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EFFECT OF SOWING RATE ON QUANTITY AND QUALITY OF YIELD OF SHALLOT CULTIVAR 'MATADOR F_1' GROWN IN THE CLIMATIC CONDITIONS OF WESTERN POMERANIA

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Abstract

In the years 2005-2007 in the Department of Vegetable Growing of Agricultural University in Szczecin the field experiment was carried out. The aim of the experiment was to estimate the effect of different sowing rates (6, 8, 10, 12 and 14 $kg \cdot ha^{-1}$) on the quantity and quality of the yield of shallot cultivar 'Matador F_1' grown in the climatic conditions of Western Pomeranian.
Seeds were sown in the first decade of April into rows at 20 cm distance.
The shallot was harvested in August. The yield was sorted into three classes depending on bulb diameter: <3, 3-4 and >4 cm. After the harvest, quality measurements of the following features were taken: mean weight and diameter of bulbs for each class, and content of dry matter. In dried plant material content total nitrogen, phosphorus, potassium, sodium, calcium, copper, iron and magnesium was determined.
Used in the experiment sowing rates have a significant effect on shallot yielding. Yield of bulbs of diameter <3 cm was the least from the least sowing rate (3.01 $t \cdot ha^{-1}$) and has increased – up to 10.32 $t \cdot ha^{-1}$, in a response to sowing rate increment. Yield of bulbs of 3-4 cm diameter has significantly increased in a response to sowing rate increment, while the yield of the biggest bulbs of diameter >4 cm was the highest when the least sowing rate was used – 15.90 $t \cdot ha^{-1}$ and the least when seeds were sown in amounts of 12 and 14 $kg \cdot ha^{-1}$. Total yield of shallot has significantly increased in a response to sowing rate increment.
There was no significant effect of sowing rate on the weight and diameteter of bulbs of each diameter found.
The obtained results were subjected to an analysis of variance. The means of three years were separated by Tukey's test at p=0.05.
Yield of shallot cv. 'Matador F_1' was characterized by a high content of dry matter, macro- and microelements.

Key words: shallot, sowing rate, yield, quality yield

INTRODUCTION

Onion, after tomato, takes the second place in the world vegetable production in the group of fifteen most important species. In our country onion is placed among six vegetable species which have of great economic importance [7]. Shallot (*Allium cepa* L. var. *ascalonicum*) is one of many *Allium* crops cultivated in our country. It produces aggregations of many small bulbs, which often have red-brown skins [4, 2, 3, 6]. Due to its mild taste shallot is perfect addition to salads, soups, sandwiches, sauces and meat dishes [9]. Shallots can be grown from seeds, but usually small bulbs are planted. The seeds of shallot hybrids are available for purchasing in Poland. It has resulted in increment of an area of its cultivation and also in increment of consumers intrest because of its quality features [12]. Growing shallot from seeds, it is recommended to use higher sowing rates in comparison with common onion cultivation. In the case of cultivar 'Creation F_1' recommended sowing rate amounts 12-17 kg·ha^{-1} [8].

The aim of the study was to estimate the effect of different sowing rates on the quantity and quality of the yield of shallot cultivar 'Matador F_1'.

MATERIAL AND METHODS

The experiment was conducted in the years 2005-2007 in the Department of Vegetable Growing of Agricultural University in Szczecin. The aim of the field experiment was to estimate the effect of different sowing rates on the quantity and quality of the yield of shallot cultivar 'Matador F_1' grown in the climatic conditions of Western Pomerania.

The following sowing rates were applied: 6, 8, 10, 12 and 14 kg·ha^{-1}. The experiment was set in one-factorial, randomized block design with four replications. Seeds were sown in the field in the first decade of April into rows at 20 cm distance. Mineral fertilization was quantified according to the results of the chemical analysis of the soil samples and supplemented to the level of 150 mg N-NO_3, 75 mg P_2O_5 and 175 mg K_2O per 1 dm^3. During the growing season, the crop management treatments were carried out. These included mainly weeding and irrigation. In order to protect the plants from fungal diseases, mainly from powdery mildew of onion (*Peronospora destructor* Casp.), they were sprayed with Bravo 500 SC (2.0 l·ha^{-1}), Ridomil MZ 72 WP (2.25 kg·ha^{-1}) and Gwarant 500 SC (2.0 l·ha^{-1}).

The shallot was harvested in August. The yield was sorted into three classes depending on bulb diameter: <3, 3-4 and >4 cm. Moreover, after the harvest, quality measurements of the following features were taken: mean weight and diameter of bulbs for each class, and content of dry matter (drying at 105°C to constant weight). In dried plant material, an analysis of the chemical composition was carried out. The following mineral elements were determined:

- total nitrogen with Kjeldahl's method,
- phosphorus with colorimetric method,
- potassium, sodium and calcium with flame photometry method,

- copper, iron and magnesium with flame spectrophotometry of atomic absorption method (ASA) [5].

The obtained results were subjected to an analysis of variance. The means of three years were separated by Tukey's test at p=0.05.

RESULTS AND DISCUSSION

Results of this study have shown that there is a significant influence of the sowing rate on the yielding of shallot (Table 1). In the first year of study the yield of the smallest shallot bulbs (with diameter <3 cm) was significantly higher when sowing rate amounted 14 kg·ha^{-1} – by 7.16 t·ha^{-1} in comparison with the least sowing rate. Also, in the second year of study higher yield of the mentioned size class bulbs was obtained when the highest sowing rate was used (11.16 t·ha^{-1}). However, it has differed significantly only in comparison with the least sowing rate (3.81 t·ha^{-1}). In the last year of experiment, yield of bulbs of diameter <3 cm was the least when sowing rates amounted 6 and 8 kg·ha^{-1}, and the highest – when sowing rates amounted 12 and 14 kg·ha^{-1}.

Average of three-year study results proved that yield of bulbs of diameter <3 cm was the least when the least sowing rate was used (3.01 t·ha^{-1}) and has increased in accordance with the increment of sowing rate – up to 10.32 t·ha^{-1} when sowing rate was 14 kg·ha^{-1}.

In the case of yield of bulbs of diameter 3-4 cm, in the first year, it was proved that it was the least (5.28 t·ha^{-1}) when the least sowing rate was used and the highest for the highest sowing rate. In 2006, there was no significant effect of sowing rate on the yield of analyzed size class noted. However, in the last year of the study it was significantly higher when the highest sowing rate was used (9.69 t·ha^{-1}).

On average for the study years it was proved that the yield of bulbs of diameter 3-4 cm has increased in accordance with the increment of sowing rate. The yield of the biggest bulbs (with diameter >4 cm) in the first two years of the study was the highest when the least sowing rates were used (23.52 and 13.26 t·ha^{-1}), and the least for the highest sowing rates (15.35 and 3.24 t·ha^{-1}). On the other hand, in the last year it was significantly higher when sowing rates amounted 6 and 8 kg·ha^{-1} in comparison with yield obtained from objects where sowing rates were 12 and 14 kg·ha^{-1}.On average for the study years, the highest yield of the biggest bulbs of diameter >4 cm was collected when the least sowing rate was used – 15.90 t·ha^{-1} and the least when sowing rates amounted 12 and 14 kg·ha^{-1} – respectively 8.27 and 8.31 t·ha^{-1}. Also, in the case of total yield of shallot, only in 2006 (second year of experiment), making difference to the rates of sowing had no significant effect on this quantity. On the base of three-year results in was proved that increase of sowing rate resulted in increasing total yield of shallot – the difference between yield obtained when the highest and the least sowing rates were used amounted on average 7.53 t·ha^{-1}.

The yield collected in this experiment was almost twice higher compared with the one obtained by Tendaj [13]. In opinion of Piusińska-Siedlecka & Tendaj [10] growing shallot from seeds does not have a positive effect on forming high number of lateral bulbs. Moreover, it is possible to collect big bulbs of diameter >35 mm

Table 1. The effect of sowing rate on the shallot yield

Sowing rate ($kg \cdot ha^{-1}$)	Yield ($t \cdot ha^{-1}$)															
	2005				2006				2007				2005-2007			
	1	2	3	total	1	2	3	total	1	2	3	total	1	2	3	total
6	1.06	5.28	23.52	29.86	3.81	5.9	13.26	22.97	4.15	4.08	10.92	19.15	3.01	5.09	15.9	24.0
8	2.07	9.95	19.79	31.81	6.71	7.89	10.65	25.25	5.85	5.15	11.81	22.81	4.87	7.66	14.08	26.61
10	3.37	12.03	22.81	38.21	6.2	12.65	8.86	27.71	7.98	5.94	9.29	23.21	5.85	10.21	13.64	29.70
12	4.37	14.99	11.83	31.19	9.59	9.23	5.92	24.74	10.53	5.55	7.06	23.14	8.16	9.92	8.27	26.35
14	8.22	19.97	15.35	43.54	11.16	9.05	3.24	23.45	11.58	9.69	6.35	27.62	10.32	12.9	8.31	31.53
$LSD_{\alpha=0.05}$	3.32	7.68	6.62	12.68	6.84	n.s.	4.95	n.s.	2.45	3.38	3.32	7.53	0.8	1.12	0.89	1.86

1 – bulbs of diameter < 3 cm; 2 – bulbs of diameter 3-4 cm; 3 – bulbs of diameter > 4 cm

Table 2. Quality characteristics of the shallot yield (mean for the years 2005-2007)

Sowing rate ($kg \cdot ha^{-1}$)	Single bulb weight (g)			Bulb diameter (cm)					
	bulbs of diameter (cm)			bulbs of diameter*			bulbs of diameter**		
	<3	3-4	> 4	<3	3-4	> 4	<3	3-4	> 4
6	10.78	25.07	81.66	2.51	3.42	5.63	2.62	3.62	6.57
8	9.32	22.37	66.07	2.43	3.56	5.08	2.56	3.68	6.09
10	9.45	23.56	80.40	2.43	3.36	5.33	2.65	3.59	6.09
12	11.01	24.02	73.58	2.40	3.46	5.31	2.54	3.72	5.80
14	9.54	26.58	71.98	2.46	3.56	5.81	2.63	3.89	7.05
Mean	**10.02**	**24.32**	**74.74**	**2.45**	**3.47**	**5.43**	**2.60**	**3.70**	**6.32**
$LSD_{\alpha=0.05}$	n.s.	n.s.	22.606	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

* - narrower diameter; ** - wider diameter

Table 3. Content of macro- and microelements in shallot yield

Year of investigations	Dry matter (%)	($g \cdot kg^{-1}$ d.m.)						$mg \cdot kg^{-1}$ (d.m.)	
		N	**P**	**K**	**Na**	**Ca**	**Mg**	**Fe**	**Cu**
2006	30.22	17.22	5.73	16.81	0.15	2.33	0.87	350.0	12.0
2007	27.82	13.30	5.10	14.32	0.17	3.20	1.03	500.0	11.0
Mean	**29.02**	**15.26**	**5.41**	**15.56**	**0.16**	**2.76**	**0.95**	**425,0**	**11.5**

only by growing shallots from seeds. The present studies showed that the highest yield of bulbs of diameter >4 cm (best for consumption) was obtained when sowing rates were lower. The least yield with the highest share of bulbs of diameter < 3 cm was noted when seeds were sown in amount of 14 kg·ha^{-1}. According to Tendaj [13], in Poland shallot should be grown from sets. This opinion is not in agreement with the results of present study. The yield of shallot bulbs grown from seeds was high and amounted on average 27.56 t·ha^{-1}. Also the results of studies carried out by Rabinowitch & Kamenetsky [11] confirmed that in Israel F_1 hybrids gave yield means of 30-50 t·ha^{-1}. High yields of shallot grown from seeds were also obtained in Belgium [15, 16, 17] and Ethiopia [1].

Used in the experiment sowing rates had no significant effect on the quality features of bulbs of each diameter (Table 2). Only in the case of bulbs of diameter >4 cm, significantly lower bulb weight was noted when sowing rate amounted 10 kg·ha^{-1}, however just in comparison with bulb weight assessed when the sowing rate was 8 kg·ha^{-1}. The single bulb weight obtained in present study was higher compared to data gave by Tendaj & Piusińska-Siedlecka [14], for local populations of shallot propagated vegetatively.

The yield of shallot bulb was characterized by a high content of dry matter, macro- and microelements (Table 3). Similar results for shallot grown for bunching harvest were shown by Orłowski et al. [9], Those authors have noted also that the type of cover had no significant effect on the content of mineral compounds in the shallot yield.

CONCLUSIONS

1. Sowing rate has a significant effect on shallot yielding
   - yield of bulbs of diameter <3 cm was the least from the least sowing rate (3.01 t·ha^{-1}) and has increased – up to 10.32 t·ha^{-1}, in a response to sowing rate increment,
   - yield of bulbs of 3-4 cm diameter has significantly increased in a responce to sowing rate increment,
   - yield of the biggest bulbs of diameter >4 cm was the highest when the least sowing rate was used – 15.90 t·ha^{-1} and the least when seeds were sown in amounts of 12 and 14 kg·ha^{-1},
   - total yield of shallot has significantly increased in a responce to sowing rate increment.
2. There was no significant effect of sowing rate on the weight and diameteter of bulbs of each diameter found.
3. Yield of shallot cv. 'Matador F_1' was characterized by a high content of dry matter, macro- and microelements.

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