w. However, according to Kotlińska et al. (2005), Welsh onion leaves include 1.5–6.0% of sugars. In the present experiment, Welsh onion leaves included (on average) 3057.0 mg × $100g^{-1}$ f.m. of total sugars and 2089.0 mg × $100g^{-1}$ f.m of reducing sugars, regardless of sowing date (Table 5).

In the present experiment, the two-year results showed that the content of total sugars and reducing sugars in Welsh onion plants depended significantly on the sowing date (Table 6). In 2003 plants grown from seeds sown on 10th and 25th April contained significantly more total sugars (3192.1 and 3080.4 mg × $100g^{-1}$ f.m., respectively) than plants from seeds sown on 10lh of May (2873.4 mg × $100g^{-1}$ f.m.). However, Welsh onion plants obtained from the earliest date (10th April) contained significantly more reducing sugars in comparison to plants obtained from the second and third sowing dates (25th April and 10th May).

After synthesis of the two-year results, it was found that in 2004 Welsh onion grown from seeds sown on 25th April contained significantly more total sugars than plants obtained from seeds sown on 10th May. In 2004 plants obtained from seeds that were sown on 10th and 25th April were characterized by significantly higher reducing sugar content (2411.8 and 2433.4 mg × 100g^{-1} f.m., respectively) than plants from the last sowing date (l943.6 mg × 100g^{-1} f.m.).

After synthesis of the results, it was demonstrated that Welsh onion plants obtained from the earliest sowing date contained the highest content of reducing sugars (2302.6 mg × 100g^{-1} f.m.), while those from the last sowing date – the lowest content of reducing sugars (1851.2 mg × 100g^{-1} f.m.).

Pyruvic acid content in Welsh onion plants, which decides about their pungency, taste and smell, depended significantly on the sowing date (Table 7).

In 2003 plants sown on the last date were characterized by the highest content of pyruvic acid (10.4 µmol × g^{-1}f.m.) and those obtained from the earliest sowing date were characterized by the lowest content of pyruvic acid (7.75 µmol × g^{-1}f.m.).

In 2004 Welsh onion plants obtained from seeds sown on 25th April contained the highest amount of pyruvic acid (8.15 µmolxg^{-1} f.m.) and plants from the earliest sowing date were characterized by the lowest content of pyruvic acid (6.25 µmol × g^{-1} f.m.).

After synthesis of the results, it was shown that Welsh onion plants obtained from seeds sown on 25th April was characterized by the highest pyruvic acid content (9.02 µmol × g^{-1} f.m.) and Welsh onion obtained from seeds sown on the earliest sowing date was characterized by the lowest pyruvic acid content (7.37 µmol × g^{-1} f.m.).

Significant differences in the amount of pyruvic acid produced by tree onion plants in different years of the experiment were found in the research of Jadczak (2005), which confirmed the studies mentioned by this author reporting that pungency of onions depends on various factors, including weather conditions. The information was confirmed in our study in which, depending on the date of sowing of Welsh onion, in the first year from 7.75 to 10.37 µmol × g^{-1} of pyruvic acid was determined and from 6.25 to 8.15 µmol × g^{-1} in the second year. In 2003, compared to 2004, higher average air temperature and the total amount of sunlight hours were recorded.

Schwimmer and Weston (1961) sorted onion cultivars according to the quantity of pyruvic acid in l g material into the following types: mild cultivars (2–4 µmol), medium-spicy cultivars (8–10 µmol), and spicy cultivars (15–20 µmol). In the present experiment, pyruvic acid content in Welsh onion plants was on average 8.23 µmol × g^{-1} f.m., so that 'Sprint' can be rated as a mild cultivar.

Table 3
Influence of sowing date, sowing rate and row spacing
on the quantity of marketable yield of Welsh onion 'Sprint' (t × ha^{-1}) – average for 2002–2004

Sowing date (T)	Sowing rate (N) (kg × ha^{-1})	Row spacing (R) (cm)			Mean
		30	25	20	
10.04	4	18.9	21.0	22.1	20.6
	6	24.2	25.4	27.8	25.8
	8	24.6	25.5	30.0	26.7
	mean	22.6	23.9	26.6	24.4
25.04	4	23.0	25.2	30.9	26.4
	6	31.6	33.2	41.0	35.2
	8	35.6	40.7	41.0	39.1
	mean	30.1	33.0	37.6	33.6
10.05	4	19.4	22.8	20.9	21.0
	6	28.3	29.2	30.5	29.3
	8	28.1	32.7	34.3	31.7
	mean	25.3	28.3	28.6	27.4
Mean	4	20.4	23.0	24.6	22.7
	6	28.0	29.2	33.1	30.1
	8	29.4	33.0	35.1	32.5
Mean		26.0	28.4	30.9	

LSD $_{=0.05}$ T=1.20, N=1.26, R=1.21, N(T)=2.10, T(N)=2.19, N(R)=2.10, R(N)=2.11, R(T)=2.02, T(R)=2.10

Table 4
Influence of sowing date, sowing rate and row spacing
on the quantity of total yield of Welsh onion 'Sprint' ($t \times ha^{-1}$) – average for 2002-2004

Sowing date (T)	Sowing rate (N) ($kg \times ha^{-1}$)	Row spacing (R) (cm)			Mean
		30	25	20	
10.04	4	20.0	21.8	23.1	21.6
	6	25.9	26.7	29.6	27.4
	8	26.3	27.4	31.6	28.4
	mean	24.1	25.3	28.1	25.8
25.04	4	23.4	25.6	31.4	26.8
	6	32.1	34.0	42.2	36.1
	8	36.6	42.1	42.7	40.5
	mean	30.7	33.9	38.8	34.5
10.05	4	19.9	23.2	21.3	21.5
	6	29.1	29.9	31.4	30.1
	8	29.7	34.1	35.3	33.0
	mean	26.2	29.1	29.3	28.2
Mean	4	21.1	23.5	25.3	23.3
	6	29.0	30.2	34.4	31.2
	8	30.8	34.5	36.5	34.0
Mean		27.0	29.4	32.1	
$LSD_{=0.05}$ T=1.26, N=1.23, R=1.23, N(T)=2.09, T(N)=2.13, NxR n.s., R(T)=2.07 T(R)=2.12					

n.s. – not significant differences

Table 5
Dry matter and L-ascorbic acid contents in Welsh onion leaves
depending on sowing date and part of the plant

Sowing date (T)	Examined part of the plant (C)	Dry matter (%)			L-ascorbic acid (mg × 100 g f.m.)		
		2003	2004	mean	2003	2004	mean
10.04	green shoots	8.43	7.20	7.81	42.7	41.7	42.2
	pseudostem	12.8	10.0	11.4	15.7	17.9	16.8
	Mean	10.6	8.60	9.61	29.2	29.8	29.5
25.04	green shoots	6.47	8.59	7.53	36.8	44.1	40.4
	pseudostem	11.5	17.7	14.6	16.6	17.3	16.9
	Mean	8.98	13.1	11.0	26.7	30.7	28.7
10.05	green shoots	9.22	9.43	9.32	35.1	30.1	32.6
	pseudostem	15.5	18.9	17.2	18.6	17.0	17.8
	Mean	12.4	14.2	13.3	26.8	23.5	25.2
$LSD_{=0.05}$ for T		0.23	0.62	0.60	n.s.	2.10	2.12
Mean	green shoots	8.04	8.41	8.22	38.2	38.6	38.4
	pseudostem	13.3	15.5	14.4	17.0	17.4	17.2
$LSD_{=0.05}$	C	0.66	0.39	0.29	1.76	1.66	0.93
	C (T)	1.07	0.65	0.69	5.52	2.60	2.32
	T (C)	1.14	0.67	0.51	3.05	2.87	1.61

Table 6
Sugar content in Welsh onion yield depending on sowing date

Sowing date	Sugars (mg × 100g^{-1} f.m.)					
	total			reducing		
	2003	2004	mean	2003	2004	mean
10.04	3080.4	3061.2	3070.8	2193.3	2411.8	2302.6
25.04	3192.1	3643.5	3417.8	1793.5	2433.4	2113.5
10.05	2873.9	2491.0	2682.5	1758.7	1943.6	1851.2
Mean	3048.8	3065.2	3057.0	1915.2	2262.9	2089,0
LSD $_{=0.05}$	115.05	100.57	108.23	133.93	94.59	111.83

Table 7
Pyruvic acid content in Welsh onion yield depending on sowing date

Sowing date	Pyruvic acid (μmol × g^{-1} f.m.)		
	2003	2004	mean
10.04	7.75	7.00	7.37
25.04	9.90	8.15	9.02
10.05	10.37	6.25	8.31
Mean	9.34	7.13	8.23
LSD $_{=0.05}$	0.048	0.083	0.028

CONCLUSIONS

1. Sowing date significantly affected the yield of Welsh onion cv. 'Sprint'. The highest total and marketable yield were obtained when seeds were sown on 25th April.
2. An increase in sowing rates resulted in a significant increase in Welsh onion yield. The highest total and marketable yield were obtained at a sowing rate of 8 kg × ha^{-1}.
3. As far as row spacing is concerned, significantly higher total and marketable yield were obtained when plants were grown in rows 20 cm apart.
4. Dry matter content in Welsh onion yield depended significantly on the sowing date and the part of the plant. Plants obtained from seeds sown on 10th May had the highest dry matter content. Significantly more dry matter was estimated in Welsh onion pseudostems than in green shoots.
5. Higher L-ascorbic acid content was in Welsh onion leaves than in pseudostems.
6. Welsh onion obtained from the earliest sowing date contained significantly the highest amount of reducing sugars.
7. The highest content of pyruvic acid was found in Welsh onion obtained from seeds sown on 25th April.

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Wpływ wybranych czynników agrotechnicznych na wielkość plonu oraz wartość odżywczą cebuli siedmiolatki (*Allium fistulosum* L.) odmiany 'Sprint'

Streszczenie

W doświadczeniu badano wpływ trzech czynników: terminu siewu nasion (10 i 25. kwietnia oraz 10. maja), normy siewu nasion (4, 6 i 8 kg × ha^{-1}) oraz odległości między rzędami uprawianych roślin (20, 25 i 30 cm) na wielkość i jakość plonu cebuli siedmiolatki odmiany Sprint. Największy plon ogółem i plon handlowy uzyskano, gdy nasiona wysiewano 25. kwietnia. Wzrastające normy siewu nasion powodowały istotne zwiększenie plonu. Największy plon ogółem i plon handlowy zebrano przy zastosowaniu normy siewu wynoszącej 8 kg × ha^{-1}. Natomiast przy zastosowaniu różnej odległości między rzędami uprawianych roślin, istotnie większy plon ogółem i plon handlowy zebrano, gdy rośliny uprawiano w rzędach co 20 cm. Zawartość suchej masy w plonie siedmiolatki była istotnie zależna od terminu siewu nasion oraz części rośliny. Najwięcej suchej masy zawierały rośliny uprawiane z siewu 10. maja. Porównując z kolei badane części rośliny, istotnie więcej suchej masy oznaczono w cebulach niż w szczypiorze. Większą zawartość kwasu L-askorbinowego stwierdzono natomiast w szczypiorze. Siedmiolatka uprawiana z najwcześniejszego terminu siewu zawierała istotnie najwięcej cukrów redukujących. Największą zawartość kwasu pirogronowego stwierdzono w siedmiolatce uprawianej z siewu nasion 25. kwietnia.