PRELIMINARY ASPECTS CONCERNING THE INTRODUCTION INTO CROP OF THE *DRACOCEPHALUM MOLDAVICA* L. (MOLDAVIAN DRAGONHEAD) SPECIES UNDER THE ENVIRONMENTAL CONDITIONS OF NIRDPSB BRASOV

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Abstract

The researches are carried out within the research project ADER 2.4.1., during the years 2015-2018, a project coordinated by SCDA Secuieni and to which NIRDPSB Brasov is partner.
The overall objective of this study is to introduce in crop a valuable medicinal species from *Lamiaceae* family, respectively *Dracocephalum moldavica* L. (Moldavian dragonhead) species. This objective resides from the growing concerns of consumers about nutrition, preservation of a proper health status, from the increased responsability for maintaining and protecting the environment. Originally from Central Asia and acclimatized in Central and Eastern Europe, the Moldavian dragonhead is traditionally used for medicinal purposes worldwide, for its sedative and analgesic properties, but also as a good anti-rheumatoid, antitumoral, antimutagenic, antiseptic and antioxidant.
It was followed the establishment of multiplication way, the seed norm/ha, the optimum sowing time and the optimal nutrition space, in order to establish a crop technology adapted to the environmental conditions of Bârsa county. To determine the optimum sowing time was set up a single factor experience of five variants and three repetitions. For determining the optimal nutrition space of the plant was established a bifactorial experience of nine variants in three repetitions. At each variant / repetition, biometric measurements were made on the plants, and the fresh and dried herba production was also evaluated. The results were subjected to the statistical analysis, so that the best variants were highlighted, depending on the experience set up and its purpose.
The contribution with new information on the crop technology of *Dracocephalum moldavica* L. species leads at the enrichment of knowledge in this field, as the information in the literature is more geared towards studying the species in terms of active principles in the plant, rather than crop technology.

Key words: medicinal plants, Moldavian dragonhead, introduction into crop, crop technology

Within the last 30 years, the world has experienced an increased trend towards healthy diet and natural products, that leds to a growing demand for medicinal and aromatic plants (Gabler, 2002). Together with requirements for safety, efficacy and stability of medicinal and aromatic plant products, the need for high quality raw materials is increasing (Omidbaigi *et al.*, 2010).

Dracocephalum moldavica L. which is known as Moldavian balm or Moldavian dragonhead is an annual herbaceous aromatic and honey yielding plant belonging to family *Lamiaceae*, with attractive blue or white flowers and aromatic lemon scented foliage (Frąc *et al.*, 2015). Extracts and oil from this plant are used widely in the pharmaceutical, cosmetic, food and flavouring industries as indicated by Alaei and Omidbaigi, 2014.

The plant has been used for ages in folk medicine to treat, mainly, heart disease, blood pressure, angina, atherosclerosis, neuralgia, migraine, headache and toothache, additionally it has been reported, that *Dracocephalum moldavica* L. extracts possess sedative and analgesic activity (Nejatzadeh-Barandozi *et al.*, 2015), even antirheumatism, antitumor, antimutagens, antioxidant, antiseptic and stimulant properties (Golparvar *et al.*, 2016).

It is native to central Asia and naturalized in eastern and central Europe. Alaei *et al.*, 2013 shows that drought is one of the environmental stresses that determine the global distribution and cropping patterns of the crop plants in the world.

Since dragonhead is an important species known in medicine worldwide, plant

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investigations are multilaterally developed between studies on the active properties of the plant, but also on field culture issues, such as the behavior of the plant under the influence of various doses of fertilization, different climatic conditions and soil. The information from the literature does not refer to the identification or application of a specific crop technology of this species, so in this paper we propose to present preliminary aspects of a crop technology that is available in the area of NIRDPSB Brasov.

MATERIAL AND METHOD

The remarks regarding maintaining biodiversity at medicinal plants are currently in progress at NIRDPSB Brasov and this study presents preliminary results about introduction into crop of *Dracocephalum moldavica* L. (Moldavian dragonhead) species, respectively specific crop technology. The researches are carried out within the research project ADER 2.4.1., during the years 2015-2018, a project coordinated by SCDA Secuieni and to which NIRDPSB Brasov is partner.

The seed necessary for the establishment of the experience comes from SCDA Secuieni.

Species description (after Ardelean and Mohan, 2008)

Annual herbaceous plant that presents a superficial fascicular root in the soil. Erect stem, 4-edged, often reddish, branched, up to 70-80 cm high. Leaves opposite, elongated-lanceolate, on the underside glandulous-dotted. Flowers of blue, pink or white color, short pedicellate, grouped 6-10 in the verticals at the arches of the leaves at the upper nodes. Blooms in July-August. The fruit is a 4-parted schizocarp, ovoid, brown.

Establishing the experience

The establishment of the crop followed the sketch of experiences drawn so that we can determine the optimum sowing time and the optimal nutrition space of the plant.

Thus, to determine the optimum sowing time was set up a single factor experience of five variants (three repetitions) (*Figure 1*), the first two were sown in autumn (year 2015) and variants V3-V5 in the spring of 2016 year, function of climatic conditions.

Single factor experience:

V3 - sowed in the urgency I, late March to early April

V4 - sowed in the urgency II, the second decade of April to the third decade of April

V5 - sowed in the last decade of April - early May.

A - distance between rows with graduations: 50 cm;

B - distance between plants on row: 25 cm;

C - repetition length: 500 cm.

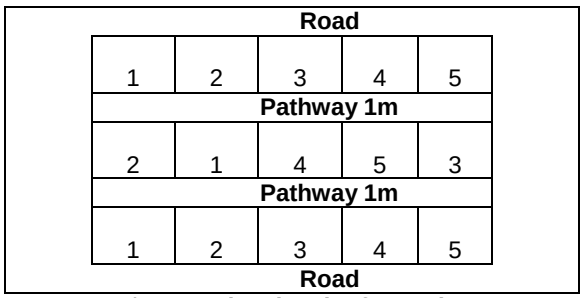


Figure 1 **The sketch of experiences to determine the optimum sowing time**

In order to determine the optimal nutrition space of the plant was established a bifactorial experience of nine variants in three repetitions (*Figure 2*) as follows:

Bifactorial experience:

A - distance between rows with graduations: 25 cm, 50 cm; 70 cm;

B - distance between plants on row with the graduations: continuous line; 15 cm; 25 cm;

C - repetition length: 200 cm;

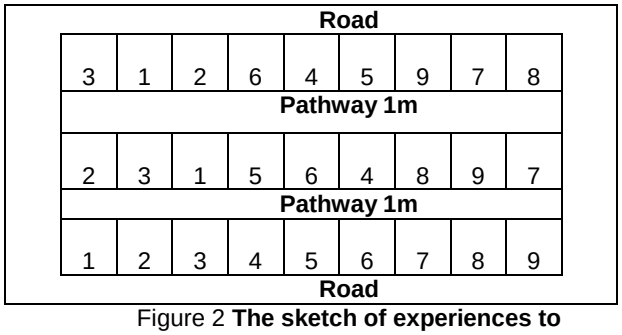


Figure 2 **The sketch of experiences to determine the optimal nutrition space of the plant**

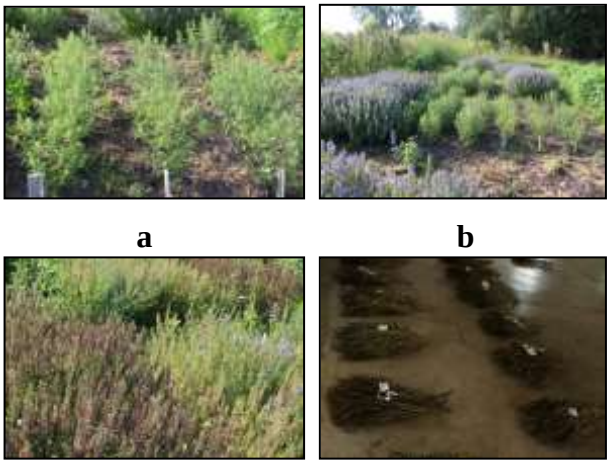
At each variant/repetition was determined the number of plants/ha, was evaluated plant height, number of ramifications, the total weight of the plant (stems, leaves, flowers), was established production of fresh and dry herb and rate of seed / ha. Results were subjected to statistical analysis.

RESULTS AND DISSCUSIONS

To determine the optimum sowing time was established in autumn 2015 a single factor experience, with 50 cm between rows and 25 cm between plants / row, 2 variants (V1 and V2) of 3 repetitions, with a length of repetition of 500 cm. Variants V3, V4, V5 were sown in the spring of 2016 at different intervals of time (*Figure 1*).

The crop establishment of *Dracocephalum moldavica* L. by sown in the autumn did not generate favorable results, because in the environmental conditions from NIRDPSB Brasov, the seed has not germinated (V1-V2). Instead, setting up the crop by sowing in spring generated favorable results. Regarding variants V3-V5, they behaved differently, namely, the most uniform emergence was made at V1, which was planted in late March to early April, and the less uniform

emergence was realized at the variant V3 sown in the last decade of April - early May. In Figure 3 are exposed several aspects of the species, in different crop phases, from establishment to herb harvest.



a **b**

c **d**

Figure 3 a,b,c,d. *Dracocephalum moldavica* L. species from crop establishment to harvest

As shown in Table 1, were made measurements on plant height, the results are different on variants/repetitions with values ranging from 56 cm (V3R3) to 74 cm (V1R1) and measurements concerning the number of ramifications of each plant, number between 7 (V3R2, V3R3) to 10 (V1R1) ramifications/plant.

Plant weight fluctuated between variants, having values between 314 g (V3R3) and 378 g (V1R1).

The amount of fresh or dried herb assured distinct productions depending on the variant/repetition. The best variant was V1, which conducted a production of fresh herb between 27.760 - 30.240 kg/ha and a production of dry herb of 5.120 - 5.620 kg/ha.

Table 1

Biometric measurements for determining the optimal time of sowing

Var. No.	Plant height (cm)	Ramifications number	Plant weight (g)	Fresh herb production (kg/ha)	Dry herb production (kg/ha)
V_1R_1	74	10	378	30240	5620
V_2R_1	67	9	348	27840	5010
V_3R_1	61	8	325	26000	4590
V_1R_2	71	9	347	27760	5120
V_2R_2	63	8	339	27120	4840
V_3R_2	58	7	317	25360	4450
V_1R_3	70	9	352	28150	5160
V_2R_3	65	9	344	27520	4850
V_3R_3	56	7	314	25120	4390
Average V1	71.7	9.3	359	28716.7	5300
Average V 2	65	8.7	343.7	27493.3	4900
Average V3	58.3	7.3	318.7	25493.3	4476.7

To establish the optimal nutrition space, it was established a bifactorial experience with the distance between rows 25, 50 and 70 cm, between plants/row of 15 cm, 25 cm and a continuous row, in three randomized repetitions with a repetition length of 200 cm (*Figure 2*).

The number of plants/ha was between 57-600 mii thousand plants/ha, depending on the variant (*Table 2*).

Table 2

The number of plants / ha depending on the variation

Variant	The number of plants (thousand) / ha
V1 (continuous row -25 between rows)	600
V2 (15 cm between plants/row -25 cm between rows)	280
V3 (25 cm between plants/row -25 cm between rows)	160
V4 (continuous row -50 cm between rows)	300
V5 (15 cm between plants/row -50 cm between rows)	140
V6 (25 cm between plants/row -50 cm between rows)	80
V7 (continuous row-70 cm between rows)	215
V8 (15 cm between plants/row -70 cm between rows)	100
V9 (25 cm between plants/row -70 cm between rows)	57

From the data presented in Table 3 we can see that the plants had a height between 65 cm (V6R2) and 86 cm (V3R3), with a number of ramifications between 6 (V2R1) and 11 (V2R2, V2R3, V8R3) of ramifications. The weight of the plant it had different values depending on the variant/repetition and reached values between 127 g (V1R1) and 555 g (V9R3).

Table 3

Biometric measurements for determining optimal nutrition space

Var. No.	Plant height (cm)	Ramifications number	Plant weight (g)	Fresh herb production (kg/ha)	Dry herb production (kg/ha)
V_1R_1	78	10	127	76200	13860
V_2R_1	80	6	240	67200	11340
V_3R_1	80	10	330	52800	9168
V_4R_1	77	9	220	66000	11880
V_5R_1	68	9	339	47460	8134
V_6R_1	72	9	354	28320	4864
V_7R_1	83	8	208	44571	8014
V_8R_1	66	9	347	34700	5880
V_9R_1	75	8	396	22629	3812
V_1R_2	72	7	138	82800	14760
V_2R_2	76	11	251	70280	12180
V_3R_2	73	10	350	56000	10208
V_4R_2	70	7	215	64500	11370
V_5R_2	79	10	357	35700	6188
V_6R_2	65	9	382	30560	5104
V_7R_2	75	8	310	66428	12300
V_8R_2	73	10	394	39400	6780
V_9R_2	82	10	520	29715	4954
V_1R_3	81	9	145	87000	15120
V_2R_3	75	11	248	69440	12348
V_3R_3	86	9	312	49920	9376
V_4R_3	73	7	217	65100	11580
V_5R_3	82	8	313	36680	6902
V_6R_3	68	8	363	29040	5344
V_7R_3	75	10	218	46714	7157
V_8R_3	72	11	412	41200	6930
V_9R_3	80	8	555	31715	5463

In Table 4 was performed the statistical interpretation of the fresh herb within each variant, as shown the productions from Table 3. The standard deviation was calculated (the value deviating from calculated average of average population from which has been extracted the batch on which the measurements were made) and the amplitude of each variant (minimum and maximum production in the variant).

At the same time, we evaluated statistically also between variations the production of fresh herb (Table 5).

Table 4

Statistical evaluation within variants on the production of fresh herb (kg / ha)

Statistics		V1	V2	V3	V4	V5	V6	V7	V8	V9
N	Valid	3	3	3	3	3	3	3	3	3
	Missing	0	0	0	0	0	0	0	0	0
Mean		82000.0	68973.3	52906.6	65200.0	39946.6	29306.6	52571.0	38433.3	28019.6
Std. Deviation		5444.2	1592.1	3041.4	754.9	6525.1	1143.5	12048.2	3356.0	4774.3
Minimum		76200	67200	49920	64500	35700	28320	44571	34700	22629
Maximum		87000	70280	56000	66000	47460	30560	66428	41200	31715

Table 5

Statistical evaluation between variants on the production of fresh herb (kg/ha)

Statistics		
The production of fresh herb (kg/ha)		
N	Valid	9
	Missing	0
Mean		50817.48
Median		52571.00
Std. Deviation		18608.72
Minimum		28019.67
Maximum		82000.00

The average between variations is 50817,48 kg/ha, with a standard deviation of 18608,73, maximum and minimum production on variants being of 82000 kg/ha, respectively 28020 kg/ha.

To interpret which variant was better and determine optimal nutrition space needed to *Dracocephalum moldavica* L. grow well, in Figure 3 we determined according to the production of fresh herb (kg/ha), the productions diagram between the established variants.

Thus, the chart shows that the variant 1 was the best, namely, continuous row and 25 cm between rows and ensured the variant 9 weakest production (70 cm between rows-25 cm between plants/row). From the above, we can infer that the large distance between rows and between plants on the row has led to lower production herb/ha.

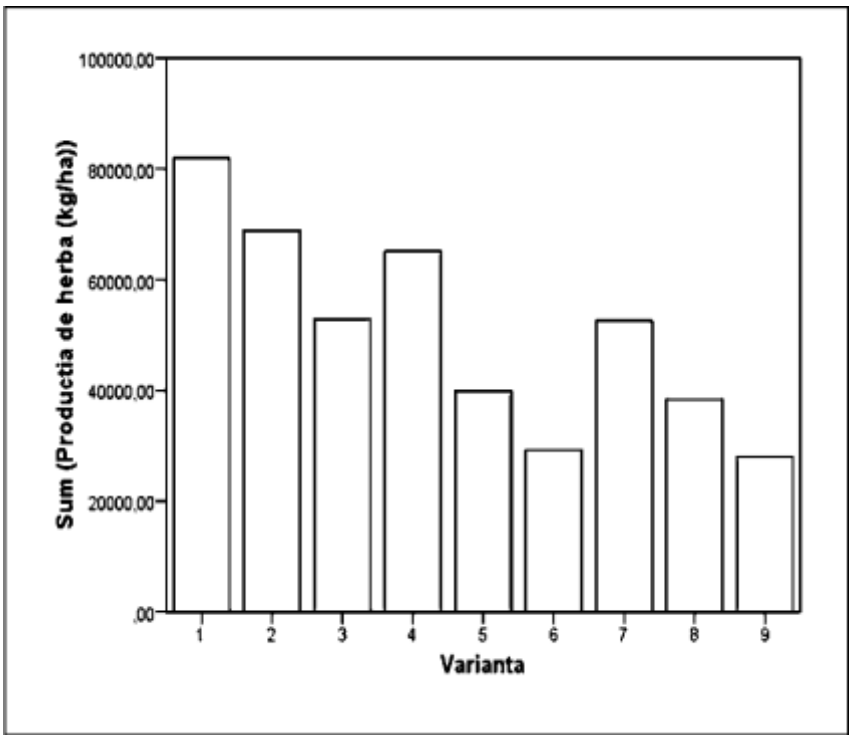


Figure 3. Production of fresh herb between the variants established (kg / ha)

After calculating the MMB (1000 grain weight), depending on experience, respectively, to determine the optimal time of sowing and determination of optimal nutrition space, was established norm of seed/ha. According to calculation, the 1000 grain weight measurements revealed that the value of MMB=2,1. At the single factor experience (50 cm between rows-25 cm between plants/row) where we watched optimum time sowing the norm seed/ha is 0,168 kg/ha. At the second trial, which was targeted optimal nutrition space, norm seed/ha depending on the variants differ, as shown in Table 6. The biggest norm of seed /ha is required for V1 (1,260 kg), and the lowest seed norm is needed to V9 (0,120 kg).

Table 6

Setting the norm seed/ha

Variant	The norm seed/ha (kg)
V1	1.260
V2	0.588
V3	0.336
V4	0.630
V5	0.294
V6	0.168
V7	0.452
V8	0.210
V9	0.120

In terms of favorability for harvest period, both experiences, in the environmental conditions from NIRDPSB Brasov recommending the optimal time to harvest the last decade of July.

CONCLUSIONS

1. *Dracocephalum moldavica* L., is a species of great therapeutic properties and can be introduced into intensive crop.

2. Generative propagation method gives good results at NIRDPSB Brasov in terms of compliance the period of end of March-beginning of April, as the optimum sowing time.

3. The optimal nutrition space necessary for the harmonious development of the plant is differently depending on the scheme of crop established, also norm seed/ha.

4. As a cropped plant provides higher herb/ha productions in terms of technology applied judiciously.

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REFERENCES

Alaei Shima, Melikyan Andreas, Kobraee Soheil and Mahna Nasser, 2013. *Effect of Different Soil Moisture Levels on Morphological and Physiological Characteristics of Dracocephalum moldavica.* Agricultural Communications, 1(1): 23-26.

Alaei Shima and Omidbaigi Reza, 2014. *The Vegetative Growth and Development of Dracocephalum Moldavica Under Different Soil Moisture Levels.* International Conference on Civil, Biological and Environmental Engineering (CBEE-2014), Istanbul (Turkey).

Ardelean Aurel, Mohan Gheorghe, 2008. *Flora Medicinală a României.* Ed. All, București, pg. 280.

Frąc Magdalena, Oszust Karolina, Kocira Anna, Kocira Sławomir, 2015. *Molecular identification of fungi isolated from Dracocephalum moldavica L. seeds.* Agriculture and Agricultural Science Procedia 7 (2015) 74 – 79.

Gabler J. 2002. *Breeding for resistance to biotic and abiotic factors in medicinal and aromatic plants: general situation and current results in annual caraway.* J. Herbs Spices Med. Plants 9: 1-11.

Golparvar Ahmad Reza, Hadipanah Amin, Gheisari Mohammad Mehdi, Khaliliazar Reza, 2016. *Chemical constituents of essential oil of Dracocephalum moldavica L. and Dracocephalum kotschyi Boiss. from Iran*. Acta agriculturae Slovenica, 107 - 1, pg. 25 - 31

Nejatzadeh-Barandozi F., Shahvaladi E. H. and Gholami-Borujeni F., 2015. *Nitrogen fertilization and microelements influences growth index and yield in (Dracocephalum moldavica L.)*. Bulgarian Journal of Agricultural Science, 21 (No 2): 266–269

Omidbaigi Reza, Yavari Saba, Hassani Mohammad Esmaeil and Yavari Sara, 2010. *Induction of autotetraploidy in dragonhead (Dracocephalum moldavica L.) by colchicine treatment*. Journal of Fruit and Ornamental Plant Research, Vol. 18(1) : 23-35