THE INFLUENCE OF THE NUTRITION SPACE ON THE HERB AND SEED YIELDS AT MOLDAVIAN DRAGONHEAD *(Dracocephalum moldavica L.),* IN A.R.D.S. SECUIENI PEDOCLIMATIC CONDITIONS

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Abstract

The *Dracocephalum moldavica* (L.) species, known under the popular name of moldavian dragonhead, is used in the pharmaceutical, cosmetic and food industry due to its high content in active principles. To ensure the necessary of raw material at A.R.D.S. Secuieni are conducted researches regarding the development of the cultivation technology for its introduction into culture and extension in agriculture. In the conditions of 2015 – 2016 agricultural year, due to the observations made, it was found that the fresh herba, dry herba and seed yields were positively influenced by the distance between the rows (average factor A), but also by the distance between plants per row (average factor B). The obtained data have showed that the highest average yields of fresh herba (34063,33 kg/ha), dry herba (9313,33 kg/ha) and seeds (1069 kg/ha) were obtained at the a1xb1 interaction sown at 25 cm between rows and in continuous row (control variant). In the experience with the nutrition space, it was found that, the plants harvested for herba had a vegetation period of 109 days requiring 1877,9ºC and 325,2 mm of rainfall, and the plants harvested for seed developed in 137 days, the sum of accumulated temperatures being of 2492,1º C and of rainfall of 355 mm.

Key words: melliferous plant, nutrition space, moldavian dragonhead, climatic conditions, seed

Dracocephalum moldavica (L.) (moldavian dragonhead) is an annual plant belonging to Lamiaceae family. This species has a branched stem, up to 60 cm high, strongly aromatized with a vast search for the essential oil composition (Kakasy A., et al., 2006). The origin of this plant is from southern Serbia and Himalayas and grows naturally in the temperate areas of Europe and Asia (Dastmlachi K. *et al*., 2007, Dobrea D.I. *et al*., 2017, Hussein M.S. *et al*., 2006, Naie M. *et al*., 2016, Said-Al-Ahl H.A.H. *et al*., 2009).

Dracocephalum moldavica L. species - has antimicrobial and bacterial properties, being widely used in the pharmaceutical, cosmetic, food and perfumery industry (Gablet J., 2002). As tea is used to alleviate headaches, abdominal pain, remedy for treating flu, nervous system pain, kidney pain, gastrointestinal and teeth pains. This plant can also be used as cataplasm in rheumatic pains (Maham N. *et al.*, 2013).

The chemical elements contained are: galantanines (5-10%), salicarin, ferric hydroxide, flavonoid substances, heterosides, orientin, malvidol anthocyanin-diglycoside pigments and cyanidol galactosides, colina, glucose, starch, choline, a phytoncide with antibiotic activity, antibiotic substances, pectins, carotenoids, mineral substances and traces of volatile oil (Alaei S.,et al., 2013, Kakasy A., et al., 2002, 2006).

In this paper are presented data regarding the influence of the agricultural year 2015-2016 climatic conditions on the species growth and development in the Center of Moldova conditions, as well as the establishment of some technological links for seed production in agriculture in conversion system.

MATERIAL AND METHOD

The researches were carried out in 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, 25 cm.

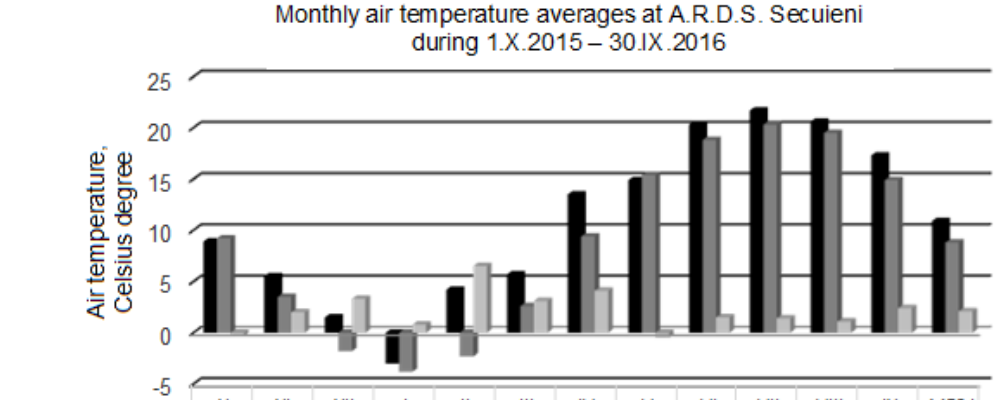
Throughout the vegetation period, biometric observations were made and the thermal and precipitation requirements for the growth and development of this species were calculated.

For the production of herba, the plants were harvested in the blooming phase by cutting at a height of 5 cm from the ground.

Drying was done naturally in the shade in thin layers in a well-ventilated place. The seeds were harvested in two stages: in the first stage the plants were cut with the mower and left two days to dry, after which in the second stage the plants were thrashered and the seed thus obtained was brought, by shoveling, at the STAS humidity, then conditioned with the small seed selector.

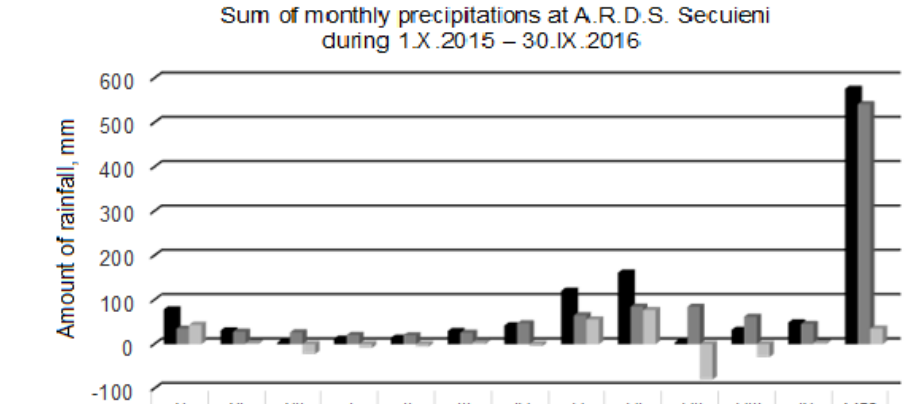
The climatic conditions of 2015-2016 agricultural year were characterized in terms of temperatures as warm, the annual average was of 10.9°C higher with 2.1°C compared to the multiannual average which is of 8.8°C. With the exception of October (2015) when the monthly average was lower than the multiannual average with a deviation of – 0.3°C, during the rest of autumn and winter months (November, December, January and February), the monthly averages recorded positive deviations from the multiannual average between 0.8°C (January) and 6.5°C (February), (figure 1).

In terms of precipitation, after the annual sum of 575.8 mm, the agricultural year is characterized as normal to rainy, the difference in the amount of annual precipitation compared to the multiannual average (540.9 mm) was of 34.9 mm. Instead, the rainfall distribution was very uneven throughout the entire plant growing season, the monthly deviations ranged from - 80 mm (July) to 76.7 mm (June), (figure 2).



	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	MEDIA
Monthly average	8.9	5.5	1.5	-3	4.2	5.7	13.5	14.9	20.3	21.7	20.6	17.3	10.9
Multiannual average	9.2	3.5	-1.8	-3.8	-2.3	2.6	9.4	15.4	18.8	20.3	19.5	14.9	8.8
Deviation	-0.3	2	3.3	0.8	6.5	3.1	4.1	-0.5	1.5	1.4	1.1	2.4	2.1

Figure 1. **Evolution of monthly average temperatures at A.R.D.S. Secuieni**



	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	MEDIA
Monthly average	78	30.4	4	12	14.2	29.4	42	120.2	161	4	32	48.6	575.8
Multiannual average	34.7	27.8	26.2	20.5	19.6	25.4	46.8	64.8	84.3	84	61.4	45.4	540.9
Deviation	43.3	2.6	-22.2	-8.5	-5.4	4	-4.8	55.4	76.7	-80	-29.4	3.2	34.9

Figure 2. **Sum of monthly precipitations at A.R.D.S. Secuieni**

RESULTS AND DISCUSSIONS

The *Dracocephalum moldavica* (L.) species was sown in the first decade of April when the soil temperature was of 13.5ºC. The plants have emerged after 33 days from sowing, suma gradelor acumulate fiind de 439,3º C, and the precipitation amount was of 42.6 mm. From the emergence to the formation of flowering stems 32 days have passed the plants accumulating 512.2ºC and 224.2 mm precipitations. From the appearance of the floral stems to the beginning of the flowering, it lasted 40 days during which 56.2 mm precipitations fell, and the sum of the thermal degrees was of 845.6ºC.

Analyzing the influence of the interaction between the distance between the rows (factor A) and the distance between plants (factor B) on the growth and development of *Dracocephalum moldavica* (L.) species it was found that the average plant height oscillated between 59.18 cm at the control variant sown at 25 cm between rows and in continuum row and 50.30 cm in the version sowed at 50 cm between rows and 25 cm between plants per row.

The average number of ramifications ranged from 14 branches/plants at the plants from the V8 variant (sown at 70 cm between rows and 15 cm between plants) and 9 ramifications/plant at the V4, V5 variants (50 cm between rows/continuous row respectively 50 cm between rows/15 cm between plants per row).

Average flower weight varied between 6.57 g at the V9 variant seeded at 70 cm between rows/25 cm between plants per row and 1.71 g at V5 variant sowed at 50 cm between rows/15 cm between plants per row. The average plant weight recorded values ranging from 118.26 g in V9 variant (sown at 70 cm between rows/25 cm between plants per row) and 66.87 g in V2 variant (sown at 25 cm between rows/15 cm between plants per row).

Table 1.

Data regarding the phenophases at *Dracocephalum moldavica* (L.) (dragonhead) species

Phenological observations	The date from which the phenophase began	Duration in days		Σ of thermal degrees (º C)	Σ of precipitations (mm)
		Herba	Seeds		
Sowing	5.04.2016	-	-	-	-
Sprouting	4.05.2016	33	33	439.3	42.6
Emitted floral stems	6.06.2016	32	32	512.2	224.2
The beginning of blossoming	16.07.2016	40	40	845.6	56.2
Harvesting for herb	20.07.2016	4	-	80.8	2.2
Total herba	-	109	-	1877.9	325.2
The beginning of fructification	3.08.2016	-	17	399.9	11.8
Harvesting for seeds	22.08.2016	-	15	295.1	20.2
Total seeds	-	-	137	2492.1	355

From the beginning of the bloom to the beginning of the fructification, it lasted 17 days, during which 399.9°C and 11.8 mm precipitation were accumulated. Seed formation and maturation was carried out 15 days after the beginning of the fructification, the plants accumulating 295.1°C and 20.2 mm precipitation. The plants harvested for herba had a vegetation period of 109 days requiring 1877.9°C and 325.2 mm precipitation, and the plants harvested for the seeds developed in 137 days, the sum of the accumulated temperatures being of 2492.1°C and precipitation of 355 mm (table 1).

The average strain weight was higher in the variant sown at 70 cm between the rows and 25 cm between plants per row this being of 52.99 g and of 29.06 g in the plants sown at 25 cm between the rows / 15 cm between plants per row (table 2).

The production of herba at *Dracocephalum moldavica* **(**L.) species, obtained in 2016 was positively influenced by the interactions between the distance between rows and the distance between plants per row.

The average production of fresh herba was between 20250.00 kg/ha and 29277.78 kg/ha for A factor (distance between rows) and 19820.00 kg/ha and 26328.90 kg/ha for B factor (distance between plants per row) where it was noted the interaction a1xb1 with the highest value of 34063.33 kg/ha (table 3*)*.

Analyzing the average yield of dried herbs, it was found that the highest value was obtained at a1xb1 interaction of 9313.33 kg/ha sown at 25 cm between rows and in continuous row (mt), and the lowest of 4953.33 kg/ha at a2xb3 interaction sown at 50 cm between rows and 25 cm between plants per row.

Table 2.

Determinations carried out on *Dracocephalum moldavica* (L.), at seed plants harvesting

Variant/ determinations	Average plant height (cm)	Average number of branches / plant	Average strain weight (g)	Average leaf weight (g)	Average flower weight (g)	Average plant weight (g)
V1 (mt)-a1xb1	59.18	11	34.28	38.71	2.80	75.80
V2-a1xb2	55.38	11	29.06	35.45	2.35	66.87
V3-a1xb3	51.66	10	38.77	42.77	6.75	88.30
V4-a2xb1	57.16	11	38.48	39,58	2.76	80.84
V5-a2xb2	51.85	9	30.34	40.65	1.71	72.71
V6-a2xb3	50.30	9	38.37	44.65	6.00	89.02
V7-a3xb1	57.57	12	47.30	52.58	3.11	103.00
V8-a3xb2	52.71	14	43.87	55.76	3.61	103.24
V9-a3xb3	54.20	11	52.99	58.70	6.57	118.26

Table 3.

Influence of the nutrition space on average fresh herba production at *Dracocephalum moldavica* (L.), in 2016

Distance between rows (A)	Plant spacing (B)	Yield (kg/ha)	% compared to control variant	Diff. (kg/ha)	Significance
a1-25 cm	b1- continuous row	34063.33	100	mt	mt
	b2-15 cm	20783.33	61.12	-1328.00	ooo
	b3-25 cm	18453.33	54.18	-15610.00	ooo
a2-50 cm	b1- continuous row	24700.00	75.51	-9363.33	ooo
	b2-15 cm	19263.33	56.55	-14800.00	ooo
	b3-25 cm	15496.67	45.49	-18566.66	ooo
a3-70 cm	b1- continuous row	29070.00	85.34	-4993.33	ooo
	b2-15 cm	23116.67	67.86	-10946.66	ooo
	b3-25 cm	26800.00	78.67	-7263.33	ooo
DL 5%=1413 (kg/ha) DL 1%=1983 (kg/ha) DL 0.1%=2799 (kg/ha)					
Media A	b1- continuous row	29277.78	100	mt	mt
	b2-15 cm	21054.44	71.92	-8223.34	ooo
	b3-25 cm	20250.00	69.17	-9027.78	ooo
DL 5%=1793 (kg/ha) DL 1%=2966 (kg/ha) DL 0.1%=5552 (kg/ha)					
Media B	a1-25 cm	24433.33	100	mt	mt
	a2-50 cm	19820.00	81.12	-4613.33	ooo
	a3-70 cm	26328.90	107.76	1895.57	xxx
DL 5%=815.6 (kg/ha) DL 1%=1145 (kg/ha) DL 0.1%=1616 (kg/ha)					
Media AxB		23527.40	80.40	-5750.38	ooo
DL 5%=2118 (kg/ha) DL 1%=3320 (kg/ha) DL 0.1%= 5742 (kg/ha)					

The A factor average (distance between rows) was between 5340.00 kg/ha and 8920.00 kg/ha, and the B factor average was between 6197.78 kg/ha and 7148.89 kg/ha. The yields were statistically insured as very negatively distinctly significant and negative very significant to a1xb1 (25 cm between rows / continuous row), (table 4).

The drying ratio between green herb production and dry herb production had close values ranging from 3.61 to 3.92 (figure 3).

Analyzing the a1xb1 influence on the average seed production, it was found that the highest value was recorded at the interaction of a1xb1 of 1150 kg/ha and the lowest was of 907.67 kg/ha at the interaction a2xb2 sown at 50 cm between the rows and 15 cm between plants per row.

The A factor average (distance between rows) ranged between 1054.00 kg/ha and 976.33 kg/ha, and the B factor average was between 1094.44 kg / ha and 988.33 kg / ha. The yields were statistically insured as being significantly negative, distinctly negative and very negative for the a1xb1 interaction (25 cm between rows/continuous row), (table 5).

Table 4.

Influence of nutrition space on average dry herba production at *Dracocephalum moldavica* (L.), in 2016

Distance between rows (A)	Plant spacing (B)	Yield (kg/ha)	% compared to control variant	Diff. (kg/ha)	Significance
a1-25 cm	b1- continuous row	9313.33	100	mt	mt
	b2-15 cm	5493.33	58.98	-3820.00	ooo
	b3-25 cm	5053.33	54.26	-4260.00	ooo
a2-50 cm	b1- continuous row	8320.00	89.33	-993.33	oo
	b2-15 cm	5320.00	57.12	-3993.33	ooo
	b3-25 cm	4953.33	53.19	-4360	ooo
a3-70 cm	b1- continuous row	9126.67	97.98	-186.66	
	b2-15 cm	6306.67	67.72	-3006.66	ooo
	b3-25 cm	6013.33	64.57	-3300	ooo
DL 5%=587.6 (kg/ha) DL 1%=824.8 (kg/ha) DL 0.1%=1164 (kg/ha)					
Media A	b1- continuous row	8920.00	100	mt	mt
	b2-15 cm	5706.66	63.98	-3213.34	ooo
	b3-25 cm	5340.00	59.87	-3580	ooo
DL 5%= 723.1 (kg/ha) DL 1%=1197 (kg/ha) DL 0.1%=2240 (kg/ha)					
Media B	a1-25 cm	6620.00	100	mt	mt
	a2-50 cm	6197.78	93.62	-422.22	o
	a3-70 cm	7148.89	107.98	528.89	xx
DL 5%=339.2 (kg/ha) DL 1%=476.2 (kg/ha) DL 0.1%=672.3 (kg/ha)					
Media AxB		6655.55	74.61	-2264,45	oo
DL 5%=861.9 (kg/ha) DL 1%=1348 (kg/ha) DL 0.1%= 2324 (kg/ha)					

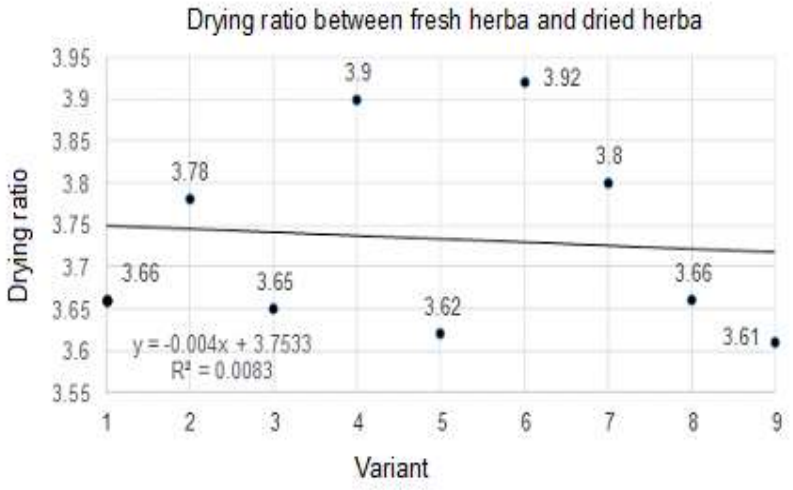


Figure 3. **The yield ratio between fresh and dry herba**

CONCLUSIONS

Based on the results obtained, the following conclusions were drawn:

- in 2015-2016 agricultural year the *Dracocephalum moldavica* (L.) species (moldavian dragonhead) sown in the 1st decade of April required for growth and development 109 days (herba) and 137 days (seed);

- the amount of temperature required for plant growth and development was of 1877.9°C (herba) and 2572.1°C (seeds), and the sum of accumulated precipitations was of 325.2 mm (herba) and 355 mm (seeds);

- in the case of fresh and dry herba and seed yields, they were influenced by both the distance between the rows (A factor average) and the distance between plants per row (B factor average);

- the highest yields of fresh, dry herba and seed were recorded at a1xb1 interaction of 9313.33 kg/ha, 34063.33 kg/ha respectively 1150.00 kg/ha sown at 25 cm between rows and in continuous row (mt).

Table 5.

Influence of nutrition space on average seed production at *Dracocephalum moldavica* (L.), in 2016

Distance between rows (A)	Plant spacing (B)	Yield (kg/ha)	% compared to control variant	Diff. (kg/ha)	Significance
a1-25 cm	b1- continuous row	1150.00	100	mt	mt
	b2-15 cm	1025.33	89.13	-124.67	oo
	b3-25 cm	1108.00	96.34	-48.00	
a2-50 cm	b1- continuous row	1034.33	89.63	-119.67	o
	b2-15 cm	907.67	78.92	-242.33	ooo
	b3-25 cm	1023.00	88.95	-127	oo
a3-70 cm	b1- continuous row	979.00	85.13	-171	oo
	b2-15 cm	996.00	86.60	-154	oo
	b3-25 cm	1007.00	87.56	-143	oo
DL 5%=88.03 (kg/ha) DL 1%=123.6 (kg/ha) DL 0.1%=174.5 (kg/ha)					
Media A	b1- continuous row	1054.44	100	mt	mt
	b2-15 cm	976.33	92.59	-78.11	oo
	b3-25 cm	1046.00	99.18	-8.44	
DL 5%=71.53 (kg/ha) DL 1%=118.4 (kg/ha) DL 0.1%=221.5 (kg/ha)					
Media B	a1-25 cm	1094.44	100	mt	mt
	a2-50 cm	988.33	90.30	-106.11	ooo
	a3-70 cm	994.00	90.82	-100.44	oo
DL 5%=50.83 (kg/ha) DL 1%=71.34 (kg/ha) DL 0,1%=100.7 (kg/ha)					
Media AxB		1025.59	97.20	-28.85	
DL 5%=100.7(kg/ha) DL 1%=152.4 (kg/ha) DL 0.1%=248.6 (kg/ha)					

ACKNOWLEGMENTS

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