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INFLUENCE OF ROW SPACING ON HERB YIELD OF COMMON CHAMOMILE (*Chamomilla recutita* (L.) Rausch.) AS WELL AS SEED YIELD AND QUALITY

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Abstract

The experiment consisted of three single row spacings (every 25, 40 and 50 cm) and four double and triple row spacings (40-25-40 cm, 40-25-25-40 cm, 50-25-50 cm, 50-25-25-50 cm). The aim of the present experiment was to compare the influence of varying spacing on yields and quality of chamomile seeds. Among the row spacings under comparison, the highest seed and herb yields were achieved from the triple row spacing. 1000-seed weight was proportional to seed yield, and the seed germination capacity was not differentiated due to row spacings used. Plants growing in single rows every 25 cm formed the lowest number of branches terminated by flower heads, thus the herb and seed yields were the lowest.

Key words: chamomile, row spacing, triple spacing, double spacing, seeds, herbs, 1000-seed weight, germination capacity

INTRODUCTION

Common chamomile (*Chamomilla recutita* (L.) Rausch.), family Asteraceae, is a native of southern and eastern Europe. Today, however, this species has spread throughout most of the European continent and can be observed in North Africa, Asia, North and South America as well as Australia (Pourohit and Vyas, 2004). The plant has considerable ecological amplitude and can adapt to less than optimum climatic and soil conditions (Nirr, 2002). Chamomile is the oldest and the most common medicinal plant. It was highly prized by the ancient Greeks and is still popular today. Flower heads collected at full bloom stage are herbal materials. In phytotherapy, mainly flower anthodia (*Flos chamomilae*) are used. The chamomile drug is included in the pharamacopoeia of 26 countries. Chamomile underlies commercially produced medicinal preparations and a variety of cosmetic preparations (Kordana et al. 1996; Kołodziej, 2010). This chamomile drug has anti-inflammatory, antiseptic, stimulative, carminative, spasmolytic and sedative activity. The medicinal attributes of the chamomile drug are due to the specific constituents of essential oil, including (-) bisabolol, chamazulene and farnesene (Franke and Schilcher, 2007; Sazegar et al. 2010; Srivastava et al. 2010). Extracts of the plant are added to a variety of cosmetic preparations such as creams, soaps, skin lotions, bath preparations, and hair conditioners (Botcher et al. 2001). The chamomile herb (*Herba chamomillae*) also contains essential oils and, after processing, flowers remain which are also used as high-quality feed for animals (Gorecki, 2001).

Due to its both medicinal and industrial importance, chamomile is mass-produced in many countries, including Poland (Kordana et al. 1996; Kołodziej, 2010).

The high demand for raw material and seeding material due to the medicinal value of chamomile made the author to undertake a study on modifications of up-to-date agricultural practices in growing this plant species which can have positive effects on yields.

Among agrotechnical factors, an appropriate spacing ensuring optimum conditions for plant growth and development is an important yield-forming element (Załęcki, 1972; Jamshidi, 2000).

The aim of the present experiment was to compare the influence of varying spacing on yields and quality of chamomile seeds.

MATERIALS AND METHODS

The field experiment was carried out in 2001-2003 in Ostrów Lubelski on sand-loamy soil developed

from strong loamy sands. This type of soil is characterized by high contents of available phosphorus and potassium forms, neutral acidity; moreover, it is well--aerated, permeable, and can be quickly warmed up (Table 1). White mustard cultivated for green forage was chamomile's (*Chamomilla recutita)* forecrop. Uniform mineral fertilization was applied every year (kg×ha^{-1}): N – 50, P – 26 and K – 67. The experiment was set up as a complete randomized design in four replications, taking into account the following spacings: single rows every 40 cm (control), single rows every 50 cm, single rows every 25 cm, double rows every 25 cm by turns with 40 cm spacing (40-25-40), triple rows every 25 cm by turns with 40 cm spacing (40-25-25-40), double rows every 25 cm by turns with 50 cm spacing (50-25-50), and triple rows every 25 cm by turns with 50 cm spacing (50-25-25-50). Seeds of 'Złoty Łan' (2.5 kg×ha^{-1}) were sown in the middle of April in 27.5 m^2 area plots. The final plant height and number of branches terminated by flower heads were determined using 10 randomly selected chamomile plants from each plot prior to harvest of herbs with inflorescences grown for seeds. The herb harvest was done when the plantation turned yellow, which resulted from tubular flowers and flower heads that had become crumbled, thus about 15 days after the start of flowering.

Herbs together with inflorescences were cut using a cutter just at the stem base, and then their fresh matter was weighed. After drying at 35°C, the air-dry herb weight was determined. The herb was threshed and seeds were separated from other fractions using sieves of 3, 1, 0.8, and 0.4 mm mesh, and then their yields were assessed. The qualitative evaluation of seeds consisted in determining 1000-seed weight and germination capacity.

The results were statistically processed using Tukey's test at the 5% error level.

RESULTS AND DISCUSSION

There are few agrotechnological literature references on common chamomile cultivation applying twin row spacing. Instead, 40 cm spaces between plant rows are recommended (Załęcki, 1972; Kordana et al. 1996; Jamshidi, 2000).

Spacing applied in the present experiment significantly influenced chamomile traits. Plants growing in single rows every 25 cm were the highest, while those growing in the single row spacing every 50 cm the shortest. Plants growing in the triple row spacing were characterized by the highest number of branches terminated by flower heads. Their lowest number was produced by plants in single row spacing every 25 cm (Table 2). The obtained results are consistent with those of Gruszczyk (2001) who found that St. John's wort cultivation in twin row spacing positively affected the number of branches. Twin row spacing had a significant influence on chamomile yield. Among the compared spacing types, the highest fresh and dry herb yield was obtained from triple row spacing, the lowest one – from single row spacing every 25 cm (Table 2). Such results were confirmed by other authors (Kołodziej and Zejdan, 2000; Gruszczyk, 2001; Sugier, 2004) who found that St. John's wort, fenugreek and dandelion cultivation in double row spacing gave higher raw material yields than in single row spacing. The fresh to dry weight ratio for the herb – from diverse spacings – reached similar values: 4.5-4.6. The spacing applied in the experiment significantly modified seed yields. Chamomile plants grown in twin row spacing were higher and had more branches terminated by flower heads, which affected the increase in herb and seed yield.

The highest seed yields were achieved in triple row spacing (higher by 24% as compared to the control spacing), while the lowest ones in single row spacing every 25 cm (lower by 8% in comparison to the control). When comparing the yields from the treatments where single rows every 40 and 50 cm were used, no significant differences were found; however, the increasing tendency in single row spacing of 50 cm was prominent (Table 3). Gajzlerowicz (1971) reported that 0.26 t×ha^{-1} seed yield could be achieved under Polish conditions, whereas Czabajska et al. (1978) indicated that it could oscillate from 0.16 up to 0.39 t×ha^{-1}. Kołodziej (2010) claimed that seed yields of chamomile grown at 40 cm row spacing amounted to 0.30 t×ha^{-1}. Seidler-Łożykowska (2000) found that it could be even higher up to 0.41 t x ha^{-1}. In my own experiment, seed yields from this spacing changed within the above range, amounting to 0.25 t×ha^{-1}. The results of the present study were confirmed by the experiments of Gruszczyk (2000) who proved that twin row spacing caused an increase in St. John's wort seed yields by 17% on average in relation to single spacing.

Diverse row spacing applied in the present experiment had no crucial impact on seed germination capacity. The values of this trait were similar and amounted to 86-90%, which was confirmed by Gruszczyk (2000) who reported that St. John's wort cultivation in twin row spacing had no effects on seed germination capacity, either.

1000-seed weight for chamomile at spacings applied in the experiment oscillated within the range of 0.100-0.107 g, although the highest value of this trait was recorded from triple row spacing 50-25-25-50 cm, while the lowest one in single row spacing every 25 cm (Table 3).

Table 1
Contents of macroelements and microelements in the soil

pH in 1m KCl	Macroelements mg×kg^{-1} soil			Microelements mg×kg^{-1} soil				
	P	K	Mg	B	Cu	Mn	Zn	Fe
6.7	141.0	154.0	51.0	0.36	2.7	276.0	11.8	915.0

Table 2
Influence of row spacing on some plant traits and herb yield of common chamomile (mean values for 2001-2003).

Row spacing (cm)	Plant height (cm)	Number of branches terminated by flower heads (per plant)	Fresh herb yield (t×ha^{-1})	Air-dry herb yield (t×ha^{-1})	Fresh to dry weight ratio
40	58.7	10.1	14.5	3.2	4.5
50	57.8	10.5	14.7	3.3	4.5
25	65.2	8.6	12.0	2.6	4.6
40-25-40	60.7	11.8	17.0	3.8	4.5
40-25-25-40	63.7	13.5	17.6	3.8	4.6
50-25-50	60.6	12.4	16.7	3.6	4.6
50-25-25-50	62.8	14.1	18.2	4.0	4.6
Mean	61.4	11.6	15.8	3.5	4.6
$LSD_{0.05}$	2.01	1.23	1.25	0.27	-

Table 3
Yield of seeds and their qualitative evaluation (mean values for 2001-2003)

Row spacing (cm)	Seed yields (t×ha^{-1})	1000-seed weight (g)	Germination capacity (%)
40	0.25	0.103	88
50	0.26	0.103	88
25	0.23	0.100	86
40-25-40	0.29	0.104	90
40-25-25-40	0.31	0.106	90
50-25-50	0.30	0.106	89
50-25-25-50	0.31	0.107	90
Mean	0.28	0.104	90
$LSD_{0.05}$	0.02	0.005	r.n.

CONCLUSIONS

Among the types of row spacing compared, the most beneficial was triple row spacing (40-25-25 -40 cm, 50-25-25-50 cm). Herb and seed yields obtained from that spacing were the highest. 1000-seed weight was proportional to seed yield, and the seed germination capacity was not differentiated due to row spacings used.

Single row spacing every 25 cm appeared to be the least beneficial. Plants produced from it formed the lowest number of branches terminated by flower heads, thus herb and seed yields were the lowest.

It is recommended to cultivate chamomile at triple row spacing.

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Wpływ rozstawy rzędów na plon ziela rumianku pospolitego [*Chamomilla recutita* (L.) Rausch.] oraz plon i jakość nasion

Streszczenie

W doświadczeniu polowym zastosowano trzy rozstawy rzędów rozmieszczonych pojedynczo (co 25, 40, 50 cm) oraz cztery rozstawy w pasowym układzie rzędów podwójnych i potrójnych (40-25-40 cm, 40-25-25-40 cm, 50-25-50 cm, 50-25-25-50 cm). Celem przeprowadzonego doświadczenia było porównanie wpływu zróżnicowanej rozstawy rzędów na plonowanie oraz jakość nasion rumianku pospolitego. Spośród zastosowanych rozstaw rzędów najwyższy plon nasion oraz ziela otrzymano z rozstaw pasowych potrójnych. Masa tysiąca nasion była proporcjonalna do plonu nasion, zaś zdolność kiełkowania nie różniła się w zależności od zastosowanych rozstaw rzędów. Rośliny rosnące w rozstawie co 25 cm tworzyły najmniej rozgałęzień zakończonych koszyczkami, a w związku z tym uzyskany z tej rozstawy plon ziela i nasion był najniższy.