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Analysis of the selective value of promising *Melissa officinalis* L. subsp. *altissima* (Smith.) Arcang variety

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Abstract. The aim of this research was to study a promising MD 1–17 *Melissa officinalis L. subsp. altissima* (Smith.) Arcang. variety sample obtained in the collection of the gene pool of the Research Institute of Agriculture of Crimea (RIAC) in comparison with Krymchanka (selected in the RIAC) and Lada (selected in the All-Russian research Institute of medicinal and aromatic plants(VILAR) varieties of lemon balm *M. officinalis* L. subsp. *officinalis*. In 2017–2019, in the Department of Essential Oil and Medicinal Plants of the RIAC,a competitive variety trial of lemon balm varieties was conducted in accordance with the methodological recommendations for the selection of essential-oil plants. A territory where this study was conducted belongs to one of the five agroclimatic regions – the upper piedmont, warm, not enough humid; to the northern subarea with moderately mild winters. Weather conditions during the years of competitive variety trial varied significantlya fact that allowed assessing the adaptability of studied variety samples and forecasting the nature of productivity potential realization in different growing conditions. As a result, it was found that MD 1–17 variety sample significantly exceeds other varieties in terms of yield of fresh raw materials, on average, by 62.2 and 77.4%, and in yield of air-dried raw materials, on average, by 32.2 and 52.2%, respectively. In terms of obtaining essential oil from air-dried raw materials, this variety sample exceeds the best in this parameter Crimean variety Krymchanka by 56.3%. Basic components of its essential oil are caryophyllene (25.3–35.9%) and germacrene D (17.7–31.2%) with almost complete absence or insignificant amount of citral (0.1–7.3%); the proportion of latter in essential oils of Krymchanka and Lada varieties can reach 36.6% or more. Novelty of this study includes the creation of the first variety of a new promising essential oil plant –*M. altissima*. Raw materials of this variety and products of its processing may be of interest for different ways of use, including the perfumery and cosmetics industry, for food purposes as a component of tea compositions, etc.

Key words: essential oil plants, *Melissa officinalis*, *Melissa altissima*, competitive variety trial, variety, variety sample, essential oil, productivity parameters, morphological and biological parameters.

INTRODUCTION

Melissa officinalis L .is among the promising, high demanded plants due to the essential oil contained in its raw materials and other valuable extractive substances that determine its use in perfumes, cosmetics, pharmaceuticals, food industries, and medicine Voytkevich, 1999; Moradkhani et al., 2010; Alekseeva, 2011; Papoti et al., 2019). Developing of source breeding material is carried out both by classic methods, and modern biotechnological ones (Egorova & Stavtseva, 2016; Yakimova & Egorova, 2019). Source material for breeding work includes collection samples. In the collection of essential-oil and medicinal plants of the Institute, along with the registered varieties of lemon balm *Melissa officinalis* L. subsp. *officinalis,* there is a sample of *Melissa altissima - M. officinalis* L. subsp. *altissima* (Smith.) Arcang. A preliminary study of the collection sample showed that *M. altissima*is characterized by a higher yield of green mass, has a medicinal component composition of essential oils that differs from *M. officinalis*, and may be of interest both for the perfumery and cosmetics industry and for using as a component of tea compositions for food purposes. *M. altissima* significant antipsoriatic in vivo activity open considerable therapeutic capabilities against this severe autoimmune disease (Ulianych et al., 2019).

In selective breeding studies of high-potential species (subspecies) of plants that were previously not used for cropping, a comparative test of breeding samples with varieties of related species (subspecies) is often carried out (Dimas et al., 2020).

The aim of this research is to study morphological and biological parameters and productivity parameters of promising MD 1–17*M. M.officinalis* subsp. *altissima* variety sample in comparison with Krymchanka (selected in the Research Institute of Agriculture of Crimea (RIAC)) and Lada (All-Russian research Institute of medicinal and aromatic plants (VILAR)) varieties of M. *officinalis* subsp. *officinalis*. Selection trials are carried out in the Department of Essential Oils and Medicinal Plants of the (RIAC), aimed at creating highly productive varieties of a number of essential-oil plants.

MATERIALS AND METHODS

The study was conducted in 2017–2019 in the Department of Essential Oils and Medicinal Plants of the RIAC. The experimental site was located in the eastern part of Crimea (village Krymskaya Roza, Belogorsky district). The climate of this region is moderately continental. This area belongs to one of the five agroclimatic regions –upper piedmont, warm, not enough humid; to the northern subarea with moderately mild winters (Savchuk, 2006). According to long-term meteorological observations, average annual air temperature in the village Krymskaya Roza is 10 °C. Period with positive air temperature lasts for 292 days a year. Average temperature of the warmest month, July, is +21 °C, that of the coldest, January, is –0.8 °C. Temperature maximum in summer up to 40 °C and minimum in winter down to – 30–35 °C is possible. Average long-term amount of precipitation is 498 mm, during the growing season – 280 mm. Average annual humidity is 70%. Hydrothermal coefficient is 0.91 what indicates arid weather conditions. Soil at the study site is southern carbonate heavy loamy chernozem (pH – 7.0–7.2, humus content in arable layer – 2.7–3.0%, total nitrogen – 0.12%, phosphorus – 0.10%, potassium – 1.0%).

A nursery for competitive variety trial (CVT) was established on April 05, 2017. Seedlings of tested variety samples were obtained by vegetative propagation (rooting of green cuttings). The length of double row plots was 5 m, space between rows – 0.6 m, plot area – 6 m^2. The number of plants in the plot was 34 (17 plants per row). The experiment was carried out in three replications.

Registration and analysis of basic morphological and biological parameters (plant height and diameter, ratio of fresh and air-dried mass of raw materials, structure of fresh and air-dried raw materials), productivity parameters (productivity of fresh and air-dried raw materials, amount of obtained essential oil) and biochemical parameters (content of essential oil in fresh and air-dried raw materials) was carried out in full blossom phase in accordance with the guidelines for essential-oil plants (Biochemical methods…, 1972; Selection of essential-oil plants, 1977).

Chromatographic analysis of the composition of essential oil was carried out using Crystal 5000.2 gas chromatograph under the following technical conditions: carrier gas –helium A grade; type of detector – flame ionization; capillary column CR-WAXms 30 m×0.32 mm; film thickness in stationary phase – 0.5 μm; detector temperature – 250 °C; evaporator temperature – 230 °C; carrier gas flow rate – 1.9 mL min^{-1}. Starting temperature of the column is 75 °C with an exposure of 1 minute; heating rate 4 °C min^{-1}; final column temperature 220 °C without exposure; analysis duration – 37.3 min; split ratio 1:20. Components were defined by comparing the chromatographic profiles of essential oil (fingerprints method) after preliminary analysis of samples using Agilent Technologies 6890N gas chromatograph/mass spectrometer with Agilent 5973N mass selective detector and Crystal 5000.2 chromatograph under the same chromatographic conditions (Zenkevich et al., 2003; Leontiev et al., 2006).

Statistical processing of the obtained data was performed according to B.A. Dospekhov using software package Microsoft Office Excel 2010 (Dospekhov, 2012).

RESULTS AND DISCUSSION

Weather conditions during the years of competitive variety trial varied significantly. It should be noted that contrasting conditions are very useful for selection trials since they allow evaluating the adaptability of studied variety samples and forecasting the nature of productivity potential realization in different growing conditions. As one can see in Fig. 1, in the years of conducting the competitive trial, during the period from plant growth to blooming phase, temperature conditions of all months, except for April, exceeded long-term average values (norm). Maximum temperature in April-May when vegetal mass was actively growing was noted in 2018. The highest temperatures in June were in 2019.

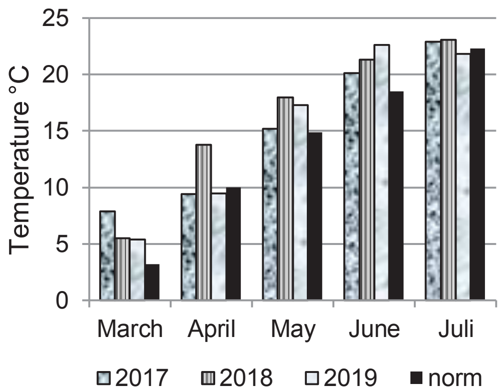

Figure 1. **T**emperature conditions (°C) of the periods of active vegetation, 2017–2019.

The period of active vegetation during the years of study was the most contrasting by the amount of precipitation (Fig. 2).

The maximum amount of precipitation significantly exceeding long-term average values (norm) of April and May was in 2017. Conditions in 2019 were arider, but in 2018, this period turned out to be extremely hot and arid. The amount of precipitation registered in May 2018 was due to single productive rain (30 mm) in the first decade. The difference in weather conditions led to different periods of time required for the ontogenesis phases.

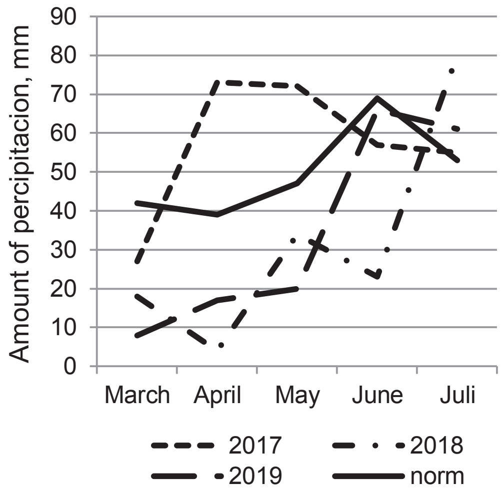

Figure 2. Amount of precipitation (mm) during the period of active vegetation, 2017–2019.

The nursery was founded on April 05, 2017. Measurements were performed during the blossom period, on July 10–11. In 2018, the start of plant growth was noted on March 05. Blooming occurred much earlier than in the previous year due to extreme weather conditions. The measurements were conducted were performed on June 15 (*M. officinalis*) and June 21 (*M. altissima*). In 2019, growing was noted on April 26, and count was performed on July 01.

Analysis of morphological and biological parameters of the plants of studied samples showed that Krymchanka and Lada lemon balm varieties are similar in plant height which is, on average, 49.9 and 55.4 cm, respectively (Table 1). Plants of MD 1–17 sample have a significantly greater height with the average value of 82.0 cm what is 27–32 cm higher than that of plants of the compared varieties.

When drying fresh raw materials of both varieties, its weight decreases, on average, by 2.8 times. The weight of air-dried raw materials of MD 1–17 sample is 3.5 times less than the weight of fresh raw materials.

As a result of analysis of the structure of raw materials, it was found that the weight of fresh raw materials without stems (leaves and inflorescences) in varieties is 69.5% of the total weight, and in MD 1–17 sample it is less, on average, by 11%. The difference between these parameters for air-dried weight is 6.5%.

The loss of more moisture during drying of fresh raw materials, as well as a smaller proportion of inflorescences and leaves in the structure of raw materials in MD 1–17 sample are due to the more massive stem.

M. officinalis subsp. *altissima* plants significantly exceed *M. officinalis* subsp. *officinalis* in height and have a denser leaf blade. Higher quantitative parameters of plants can be associated with different ploidy of subspecies. In a number of literary sources, it is specified that the chromosome set of *M. officinalis* subsp. *altissima* includes 64 chromosomes and that of *M. officinalis* subsp. *officinalis* – 32 chromosomes (Miceli et al., 2006; Kittler et al., 2015). It is known that polyploidy causes an increase in a number of quantitative parameters (plant height, leaf thickness, etc.) (Javadian et al., 2017; Vershinina et al., 2017; Wang et al., 2017; Aqafarini et al., 2019).

Table 1. Characteristics of morphological parameters of lemon balm variety samples. CVT, 2017–2019

Variety sample	Bush height, cm	Bush diameter, cm	Ratio of air-dried weight of raw materials to the weight of fresh raw materials, %	Share of inflorescences and leaves in the total weight of fresh raw materials, %	Share of inflorescences and leaves in the total weight of air-dried raw materials, %
2017					
Krymchanka	46.4	61.9	33.4	78.5	65.3
Lada	47.4	64.4	35.6	78.4	64.9
MD 1–17	70.9	60.7	21.0	66.3	64.9
$LSD_{0.5}$	3.4	3.9			
2018					
Krymchanka	53.0	73.0	37.0	65.7	59.1
Lada	62.3	76.0	37.5	66.6	60.6
MD 1–17	86.7	84.0	34.8	55.5	50.5
$LSD_{0.5}$	7.4	10.1			
2019					
Krymchanka	51.1	62.3	33.9	64.3	62.4
Lada	55.4	60.9	34.6	63.1	61.3
MD 1–17	88.8	75.5	28.8	53.6	51.9
$LSD_{0.5}$	4.3	6.0			
Average for 2017–2019					
Krymchanka	49.9	65.7	34.8	69.5	62.3
Lada	55.4	67.1	35.9	69.4	62.3
MD 1–17	82.0	77.3	28.2	58.5	55.8
$LSD_{0.5}$byfactor A (sample)	3.6	4.4			
$LSD_{0.5}$by factor B (year)	3.6	4.4			

Studying productivity parameters revealed the absence of significant differences between Krymchanka and Lada varieties in terms of yield of both fresh and air-dried raw materials (Table 2).

The lowest yield of raw materials was registered in the 1st year of trial (year of nursery foundation). The total yield of fresh raw materials of MD 1–17 variety sample in 2017 did not significantly differ from that of Lada and exceeded the yield of Krymchanka.

The samples did not differ in the yield of air-dried raw materials.

The productivity of fresh and air-dried raw materials of MD 1–17 variety sample without stems significantly exceeded the yield of varieties only in the third yearwhat is due to a high proportion of stems in the total weight.

It should be noted that the yield of raw materials of both Krymchanka and Lada variety did not differ in the 2nd and 3rd years of vegetation while that of MD 1–17 variety sample was the highest in the 3rd year of vegetation.

In addition to more active growth of vegetativebiomass due to the increased age of plants, different weather conditions during these years had a significant effect on yield. Genotype and year showed the equal effect on the formation of fresh raw materials (proportion of influence was 0.4 and 0.4), and for the air-dried weight of raw material, the influence of weather conditions during a year was more significant compared with this of genotype (proportion of influence was 0.6 and 0.16, respectively).

Table 2. Characteristics of economically valuable parameters of lemon balm varieties during the years of competitive variety trial (CVT)

Variety sample	Parameter	Green crop, t ha^{-1}		Weight content of essential oil, %			Amount of obtained essential oil, kg ha^{-1}	
		fresh raw materials	air-dried raw materials[1]	in fresh raw materials	in absolutely dried raw materials	in air-dried raw materials	from fresh raw materials	from air-dried raw materials
2017								
Krymchanka	total	6.93	2.34	0.046	0.144	0.192	3.15	4.49
Lada	weight	8.32	2.96	0.000	0.000	0.062	0.00	1.23
MD 1–17	of raw	10.48	2.21	0.027	0.082	0.137	2.80	3.01
$LSD_{0.5}$	materials	**2.84**	**0.90**	**0.010**	**0.030**	**0.080**	**2.03**	**1.88**
Krymchanka	weight	5.44	1.52	0.083	0.262	0.392	4.30	5.85
Lada	without	6.36	1.91	0.029	0.092	0.146	1.89	2.83
MD 1–17	stems	6.96	1.43	0.087	0.267	0.291	6.08	4.17
$LSD_{0.5}$		**2.54**	**0.38**	**0.050**	**0.140**	**0.120**	**2.37**	**2.22**
2018								
Krymchanka	total	12.22	4.55	0.046	0.151	0.083	5.73	3.86
Lada	weight	13.56	5.06	0.013	0.041	0.050	1.76	2.53
MD 1–17	of raw	18.33	6.39	0.038	0.121	0.117	6.97	7.45
$LSD_{0.5}$	materials	**2.83**	**1.21**	**0.020**	**0.060**	**0.030**	**3.04**	**2.46**
Krymchanka	weight	8.28	2.67	0.100	0.329	0.200	8.19	5.28
Lada	without	9.06	3.06	0.053	0.179	0.092	4.85	2.82
MD 1–17	stems	10.11	3.28	0.063	0.200	0.258	6.37	8.46
$LSD_{0.5}$		**2.43**	**0.78**	**0.030**	**0.100**	**0.050**	**2.14**	**2.27**
2019								
Krymchanka	total	12.11	3.80	0.027	0.087	0.113	3.16	4.29
Lada	weight	12.33	4.27	0.000	0.000	0.046	0.00	1.96
MD 1–17	of raw	26.67	7.67	0.015	0.047	0.121	3.93	9.24
$LSD_{0.5}$	materials	**2.65**	**0.16**	**0.028**	**0.089**	**0.010**	**3.38**	**1.24**
Krymchanka	weight	7.83	2.37	0.054	0.183	0.162	4.19	3.83
Lada	without	7.78	2.62	0.020	0.070	0.079	1.59	1.82
MD 1–17	stems	14.27	3.98	0.073	0.233	0.242	10.42	9.63
$LSD_{0.5}$		**2.32**	**0.68**	**0.011**	**0.040**	**0.041**	**1.12**	**1.54**

[1]Weight of air-dried raw materials was calculated based on the weight loss during drying of raw materials (%) and the ratio of plant parts in air-dried raw materials (%).

Spring 2019 that was colder in comparison to 2018 hindered the formation of a high yield of raw materials expected for the 3rd year of vegetation. In general, according to the results of three years of competitive variety trial, MD 1–17 *M. officinalis* subsp. *altissima* variety significantly exceeded Krymchanka and Lada *M. officinalis* subsp. *officinalis* varieties inproductivity of fresh and air-dried raw materials (Table 3).

Table 3. Comparative analysis of economically valuable parameters of lemon balm varieties, CVT, 2017–2019

Variety sample (factor A)	Year (factor B)	Green crop, t ha^{-1}		Weight content of essential oil, %			Amount of obtained essential oil, kg ha^{-1}	
		fresh raw materials	air-dried raw materials	in fresh raw materials	in absolutely dry raw materials	air-dried raw materials	fresh raw materials	air-dried raw materials
Total weight of raw materials								
M. officinalis subsp. *officinalis*, Krymchanka variety	2017	6.94	2.34	0.046	0.144	0.192	3.15	4.49
	2018	12.22	4.55	0.046	0.151	0.083	5.73	3.86
	2019	12.11	3.80	0.027	0.087	0.113	3.16	4.29
	average	**10.42**	**3.56**	**0.040**	**0.128**	**0.129**	**4.01**	**4.21**
M. officinalis subsp. *officinalis* Lada variety	2017	8.32	2.96	0.000	0.000	0.062	0.00	1.23
	2018	13.56	5.06	0.013	0.041	0.050	1.76	2.53
	2019	12.33	4.27	0.000	0.000	0.046	0.00	1.96
	average	**11.40**	**4.10**	**0.004**	**0.014**	**0.053**	**0.59**	**2.13**
M. officinalis L.subsp. *altissima* (Sm.) Arcang. MD 1–17 variety sample	2017	10.47	2.21	0.027	0.082	0.137	2.80	3.01
	2018	18.33	6.39	0.038	0.121	0.117	6.97	7.45
	2019	26.67	7.67	0.015	0.047	0.121	3.93	9.24
	average	**18.49**	**5.42**	**0.026**	**0.083**	**0.125**	**4.57**	**6.58**
$LSD_{05\ factor\ A}$		1.17	0.44	0.009	0.030	0.020	1.13	0.89
$LSD_{05\ factor\ B}$		1.17	0.44	0.009	0.030	0.020	1.13	0.89
Weight without stems								
M. officinalis subsp. *officinalis*, Krymchanka variety	2017	5.44	1.52	0.083	0.262	0.392	4.30	5.85
	2018	8.28	2.67	0.100	0.329	0.200	8.19	5.28
	2019	7.83	2.37	0.054	0.183	0.162	4.19	3.83
	average	**7.18**	**2.18**	**0.079**	**0.258**	**0.251**	**5.56**	**4.99**
M. officinalis subsp. *officinalis* Lada variety	2017	6.36	1.91	0.029	0.092	0.146	1.89	2.83
	2018	9.06	3.06	0.053	0.179	0.092	4.85	2.82
	2019	7.79	2.62	0.020	0.070	0.079	1.59	2.07
	average	**7.73**	**2.53**	**0.034**	**0.113**	**0.105**	**2.78**	**2.57**
M. officinalis L.subsp. *altissima* (Sm.) Arcang. MD 1–17 variety sample	2017	6.96	1.43	0.087	0.267	0.291	6.08	4.17
	2018	10.11	3.28	0.063	0.200	0.258	6.37	8.46
	2019	14.27	3.98	0.073	0.233	0.242	10.42	9.63
	average	**10.45**	**2.90**	**0.074**	**0.233**	**0.264**	**7.63**	**7.42**
$LSD_{05\ factor\ A}$		0.99	0.25	0.016	0.047	0.032	0.93	0.88
$LSD_{05\ factor\ B}$		0.99	0.25	0.016	0.047	0.032	0.93	0.88

Comparison of variety samples in the content of essential oil should be correctly performed according to the mass fraction of essential oil in absolutely dry and air-dried raw materials (Tables 2, 3). The lowest value of this parameter for all years of trial was typical for Lada variety. In 2017 and 2019, in the total weight of fresh raw materials of this variety, only traces of essential oil were found, and only in extremely hot and arid year such as 2018, the content of essential oil in absolutely dry raw materials amounted to 0.041%.Regarding the other two varieties, the content of essential oil in the total weight of absolutely dry raw materials was higher in 2017 and 2019 in Krymchanka variety in comparison with MD 1–17 variety sample; in 2018, differences between them were unreliable. The content of essential oil in absolutely dry raw materials (without stems which are dead weight since they actually have no secretory reservoirs) in 2017 was equal in these varieties in 2018, it was higher in Krymchanka variety, in 2019 – in MD 1–17 sample.

Differences between these varieties in terms of the content of essential oil in air-dried raw materials in 2017 and 2019 are insignificant, and in 2018, this parameter was higher in MD 1–17 variety.

In general, according to the results of the competitive variety trial, the content of essential oil in the total weight of absolutely dry raw materials was higher in Krymchanka variety. For all other characteristics, the parameters of Krymchanka and MD 1–17 variety sample had no significant difference (Table 3).

Different intensity of essential oil accumulation in fresh raw materials over these years is associated with differences in weather conditions. Favorable conditions for oil-forming process are high air temperature and minimal rainfall. Summer 2018 would most of best correspond to such requirements. But extreme aridity obviously did not allow accomplishing productivity potential of studied varieties in full.

The content of essential oil in air-dried raw materials, as a rule, did not differ over these years regardless of weather conditions. The basic factor influencing essential oil accumulation is the genotype of the sample (proportion of influence was 0.5–0.6).

The highest amount of essential oil from fresh raw materials for all samples was obtained in 2018 with its extreme weather conditions; it happened due to a combination of increased yield and high content of essential oil in raw materials (Table 2, 3). Lack of precipitation and relatively low temperatures in spring 2019 prevented Krymchanka and Lada varieties from forming a high yield of raw materials. Active growth of vegetal mass compared to the previous year was observed just in MD 1–17 variety sample. Intensive rains during blooming period did not contribute to the accumulation of essential oil, despite high temperatures in June.

In general, according to competitive variety trial, Lada variety was characterized by the lowest amount of obtained essential oil (Table 3). MD 1–17 variety sample significantly exceeds Krymchanka variety in the amount of essential oil during processing of fresh raw materials without stems and air-dried raw materials.

An important parameter that determines the value of essential oil and main directions of its use is the composition and content of basic components. Basic components of lemon balm essential oil, as a rule, include:citral, citronellal, geraniol, citronellol, caryophyllene (Belgin et al., 2009; Sharafzadeh et al., 2011; Mesut Uyanik & Bilal Gurbuz, 2014; Efremov et al., 2015). As the comparison of literature data and obtained information showed, we are talking about *M. officinalis* subsp. *officinalis*. However, the ratio of components in essential oil is very unstable and depends on many factors. This statement applies to all essential-oil plants in general, as evidenced by information from many scientific publications (Alban Ibraliu et al., 2011; Morozov et al., 2015; Shelepova& Khusnetdinova, 2018).

When studying the subspecies *M. officinalis* L. subsp. *altissima*, a number of researchers found that basic components of its essential oil are caryophyllene and germacrene D (Van den Berg et al., 1997; Basta et al., 2005; Božović et al., 2018).

During competitive variety trial, the analysis of component composition of essential oil of lemon balm samples was carried out (Table 4).

Table 4. Comparative analysis of component composition of essential oil of lemon balm varieties. CVT, 2017–2019

Variety sample	Raw materials	Year	Caryo-phyllene	Caryophyllene oxide	Citral			Germacrene D
					neral	geranial	total	
Fresh raw materials								
M. officinalis subsp. *Officinalis* Krymchanka variety	total weight	2017	16.4	1.9	14.1	20.6	34.7	15.4
		2018	14.5	2.5	2.4	4.3	8.7	24.4
		2019	19.4	1.6	5.8	11.3	17.1	23.1
	without stems	2017	17.1	2.2	12.6	20.6	33.2	16.9
		2018	18.4	2.1	7.6	12.7	20.3	17.9
		2019	19.5	1.3	9.0	15.6	24.6	22.1
M. officinalis subsp. *officinalis* Lada variety	total weight	2017	19.4	2.4	7.3	11.0	17.3	19.1
		2018[1]	-	-	-	-	-	-
		2019[1]	-	-	-	-	-	-
	without stems	2017	16.6	1.9	14.5	22.1	36.6	11.8
		2018	18.9	6.1	8.9	14.3	23.2	14.9
		2019	17.8	3.1	2.8	7.7	10.5	26.5
M. officinalis subsp. *altissima* MD 1–17 variety sample	total weight	2017	**35.9**	**1.9**	**0.1**	**0.0**	**0.1**	**17.7**
		2018	**30.9**	**3.6**	**0.6**	**0.3**	**0.9**	**22.6**
		2019	**25.3**	**4.4**	**2.4**	**0.6**	**3.0**	**27.7**
	without stems	2017	**29.9**	**2.1**	**1.9**	**3.6**	**5.5**	**29.5**
		2018	**34.3**	**2.7**	**0.5**	**0.6**	**1.1**	**23.0**
		2019	**26.6**	**1.7**	**2.3**	**5.0**	**7.3**	**31.2**
Air-dried materials								
M. officinalis subsp. *officinalis* Krymchanka variety	total weight	2017	18.2	1.8	14.6	21.8	36.4	16.3
		2018	11.9	17.9	3.1	6.1	9.2	12.3
		2019	14.1	16.5	7.2	14.0	21.2	10.6
	without stems	2017	19.0	1.9	18.6	25.9	44.4	13.7
		2018	15.4	13.0	6.9	12.1	19.0	12.0
		2019	15.4	12.8	10.2	18.4	28.6	9.5
M. officinalis subsp. *officinalis* Lada variety	total weight	2017	22.6	2.2	8.4	13.4	21.8	21.1
		2018	10.7	19.4	3.9	6.9	10.8	11.0
		2019	17.4	12.9	6.1	11.9	18.0	13.3
	without stems	2017	18.7	1.7	13.4	19.2	32.6	17.0
		2018	14.4	13.4	9.4	17.4	26.8	9.6
		2019	16.4	11.4	10.0	18.2	28.2	11.0
M. officinalis subsp. *altissima* MD 1–17 variety sample	total weight	2017	**25.3**	**2.4**	**0.9**	**1.1**	**2.0**	**27.6**
		2018	**29.5**	**9.7**	**1.1**	**2.5**	**3.6**	**19.3**
		2019	**26.5**	**7.0**	**2.0**	**0.1**	**2.1**	**29.9**
	without stems	2017	**25.4**	**1.9**	**1.1**	**1.2**	**2.3**	**21.8**
		2018	**31.4**	**7.3**	**1.1**	**2.8**	**3.9**	**21.8**
		2019	**25.2**	**7.6**	**2.0**	**0.1**	**2.1**	**31.2**

[1]Component composition was not defined due to insufficient or lack of essential oil.

Basic component of the essential oil of both varieties of lemon balm (*M. officinalis* subsp. *officinalis*) is citral (a mixture of isomers – E-geranial and Z-neral). Citral content varied significantly from year to year from 8.8 to 36.6%. Based on the data obtained, it can be assumed that the optimal conditions for the accumulation of citral in essential oil are increased humidity and high air temperature.

In addition to citral, essential oil from fresh raw materials of lemon balm varieties also contains caryophyllene (14.5–19.5%) and germacrene D (11.8–26.5%) in significant quantities. The content of these components turned out to be more stable over the years in both varieties.

Component composition of MD 1–17 *M. officinalis* L. subsp. *altissima* variety sample significantly differed from the composition of essential oils in the compared varieties what is in accordance with published data (Efremov et al., 2015; Aqafarini et al., 2019). Its basic components are caryophyllene (25.3–35.9%) and germacrene D (17.7–31.2%) with almost complete absence or insignificant amount of citral (0.1–7.3%) (Table 4).

A comparative analysis of extractives content in the air-dried raw materials of *M. officinalis* of the studied varieties was carried out in the Department of the Processing and Standardization of Essential Oil Raw Materials of the RIAC. In accordance with the current standard (FS 42-3645-98 'Melissa officinalis herb'), at least 22% of extractives should be contained in lemon balm raw materials.In all three varieties Krymchanka, Lada, and MD 1–17, the content of extractives exceeded this value and amounted to 42.3; 39.0 and 28.1%, respectively.

CONCLUSIONS

As a result of the comperative variety trial of MD 1–17 variety sample of *M. officinalis* L. subsp. *altissima* (Smith.) Arcang in comparison with Lada and Krymchanka varieties of *M. officinalis* L. subsp. *officinalis*, it was revealed that the studied variety sample:

– exceeds varieties in the yield of fresh raw materials, on average, by 62.2 and 77.4%, respectively; by the yield of air-dried raw materials, on average, by 32.2 and 52.2%, respectively;

– considering the amount of essential oil from air-dried raw materials, it significantly exceeds the best Krymchankavariety by 56.3%;

– differs from varieties in the composition of essential oil. Its basic components are caryophyllene (25.3–35.9%) and germacrene D (17.7–31.2%) with a small amount of citral (0.1–7.3%); proportion of the latterin the essential oil of Krymchanka and Lada varieties reached a maximum of 36.6%.

Data obtained allow applying for registration of a new lemon balm variety Tavrida.

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