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EFFECT OF A SOWING DATE ON THE QUANTITY AND QUALITY OF THE YIELD OF TARRAGON (*ARTEMISIA DRACUNCULUS* L.) GROWN FOR A BUNCH HARVEST

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Abstract

The aim of the study was to estimate the influence of a sowing date (10 April, 25 April and 10 May) on the quantity and quality of the yield of tarragon grown for a bunch harvest. The yields of tarragon plants were assayed in 2004-2006. Chemical analyses were made in the years 2004 and 2005. In the dry plant material, the content of macro- and microelements: total nitrogen, phosphorus, potassium, calcium, sodium, magnesium, manganese, zinc, iron and copper was assessed. Moreover, the content of essential oils in dry plant material was estimated. In the raw plant material, the content of L-ascorbic acid and the scavenging effect on DPPH radical were measured. It was proved that the sowing dates had a significant effect on the yield quantity. Significantly higher yield (424.5 kg·100 m^{-2}) was obtained when seeds were sown on 10 May. The yield significantly decreased when seeds were sown on 10 April. The test sowing dates had no significant effect on the biometrical characteristics of tarragon plants during the harvest; only the leaves were significantly wider when the earliest sowing date was used. The yields were characterized by a high content of mineral compounds. However, the content of iron was twice as high in 2004 as in 2005. Also, the content of zinc and copper was higher in the first year of the study, respectively by 87.2% and 76.9%, compared with the yield obtained in the year 2005. The content of essential oils (mean for years of the study) was 0.59%, that of L-ascorbic acid was 10.08 mg·100 g^{-1} f.m. and the scavenging effect of tarragon herb on DPPH-radical was 26.74%.

Key words: tarragon, yield, macro- and microelements content, essential oil, L-ascorbic acid, DPPH percent inhibition.

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WPŁYW TERMINU SIEWU NASION NA WIELKOŚĆ I JAKOŚĆ PLONU BYLICY ESTRAGONU (*ARTEMISIA DRACUNCULUS* L.) UPRAWIANEJ NA ZBIÓR PĘCZKOWY

Abstrakt

W latach 2004–2006 badano wpływ terminu siewu nasion (10 i 25 kwietnia oraz 10 maja) na wielkość i jakość plonu bylicy estragonu, uprawianej na zbiór pęczkowy. W części laboratoryjnej badań (2004 i 2005), w próbie zbiorczej – ze wszystkich zbiorów i terminów uprawy – oceniono zawartość makro- i mikroskładników: azotu ogólnego, fosforu, potasu, wapnia, magnezu i sodu oraz cynku, manganu, żelaza i miedzi. Zawartość olejku eterycznego oznaczono w powietrznie suchym zielu metodą destylacji próbki surowca z wodą. W świeżej masie ziela wykonano oznaczenie zawartości kwasu L-askorbinowego oraz aktywność zmiatania rodników DPPH.

Wykazano, iż badane terminy siewu wpłynęły istotnie na wielkość plonu ziela estragonu. Istotnie największy plon (424,5 kg·100 m^{-2}) otrzymano z wysiewu w najpóźniejszym terminie (10 maja). Plon ten istotnie zmniejszał się wraz z przyspieszaniem terminu siewu, tj. do ok. 10 kwietnia. Terminy siewu nie miały istotnego wpływu na parametry biometryczne roślin w czasie ich zbioru, jedynie szerokość liści była istotnie większa w przypadku najwcześniejszego terminu uprawy.

W uzyskanym plonie estragonu stwierdzono wysoką zawartość składników mineralnych, zbliżoną w poszczególnych latach badań. Największe różnice wystąpiły w zawartości żelaza, którego w roślinach w 2004 r. było ponad dwukrotnie więcej niż w kolejnym roku badań. Również w tym roku odnotowano w estragonie znacznie wyższą zawartość cynku (o 87,2%) i miedzi (o 76,9%) w porównaniu z zebranym w 2005 roku.

Zawartość olejku eterycznego (średnio w latach badań) wyniosła 0,59%, kwasu L-askorbinowego 10,08 mg·100 g^{-1} ś.m.), a zdolność redukcji rodników DPPH kształtowała się na poziomie 26,74%.

Słowa kluczowe: bylica estragon, plon, makro- i mikroskładniki, olejek eteryczny, kwas L-askorbinowy, procent inhibicji DPPH.

INTRODUCTION

Tarragon (*Artemisia dracunculus* L.) is a perennial herb with slender, branched stems. It grows up to 150 cm and has narrow, dark green leaves (SZCZYGLEWSKA 2002). Tarragon is native to a wide area of steppes and wharves along the rivers of Ukraine, Caucasus and moderate climatic zones of Asia and North America. In Poland, tarragon grows only in the culture. The aroma of tarragon is produced by essential oils in the herb's leaves. The content of these essential oils is about 0.8%. Apart from essential oils, tarragon herb contains tannins, bitter principles, vitamins and minerals.

Fresh tarragon leaves have a very strong flavour and aroma. They preserve well the taste and aroma whether they are frozen or used to flavour oil and vinegar (JADCZAK, GRZESZCZUK 2005).

The aim of our experiment was to estimate the effect of a date of sowing seeds on the quantity and quality of tarragon yield.

MATERIAL AND METHODS

The experiment was carried out in 2004-2006 at the Department of Vegetable Crops of the Agricultural University in Szczecin. The aim of this study was to estimate the effect of a sowing date on the quantity and quality of the yield of tarragon grown for a bunch harvest.

Three dates of sowing were examined: 10 April, 25 April and 10 May. Sowing ration was 10 kg·ha^{-1}. The experiment was established in randomized blocks with four replications. The field was prepared according to agronomic recommendations for this species. Mineral fertilization was quantified according to the results of chemical analysis of the soil. During the growing season, the crop management treatments were carried out. These included mainly irrigation, weeding and soil cultivation.

The tarragon plants were harvested when they reached the height of about 40 cm and their shots were not lignified. The yield was harvested four times. The plant shots were cut 5-10 cm above the soil surface. After the harvest, the quantity of the yield was assessed. Moreover, measurements of the following morphological features were taken: shots length, bunch mass, leaf mass in the bunch (10 shots), length and width of leaf blade, and the participation of leaf mass in the herb mass. Also, the content of dry matter was determined in the yield of each harvest.

In the years 2004 and 2005 the laboratory part of the experiment was conducted. It was based on a representative sample consisting of the samples of all sowing dates. Total nitrogen was determined according to Kjeldahl's method, phosphorus by colorimetric method, potassium, calcium and sodium by flame photometry and copper, zinc, manganese, iron and magnesium using the method of atomic absorption spectrophotometry (AAS) (KREŁOWSKA-KUŁAS 1993). The essential oils content was determined in aerially dried herb with the use of distillation of the sample mixed with water in Deryng's apparatus. In the raw herb, L-ascorbic acid was assessed by the method of Tillmans. The scavenging effect of fresh tarragon herb on DPPH--radical was determined according to the method of YEN I CHEN (1995). The results were statistically evaluated by the analysis of variance. Significance of the differences was tested by Tukey's test at p=0.05.

RESULTS AND DISCUSSION

Results of tarragon yielding (total yield) are presented in Table 1. Statistical analysis showed a significant effect of the sowing dates on the quantity of the yield. In the years 2004 and 2005 the highest yield (311.9 and 572.5 kg 100 m^{-2} respectively) was obtained from the last sowing date, while the smallest one (150.0 and 305.0 kg·100 m^{-2} respectively) appeared

Table 1

The yield quantity of tarragon grown for a bunch harvest

Sowing date	Yield (kg 100 m^{-2})			
	2004	2005	2006	2004–2006
10 IV	150.0	305.0	476.6	310.5
25 IV	288.5	367.2	375.9	343.9
10 V	311.9	572.5	389.0	424.5
Mean	250.1	414.9	413.8	359.6
LSD α=0.05	19.41	30.9	67.5	19.12

when tarragon seeds were sown on 10 April. In the last year of the study, the yield obtained as a result of sowing on 10 April was significantly higher (476.6 kg·100 m^{-2}) than the yields obtained from the next two dates of sowing.

The mean results obtained from all of the years of the study proved that, similarly to the first two years of the experiment, significantly lower yield occurred for the sowing date of 10 April (310.5 kg·100 m^{-2}) and that it was increasing when the sowing date was postponed. When tarragon seeds were sown on 25 April, the yield was 343.9 kg·100 m^{-2} and when they were sown on 10 May it rose to 424.5 kg·100 m^{-2}. JADCZAK (2007) also proved a significant effect of a sowing date on the yield of savory grown for a bunch harvest. In this case, the highest yield was obtained when seeds were sown on 25 April. Whereas in the study concerning basil grown for a bunch harvest, it was found that the date of sowing had no significant effect on the quantity of the marketable yield of the herb (JADCZAK 2007).

Independently of the dates of sowing, the mean yield obtained in the first year of the study was 39.7% lower than the yield obtained in 2005 and 39.6% lower than the yield in 2006.

The sowing dates used in the experiment had no significant influence on the biometrical characteristics of tarragon plants (Table 2). Only the leaf blade was significantly wider (1.15 cm) when the date of sowing was the earliest, but the difference was significant only versus 10 May. In Poland, herbs are usually available as a dried product. In general, the value of dried herbs is much lower than fresh one (JADCZAK, GRZESZCZUK 2005). It is so because essential oils occur on the leaf surface. Another reason is that there are changes in the content of vitamins, mineral compounds, enzymes, colors and other biologically active compounds when herbs are dried. One of the main factors which determine the quality of raw material is the percentage leaf mass in the total herb mass (JADCZAK, GRZESZCZUK 2006). SUCHORSKA-ORŁOWSKA et al. (2006) found significantly higher amounts of microelements in spice herbs than in their shots. In this study, the contribution of leaf mass in the herb mass was on average 68.6%.

Table 2

Biometrical characteristics of harvested tarragon plants grown for a bunch harvest (mean for the years 2004-2006)

Sowing date	Shots lenght (cm)	Leaf length (cm)	Leaf width (cm)	Bunch mass (10 shots) (g)	Leaf mass (10 shots) (g)	Participation of leaf mass in the herb mass (%)
10 IV	43.0	8.93	1.15	130.7	89.6	68.5
25 IV	45.9	7.93	0.93	122.6	84.0	68.5
10 V	45.1	7.30	0.70	123.8	85.3	68.9
Mean	44.7	8.05	0.93	125.7	86.3	68.6
LSD α=0.05	n.s.	n.s.	0.38	n.s.	n.s.	–

n.s. – non-significant differences

Macro- and microelements level in the yield of tarragon were similar in all the years of the research (Table 3). The highest differences were found in the iron content: in 2004 it was two-fold higher than in the next year of the research. Moreover, in the same year the content of zinc was 87.2% higher and that of copper 76.9% higher than in 2005. The amounts of microelements determined in the experiment were close to the data given by SUCHORSKA-ORŁOWSKA et al. (2006).

Table 3

Content of dry matter, macro- and microelements in the yield of tarragon

Years of the study	Dry matter (%)	Content of macroelements ($g \cdot kg^{-1}$ d.m.)						Content of microelements ($mg \cdot kg^{-1}$ d.m.)			
		N	P	K	Mg	Ca	Na	Mn	Zn	Fe	Cu
2004	14.90	23.0	4.4	37.0	1.4	9.0	0.3	22.0	74.5	212.8	18.4
2005	15.96	36.0	4.3	48.1	1.5	14.3	0.5	21.6	39.8	99.2	10.4
Mean	15.43	29.5	4.35	42.55	1.45	11.65	0.4	21.8	57.15	156.0	14.4

In the tarragon yield, the content of essential oils was on average 0.59% and the content of L-ascorbic acid reached 10.08 $mg \cdot 100\ g^{-1}$ f.m. The scavenging effect of tarragon on DPPH-radical was 26.74% as an average of the three years (Table 4).

Table 4

The content of essential oils, L-ascorbic acid and scavenging effect on the DPPH radical in the yield of tarragon

Years of the study	Content of		Scavenging effect on DPPH radical (% DPPH)*
	essential oils (%)	L-ascorbic acid (mg · 100 g^{-1} f.m.)	
2004	0.56	9.60	17.30
2005	0.62	10.56	36.19
Mean	0.59	10.08	26.74

* 400 times dilution in 70% methanol

CONCLUSIONS

1. The sowing dates had a significant effect on the yield quantity of tarragon. Significantly higher yield was obtained when seeds were sown on 10 May. The yield of tarragon significantly decreased along with accelerating of the sowing date up to 10 April.

2. There was no significant effect of a sowing date on the biometrical characteristics of tarragon plants. Only the leaves were significantly wider following the earliest sowing date.

3. Tarragon herb is characterized by a high content of mineral compounds. Their level was similar in all the years of the study, except iron, zinc and copper. The amounts of these compounds were higher in the first year of the analyses.

4. The content of essential oils in tarragon herb was on average 0.59%, that of L-ascorbic acid was 10.08 mg 100 g^{-1} f.m. and the average scavenging effect on DPPH-radical was 26.74%.

REFERENCES

JADCZAK D. 2007. *Effect of sowing date on the quantity and quality of the yield of summer svory (Satureya hortensis L.) grown for bunch harvest*. Herba Pol., 53 (3): 22-27.

JADCZAK D. 2007. *Wpływ terminu siewu i odległości rzędów na plonowanie bazylii pospolitej (Ocimum basilicum L.)*. Rocz. AR Poznań, 383 (41): 505-509.

JADCZAK D., GRZESZCZUK M. 2005. *Cząber ogrodowy*. Panacea, 3(12):18-20.

JADCZAK D., GRZESZCZUK M. 2006. *Zbiór i konserwacja ziół*. Panacea, 4 (17): 28-31.

KREŁOWSKA-KUŁAS M. 1993. *Badania jakości produktów spożywczych*. PWE, Warszawa.

SUCHORSKA-ORŁOWSKA, J. JADCZAK D., BRZOSTOWSKA-ŻELECHOWSKA D. 2006. *Zawartość niektórych mikroelementów w wybranych gatunkach ziół*. Fol. Hort., 2: 174-180.

SZCZYGLEWSKA D. 2002. *Rośliny zielarskie w apteczce domowej i w kuchni*. Wiad. Zielar., 2: 12.

YEN G.C., CHEN H.Y. 1995. *Antioxidant activity of various tea extracts in relation to their antimutagenicitu.* J. Agric. Food Chem., 43: 27-32.