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Influence of feeding area on productivity of medicinal balm at seedling method of growing

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The purpose. To determine regularities of influence of feeding area on productivity and quality of raw material of medicinal balm at seedling method of growing in conditions of dropping irrigation. **Methods.** Methodical approaches which are applied in domestic practice and medicinal plant growing are used. In particular, development of schemes of experiments was executed according to B.A. Dospehov and M.M. Gorianskiy techniques. Sampling of plants, biometric measurements and phenological observations were spent in view of specific features of medicinal crops according to A.I. Brykin and A.A. Porada techniques. Damp of roots layer of soil during vegetation was maintained at the level of 80% of the least humidity. **Results.** Dependence of productivity of balm on feeding area of plants is established. It is determined that with increase in amount of plants at 1 hectare up to 83 thousand plants/hectare productivity of grass raises up to 4.53 t/hectare in the first year of vegetation, and to 6.99 t/hectare in the second year. The further increase of amount of plants decreases productivity of crop. Regularity of increase in share of a leaf in raw material from 63.1 up to 69.5% is fixed at increase of feeding area from 167 up to 42 thousand plants/hectare. Results of phyto-chemical probes specify that high content of essential oil (0.72%) is fixed for alternative with firmness of planting 56 thousand plants/hectare. **Conclusion.** It is proved that high productivity of raw material of balm is ensured with its cultivation at firmness of planting 83 thousand plants/hectare. For deriving high quality raw material, concerning content of essential oil, the amount of plants for 1 hectare should not exceed 53 thousand.

Key words: *medicinal balm, feeding area, growth and development, productivity, quality of raw material.*

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Plants are an indispensable source for receiving diverse medicines. Among all the drugs used in the area of modern medicine phytopreparations occupy about 40% [1, 2]. The growth of popularity of herbal medicines promotes the growth of the world market medical vegetable raw materials that by estimates of analysts exceeds 60 billion US dollars [1].

According to the State Statistics Service in Ukraine, 50 species of medicinal plants are grown on an area of more than 16 thousand hectares. Climate change, imperfect cultivation technologies are among the most important determinants that affect the volume of crop areas of medicinal and essential oil crops. Today, the domestic pharmaceutical industry produces a significant list of therapeutic and prophylactic preparations from plant material, according to experts, further growth is projected, both by volumes of production and the range of phytopreparations [3, 4].

In the world practice, Melissa is widely cultivated in Russia, Germany, Turkey, the USA and other countries. On the territory of Ukraine, it is grown in the conditions of culture, but sometimes in the Crimea, it becomes wild and can be seen in forest lawns, on the banks of reservoirs and roadsides.

Melissa Officinalis (Melissa officinalis L.) is a perennial herbaceous plant of the Lamiaceae family with a pleasant lemon flavor. Melissa raw material is an overland part (grass), which has been widely used by traditional medicine since old times. It can be used in the pharmaceutical, food and cosmetic industries. It is widely used as a sedative during general nervous excitement, migraines, insomnia, impaired rhythm of the heart, changes in blood pressure under the influence of emotional excitement, as well as with digestive disorders, gastritis, colitis, etc. [2, 5, 6].

In recent years, the demand for dried Melissa grass has been increased and stabilized at the expense of exports from Poland, Egypt, Turkey, India and China. In this regard, there is a need to expand the sown area of culture, which in turn prompts the development of new intensive technologies and the improvement of existing cultivation technologies.

The research on the development of the seedling method of growing medicinal cultures is carried out in most European countries; their main areas are the studying and implementation of energy-saving and environmentally sound cultivation technologies. In particular, Turkish scientists made researches to study the influence of the nutrition area of Melissa Medicinal on the yield and quality of raw materials in the conditions of Phrakiiskyi region of Northwest Turkey. The highest yield (11167 kg / ha) was obtained in the second year of vegetation under the growing scheme of 40 x 20 cm. The content of essential oil (0.20-0.28%) did not significantly change in the variants of research [7, 8].

For the studying of the influence of the nutrition area on its productivity in Egypt, it was found out that the increase in the number of plants per unit area contributed to the increase in the productivity of raw materials of culture, and the decrease in the number of plants contributed to their better growth and development [5].

The development of new cultivation technologies, agro-measures and their introduction into production will allow not only to reduce the cost of cultivating of raw materials of Melissa, but also to increase its quality. It will also allow to stabilize the domestic raw material base of this culture for the needs of chemical and pharmaceutical, food and perfume and cosmetic industry of Ukraine.

To solve this problem, different researches and studies were conducted to determine the regularities of the nutrition area influence on the productivity and quality of raw material of Melissa. The seedling method of cultivation is quite promising, it is confirmed by the results of studies in vegetable growing and the cultivation of certain types of medicinal plants, in particular valerian medicines and echinacea purpurea [7, 9].

The purpose of the work is to find out the regularities of nutrition area influence on the productivity and quality of Melissa using the seedling method of cultivation in conditions of drip irrigation.

Materials and methods of research: the research was conducted during 2016-2018 at the Experimental Station of Medicinal Plants, IAP NAN.

The research object was Melissa, its improved item.

During scientific research, methodological approaches used in domestic practice and in medicinal plant growing were taking into consideration. In particular, the development of schemes of experiments was carried out according to the methods of Dospekhov B.O. and Horianskyi M.M. The selection of plant samples, biometric measurements and phenological observations were carried out taking into account the characteristics of medicinal crops by methods of A.I.Brykin and O.A. Porada [10-13].

On the area where the experiment was held, there was used pure pair. The soil of the experimental field is powerful, low-humus black earth; the capacity of the humus horizon is 87-100 cm. The reaction of the soil solution is slightly acid; the soil is characterized as medium acidic. The soil is provided with the main elements of nutrition: easily hydrolyzed nitrogen - low, mobile phosphorus – very high, exchangeable potassium – elevated. By the amount of salts, the soil belongs to unreached. The total size of the area is 25-45 m2, accounting – 20-30 m2, with a four-time repetition.

The seedlings were planted into the soil in the second decade of May under the following schemes:

60 x 10 cm (167 thousand plants / ha);
60 x 20 cm (83 thousand plants / ha);
60 x 30 cm (56 thousand plants / ha);
60 x 40 cm (42 thousand plants / ha).

The experimental area of Melissa was planted with seedlings of 8-10 cm in the phase of 4-5 pairs of real leaves.

During this process, the drip irrigation system was installed; the moisture content of the root-bearing soil layer during vegetation was maintained at 80% of the minimum moisture content.

The quality of the raw material of Melissa was determined by the content of essential oils according to the method of microtesting developed by the Experimental Station of Medicinal plants IAP NAAS.

The research results: the first stage of the study was to determine the regularities of the influence of the nutrition area on the linear sizes of Melissa Medicinal plants. During the studying of the influence of the nutrition area on the plant height, there was admitted the tendency of height increase when the nutrition area was decreased. According to the results of the first-year vegetation studies, the most intense plant growth in the variant with seedlings planting density was noted at 166.7 thousand plants / ha, where the average plant height was 49.1 cm. The smallest indicators in height were 38.8 and 42.9 cm in variants with plant density 41700 kg / ha and 55,600 kg / ha. However, there was clearly seen a regularity of increasing of the output of raw materials aboveground part of the plant with the increase of nutrition area. So, the smallest output of 79.9 g / plant was fixed in the variant with the smallest plant nutrition area – 60x10 cm (166.7 thousand plants/ha). With the increase of the nutrition area up to 83.3 thousand plants per hectare, the yield of raw material from one plant increased to 195.8 g. The largest yield of raw material from one plant was 296.2 g recorded for the density of planting 41.7 thousand plants/ha (Table 1).

1. Influence of nutrition area on the growth and the development of Melissa during the first year of vegetation in the condition of drip irrigation

The scheme of planting seedlings, cm (thousand of plants/ha)	Height of plants in the flowering phase, cm	Weight of the aboveground part g / plant.	Area of leaves, m2 / plants
60x10 (166,7)	49,1	79,9	0,102
60x20 (83,3)	45,3	195,8	0,258
60x30 (55,6)	42,9	264,0	0,474
60x40 (41,7)	38,8	296,2	0,543
$HIP_{0,5}$	0,8	4,3	0,23

During this research, the regularities of the influence of the nutrition area on the area of the leaf surface of Melissa were admitted. It was established that with an increase of the nutrition area of plants, the area of leaves also increases. Thus, in the flowering phase of Melissa, the smallest leaf area - 0,102 m2 / plants was with the variant 60x10 cm (166.7 thousand plants / ha), the largest one was 0.543 m2 / plants, according to the plan of planting 60x40 cm (41.7 thousand plants / ha).

Data analysis of the yield of Melissa dry grass during the 1st year of vegetation depending on the area of plant nutrition lead to the conclusion that the best raw material yield is a variant with a planting density of 83.3 thousand plants / ha, where the yield is 4.53 thousand plants/ ha, further increase in the number of plants per unit area to 166.7 thousand plantss / ha reduces yields to 3.69 tons / ha. The minimum yield of dry raw material of 3.45 t / ha per unit area during the 1 st year of vegetation was obtained in the variant with the lowest density of plant standing - 41.7 thousand plants / ha (Picture 1).

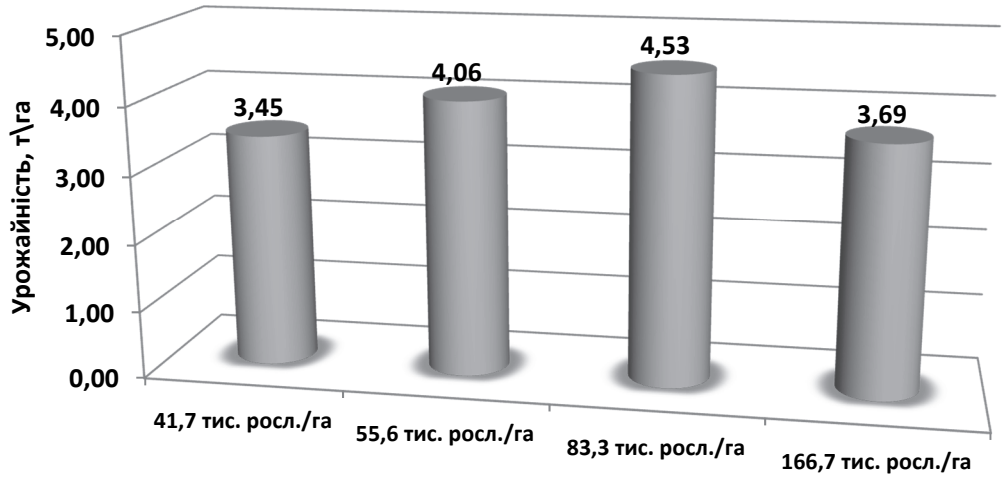

Fig. 1. Dependence of yield of Melissa dried grass during the first year of vegetation on the area of plant nutrition

The dependence of the productivity of Melissa dried grass of the 2 nd year of vegetation on the number of planted plants per unit area was established, and it was admitted that the yields decreased with the decreasing of plant density. Thus, the minimum yield of dry raw material of 5.5 t / ha per unit area was obtained in the variant with the lowest plant density – 41.7 thousand plants / ha. Analyzing the indices of the yield of Melissa dried grass depending on the area of plant nutrition, it was found out that the best yield is the variant with the planting density of 83.3 thousand plants / ha, where the yield during the 2nd year of vegetation was 6.99 tons / ha, a further increase in the number of plants to 166.7 thousand plants / ha led to the yield reduce (Fig. 2).

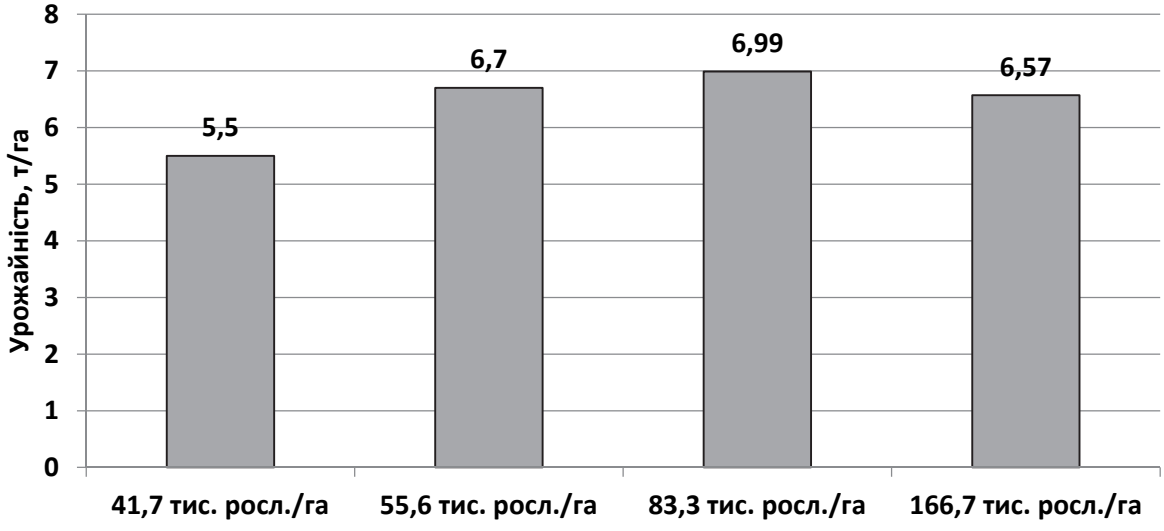

Fig. 2. Dependence of yield of Melissa dried grass during the second year of vegetation on the area of plant nutrition

The quality of Melissa raw material is mainly determined by the proportion of leaves in the aboveground part (grass) and the output of essential oils. Melissa structural analysis was carried out to evaluate the qualitative characteristics of the received raw material.

There was a tendency to increase the number of leaves in the raw material with the increase of Melissa nutrition area. Thus, the proportion of leaves (63.1%) was in the version with the density of 166.7 thousand plants / ha, the increase of plant nutrition by reducing the number of plants per hectare to 41.7 thousand hectares / ha increased the part of leaves to 69.5% (Picture 3).

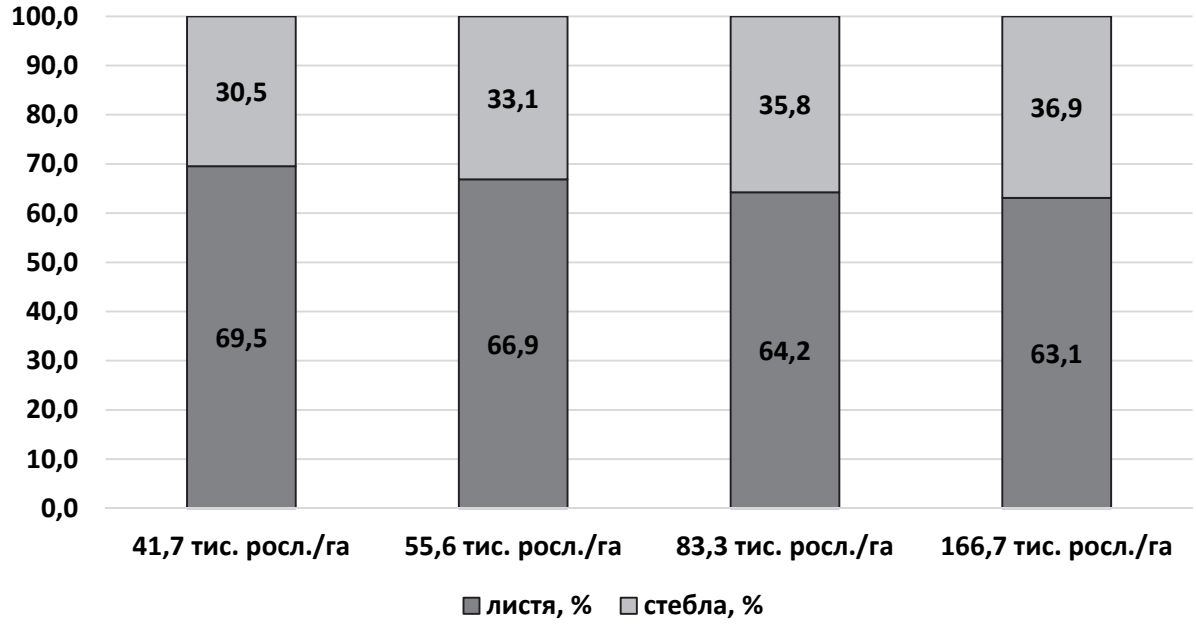

Fig. 3. The structure of the crop of Melissa officinalis depending on the nutrition area

Phytochemical studies in the laboratory of the Experimental Station of Medicinal Plants IAP NAN (Table 2) were carried out to determine the influence of the nutrition area on the content of essential oil in the raw material of Melissa.

2. Influence of nutrition area of plants on the content of essential oils in the raw material of Melissa during the first year of vegetation

Scheme of planting seedlings, cm (thousand plants /ha)	Essential oil content,%	Conditional yield of essential oil, kg / ha
60x10 (166,7)	0,53	20,25
60x20 (83,3)	0,72	31,32
60x30 (55,6)	0,57	25,59
60x40 (41,7)	0,35	14,74

The obtained results indicate that the content of essential oils in dry grass of Melissa was the best in the condition with the plant density of 55.6 thousand plants / ha, where this indicator was the highest – 0.72%. The increase in the number of plants reduced the content of essential oils, with the density of 83.3 thousand plants / ha containing 0.58%, and the density of 166.7 thousand plants / ha was even lower – 0.35%.

The largest conditional yield of essential oil from 1 hectare of 31.32 kg / ha was recorded in the version with the density of 55.6 thousand plants / ha. It was caused by the fact that in this variant raw material, dry grass, had a significant proportion of leaves (66.9%) with the highest content of essential oil, the stems of melissa practically don't contain any essential oils. Increasing the number of plants per unit area increased the yield of the crop, but at the same time reduced the content of essential oil and the percentage of leaves in the raw material, and as a consequence, it reduced the conditional yield of essential oil per unit area. The lowest value of this indicator (14.74 kg / ha) was recorded in the variant for the density 166.7 thousand kg / ha.

Conclusions

While the development and improvement of the elements of the technology of cultivation of Melissa Officinalis, certain regularities of the influence of nutrition area on the productivity and quality of raw materials have been identified.

The obtained results indicate that while increasing the nutrition area the height of plants decreases, the weight of the aboveground part and the area of the leaf surface increase. As for biometric growth and development, the most optimal scheme of cultivating melissa was 60x40 cm (41.7 thousand plants/ha). In this variant, the largest area of leaves was found to be 0,543 m2 / plants and the highest weight of the aboveground part is 296.2 g / plants.

Taking into consideration the output of raw materials per unit area, the best variant is with the planting density of 83.3 thousand plants / ha, where the yield during the first year was 4.53 t / ha, during the second 6.99 t / ha. The increase of plant density for more than 83.3 thousand / ha or the decrease of this indicator, reduces the yield of melissa.

It has been established that the content of essential oils in dry grass of Melissa is the best in the condition with the density of plants at 55.6 thousand plants / ha, where this indicator is the highest 0.72%.

Consequently, based on the results of the research, the schemes of 60x20 and 60x30 cm (55.6 to 83.3 thousand plants / ha) can be recommended for the cultivation of Melissa Officinalis. It guarantees the receipt of high yields of raw materials of the proper quality.

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