RESEARCHES REGARDING THE INFLUENCE OF THE NUTRITION SPACE AT *DRACOCEPHALUM MOLDAVICA* L. (DRAGONHEAD) SPECIES CULTIVATED UNDER THE CONDITIONS OF A.R.D.S. SECUIENI

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Abstract: The present paper presents the results on the influence of the nutrition space at *Dracocephalum moldavica* L., cultivated under the conditions of A.R.D.S. Secuieni between 2016 and 2017. Following the interaction of the factors, the distance between the rows and the distance between the plants per row was found that in the variant sown at 70 cm between the rows and 15 cm between the plants per row there was an increase in the average number of branches (2,27). The variants sown at 50 cm and 70 cm between the rows achieved deficit production, very significant compared to the control sowing at the 25 cm between the rows.

Keywords: melliferous plant, nutrition space, dragonhead

1. INTRODUCTION

Dragonhead (*Dracocephalum moldavica* L.) is an annual aromatic plant belonging to family of *Lamiaceae* [1]. The origin of this plant is reported from southern Siberia and the Himalaya and naturally grows in temperate Zones of Europe and Asia [2, 3].

It is used to relieve headaches, abdominal pain, nervous system disorders, kidney pain, gastrointestinal pain and teeth [4]. Environmental factors have a major impact on the yield and active principles of medicinal and aromatic species. However, it is not possible to control these factors, but the potential productive of this species can be improved by improving technology cultivation [5, 6].

The researches were carried between 2016 and 2017 at A.R.D.S. Secuieni and aimed establish the optimal nutritional space for the species *Dracocephalum moldavica* L. in order to develop the technology cultivation.

2. MATERIAL AND METHOD

The researches were carried between 2016 and 2017 at A.R.D.S. Secuieni on a typical cambic soil type . Characterized as being well supplied with mobile phosphorus (39 ppm - P_2O_5), moderately supplied in nitrogen with the soil nitrogen index of 2.1, well supplied in mobile potassium (161 ppm - K_2O), slightly acidic, with the pH (in aqueous suspension) of 6.29 and a humus content of 2.3 %. At *Dracocephalum moldavica* (L.) species, the aim was to establish a technological link through the establishment of the optimal nutritional space in a bifactorial experience according to the subdivided parcel method in three repetitions.

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Experienced factors are: A - the distance between rows with graduations: 25 cm, 50 cm and 70 cm and B - the distance between plants per row with graduations: continuous row, 15 cm and 25 cm.

The soil work and the preparation of the germination bed consisted in releasing the soil from the plant debris in the pre-planting, stubble-turning and plowing at a depth of 30 cm. In spring, preparation of the germination bed was made with a harrow disc and the sowing was done manually at a depth of 2 cm. During the vegetation period at species *Dracocephalum moldavica* L., the observations and determinations were made which consisted in determining the average plant height, the average number of branches / plants, the average weight of the stem, the average weight of the leaves, the average weight of the flowers, the average weight of the plant. For the production of fresh herbs the plants were harvested manually until full blossom by cutting plants at a height of 5 cm from the ground. Seed harvesting was done by cutting plants with mowing, followed by barking. The seed obtained was conditioned by the small seed selector.

For the entire growing season of the dragonhead, the deviation from the multiannual average of temperatures varied between 0.7 ° C (2017) and 3.3 ° C (2016). From the temperatures point of view, the vegetation period of *Dracocephalum moldavica* L. in the experimental year compared to the multiannual average was characterized as very warm in 2016 and normal in 2017 (Table 1).

Table 1. Temperatures recorded at A.R.D.S. Secuieni meteorological station.

Average tempera-ture **°C**	Months									Average vegetation period	Deviation	Vegetation period charact.
	Jan	Febr	Mar	Apr	May	Jun	Jul	Aug	Sept			
2016	-3.0	4.2	5.7	13.5	14.9	20.3	31.7	20.6	17.3	19.7	3.3	Very warm
2017	-5.7	-1.8	7.0	9.1	15.4	20.3	20.4	21.2	16.3	17.1	0.7	norm.
Multiannual average	-3.8	-2.3	2.6	9.4	15.4	18.8	20.3	19.5	14.8	16.4	-	-

In terms of rainfall, the deviation from the multiannual rainfall ranged between 5.5% (2016) and - 18.9% (2017), 2016 being a normal one and 2017 less drastic (Table 2).

Table 2. Rainfall recorded at A.R.D.S. Secuieni meteorological station.

Rainfall (mm)	Months									Sum for the vegetation period	Deviation	Vegetation period charact.
	Jan	Febr	Mar	Apr	May	Jun	Jul	Aug	Sept			
2016	12.0	14.2	29.4	42.0	120.2	161.0	4.0	32.0	48.6	407.8	5.5	norm
2017	7.3	17.0	101.6	54.4	59.4	49.4	72.2	23.0	55.2	313.6	-18.9	less dry
Multiannual average	20.5	19.6	25.4	46.8	64.8	84.3	84.0	61.4	45.4	386.7	-	-

3. RESULTS AND DISCUSSION

The average height of the plant was between 79.19 cm and 85.99 cm. The variant sown at the distance of 25 cm between the rows and 15 cm between the plants per row (a1xb2), the difference from the control variant was negative, very significant (4.64 cm). A negative distinct difference was recorded at variant sown at 50 cm between rows and in continuous row (2.44 cm) compared to a1xb1 control (at 25 cm between consecutive row rows). Positive, distinctly significant differences were obtained at seed sowing at 25 cm between rows and 25 cm between plants per row (3.48 cm) (Table 3).

Due to the interaction of the factors, the distance between the rows and the distance between plants per row was found that in the variant sown at 70 cm between the rows and 15 cm between the plants per row there was an increase in the average number of branches, the difference from the control (14.93) being positive, distinctly significant (2.27) are presented in Table 4.

Regarding the average weight of the stem, the highest value was recorded at the interaction of a2xb3 (136.53 g) and the lowest at the interaction of a1xb2 (36.26 g). In *Dracocephalum moldavica* L. the average weight of the stem recorded positive, distinctly significant differences compared to the control at a1xb1 (43.79 g) at the interactions between a1xb3 (56.85 g - sown at 25 cm between rows and 25 cm between plants per row) and a2xb3 (66.96g - sown at 50 cm between rows and 25 cm between plants per row). Positive, very significant positive differences from the control were obtained in the a3xb2 interactions (80.84 g - sown at 70 cm between the rows and 15 cm between the plants per row) and a3xb3 (92.74 g - sown at 70 cm between the rows and 25 cm between plants per row) (Table 5).

The results obtained on the interaction of the studied factors showed that the average leaf weight of the species *Dracocephalum moldavica* L. recorded positive, very significant differences , at the interactions a3xb2 (106.65 g - sown at 70 cm between the rows and 15 cm between the plants per row) and a3xb3 (118.88 g - sown at 70 cm between the rows and 25 cm between the plants per row) compared to the control variant (54.17 g) (Table 6).

Interactions between a1xb3 (7.25 g - sown at 25 cm between the rows and 25 cm between the plants per row) and a2xb3 (10.56 g - sown at 50 cm between the rows and 25 cm between plants per line) influenced the mean weight of flowers compared to the a1xb1 (7.06 g), the difference being positive, distinctly significant. Positive, very significant differences were recorded in the a3xb2 interactions (11.73 g - sown at 70 cm between rows and 15 cm between plants per row) and a3xb3 (21.63 g - sown at 70 cm between rows and 25 cm between plants per row) compared to control a1xb1 (7.06 g) (Table 7).

The average plant weight in Dracocephalum moldavica L. was evidenced by distinct positive differences compared to a1xb1 interactions (104.40 g) between a1xb3 (145.31 g at 25 cm between rows and 25 cm of plants per row) and a2xb3 (181.92 g - 50 cm between rows and 25 cm between plants per line). Very significant positive differences were observed in the a3xb2 interactions (199.85 g - 70 cm between the rows and 15 cm between the plants per row) and a3xb3 (233.88 g - at 70 cm between the rows and 25 cm between the plants in a row) (Table 8).

Analyzing the interaction of the studied factors on the average production of fresh herb it was found that in variants sown at distances of 50 cm and 70 cm between rows the production were negative, very significant differences compared to the control sowing at 25 cm between the rows and in continuous row (Table 9).

The average seed yields were fluctuating and varied according to the distance between the rows and the plants per row. Variants sown at 50 cm and 70 cm between the rows achieved a deficit production, very significant compared to the control of the experience (Table 10).

Under the conditions of A.R.D.S. Secuieni, at the distances of 50 cm and 70 cm between the rows there was a decrease of the herb and seed production as compared to the control of the experience sowing at25 cm between the rows and continuously row during the study period.

Table 3. The influence of interaction from the distance between rows and the distance between plants per row on the average height of the plant (cm) at *Dracocephalum moldavica* L. (dragonhead) species, at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	**Distance between plants per row (B)**	**Height of the plant (cm)**	**% compared to control.**	**Diff.**	**Significance**
a1-25 cm	b1-continuous row	83.83	100	Ct.	
	b2-15 cm	79.19	94.47	-4.64	ooo
	b3-25 cm	87.31	104.15	3.48	**
a2-50 cm	b1- continuous row	81.39	97.08	-2.44	oo
	b2-15 cm	84.61	100.93	0.78	
	b3-25 cm	85.99	102.57	2.16	*
a3-70 cm	b1- continuous row	84.98	101.37	1.15	
	b2-15 cm	85.63	102.15	1.80	*
	b3-25 cm	84.94	101.32	1.11	
LSD 5%= 1.59 cm LSD 1%= 2.34cm LSD 0.1%=3.62 cm					

Table 4. The influence of interaction from the distance between rows and the distance between plants per row on the average number of branches per plant at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Number of branches /plant	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	14.93	100	Ct.	
	b2-15 cm	14.67	98.21	-0.27	
	b3-25 cm	15.73	105.36	0.80	
a2-50 cm	b1- continuous row	13.60	91.09	-1.33	
	b2-15 cm	14.67	98.25	-0.26	
	b3-25 cm	16.00	107.16	1.07	
a3-70 cm	b1- continuous row	14.40	96.45	-0.53	
	b2-15 cm	17.20	115.20	2.27	**
	b3-25 cm	15.73	105.35	0.8	
LSD 5%= 1.48 LSD 1%= 2.24 LSD 0.1%=3.63					

Table 5. The influence of interaction from the distance between rows and the distance between plants per row on the average weight of the stems at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Weight of the stems (g)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	43.79	100	Ct.	
	b2-15 cm	36.26	82.81	-7.53	
	b3-25 cm	100.64	229.82	56.85	**
a2-50 cm	b1- continuous row	39.35	89.86	-4.44	
	b2-15 cm	78.86	180.08	35.07	*
	b3-25 cm	110.75	252.91	66.96	**
a3-70 cm	b1- continuous row	49.80	113.72	6.01	
	b2-15 cm	124.63	284.60	80.84	***
	b3-25 cm	136.53	311.78	92.74	***
LSD 5%= 29.17g LSD 1%= 45.08g LSD 0.1%=76.17g					

Table 6. The influence of interaction from the distance between rows and the distance between plants per row on the average weight of the leaves at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Weight of the leaves (g)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	54.17	100	Ct.	
	b2-15 cm	52.32	96.59	-1.85	
	b3-25 cm	134.75	248.78	80.59	**
a2-50 cm	b1- continuous row	50.64	93.48	-3.53	
	b2-15 cm	97.14	179.32	42.97	*
	b3-25 cm	157.94	291.56	103.77	**
a3-70 cm	b1- continuous row	65.99	121.82	11.82	
	b2-15 cm	160.82	296.88	106.65	***
	b3-25 cm	173.05	319.45	118.88	***
LSD 5%= 40.38g LSD 1%= 62.53g LSD 0.1%=106.0g					

Table 7. The influence of interaction from the distance between rows and the distance between plants per row on the average weight of the flowers at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Weight of the flowers (g)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	7.06	100	Ct.	
	b2-15 cm	8.36	118.46	1.30	
	b3-25 cm	14.31	202.74	7.25	**
a2-50 cm	b1- continuous row	6.59	93.34	-0.47	
	b2-15 cm	9.72	137.67	2.66	
	b3-25 cm	17.62	249.57	10.56	**
a3-70 cm	b1- continuous row	7.33	103.82	0.27	
	b2-15 cm	18.79	266.15	11.73	***
	b3-25 cm	28.69	406.37	21.63	***
LSD 5%= 4.12 g LSD 1%= 6.41g LSD 0.1%=10.95 g					

Table 8. The influence of interaction from the distance between rows and the distance between plants per row on the average weight of the plant at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Weight of the plant (g)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	104.40	100	Ct.	
	b2-15 cm	93.62	89.67	-10.78	
	b3-25 cm	249.71	239.17	145.31	**
a2-50 cm	b1- continuous row	96.59	92.52	-7.81	
	b2-15 cm	187.39	179.49	82.99	*
	b3-25 cm	286.32	274.25	181.92	**
a3-70 cm	b1- continuous row	123.13	117.94	18.73	
	b2-15 cm	304.25	291.42	199.85	***
	b3-25 cm	338.28	324.02	233.88	***
LSD 5%= 71.20 g LSD 1%= 109.8 g LSD 0.1%=184.9 g					

Table 9. The influence of interaction from the distance between rows and the distance between plants per row on the average fresh herbs (kg/ha) at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Production of fresh herb (kg/ha)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	57866	100	Ct.	
	b2-15 cm	57186	98.82	-680	
	b3-25 cm	41880	72.37	-15986	oo
a2-50 cm	b1- continuous row	38683	66.84	-19183	ooo
	b2-15 cm	30383	52.50	-27483	ooo
	b3-25 cm	29776	51.45	-28090	ooo
a3-70 cm	b1- continuous row	33566	58.01	-24300	ooo
	b2-15 cm	34866	60.25	-23000	ooo
	b3-25 cm	29250	50.54	-28616	ooo
LSD 5%= 7811 kg/ha LSD 1%= 11511 kg/ha LSD 0.1%= 17912kg/ha					

Table 10. The influence of interaction from the distance between rows and the distance between plants per row on the average seed production (kg/ha) at *Dracocephalum moldavica* L. (dragonhead) species. at A.R.D.S. Secuieni during 2016 – 2017.

Distance between rows (A)	Distance between plants per row (B)	Production (kg/ha)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	1033	100	Ct.	
	b2-15 cm	1154	111.71	121	*
	b3-25 cm	1063	102.90	30	
a2-50 cm	b1- continuous row	517	50.04	-516	ooo
	b2-15 cm	570	55.17	-463	ooo
	b3-25 cm	723	69.99	-310	ooo
a3-70 cm	b1- continuous row	670	64.85	-363	ooo
	b2-15 cm	589	57.01	-444	ooo
	b3-25 cm	619	59.92	-414	ooo
LSD 5%= 95.35 kg/ha LSD 1%= 144.7 kg/ha LSD 0.1%= 237.3 kg/ha					

4. CONCLUSIONS

In *Dracocephalum moldavica* L. the average weight of the stem showed distinct positive differences. compared to the a1xb1 (43.79 g). at the interactions between a1xb3 (56.85 g - sown at 25 cm between rows and 25 cm between plants per row) and a2xb3 (66.96 g - sown at 50 cm between rows and 25 cm between plants per row).

At *Dracocephalum moldavica* L. the average plant weight was revealed by distinct positive differences compared to the a1xb1 (104.4 g sown at 25 cm between row in a continuous row) on the interactions between a1xb3 (145.31 g) and a2xb3 (181.92 g).

Average seed yield per hectare showed significant positive differences in a1xb2 interaction (25 cm between rows and 15 cm between plants -124 kg / ha) compared to the control a1xb1 (1033 kg/ha sown at 25 cm between rows in a continuous row).

REFERENCES

[1] El-Baky. H.H.. El-Baroty. G.S.. Chemical and biological evaluation of the essential oil of Egyptian moldavian balm. Global journal of biotechnology biochemistry. 2007. p. 74-80.
[2] Galambosi. B.. Holm. Y.. The effect of nitrogen fertilization on the herb yield of dragonhead. Journal of agricultural science in Fanland. vol. 61. 1989. p. 387-394.
[3] Hassani. A.. Effect of water deficit stress on growth. yield and essential oil content of (*Dracocephalum moldavica* L.). Iranian journal of medicinal and aromatic plants research. 2006. p. 256-261.
[4] Mozaffarian. V.. A dictionary of iranian plant. Names.farhang moaser. Tehran. Iran. 1996. p. 542.
[5] Omidbaigi. R.. Production and processing of medicinal plants. Astan quds razavi publications. Behnashr. Mashhad. vol. 2. 2005. p. 438.
[6] Abedi. R.. Golparvar. A.R. Hadipanah. A.. Identification of the essential oils composition from four ecotypes of Mentha longifolia (L.) Huds. Growing wild in Isfahan province. Iran. Journal of bio science and biotechnology. 2015. p. 117-121.