Effect of nitrogen and effective microorganisms on microelements content in lemon balm (*Melissa officinalis* L.) herb

Wpływ azotu i efektywnych mikroorganizmów na zawartość mikroelementów w zielu melisy lekarskiej (*Melisa officinalis* L.)

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The increasing demand for vegetable raw materials in medicine makes the more and more interest is enjoyed by herbs. Among them, lemon balm (*Melissa officinalis* L.) belongs to the family lamiaceae (Lamiaceae) is one of the most common herbs next to the mint, valerian, sage and chamomile. It comes from the Mediterranean, but in our climatic conditions is well acclimatised. Its advantages were known and used since antiquity for the preparation of medicines for calming the nerves, depression and headaches. Currently, leaves and herbs are a valuable resource for a wide range of applications in the pharmaceutical, cosmetic and food industries. A wide range of applications causes need to pay special attention to the chemical composition of this herb and its changes induced by various factors.

The paper presents results of research on the effects of nitrogen fertilization and effective microorganisms on the chemical composition of the lemon balm herb. The field experiment was conducted in 2011–2012 at the Experimental Station (Prusy near Krakow) belonging to the Institute of Crop Production University of Agriculture in Kraków. Experiment was established in three repetitions on degraded chernozem, formed from loess, belonging to very good wheat complex. Surface of plot to harvest was 1 m^2. The experiment comprised three factors: crop plants (with pruning, no pruning), fertilization (control, nitrogen, effective microorganisms) and date of herb harvest (twice a year in June and August). Uniform phosphorus and potassium fertilisation was applied: 70 kg P_2O_5 and 110 kg $K_2O \cdot ha^{-1}$ before experiment and next year in the spring. Nitrogen was applied in two doses of 40 kg $N \cdot ha^{-1}$: before planting and after herb harvest. Effective microorganisms were spraying on plant leaves as EM OGRÓD preparation. Herb was harvested before flowering. The samples of herb (leaves and stems) were subjected of dry mineralization in muffle furnace at 450°C, then digested in HNO_3 and next dissolved in HCl. Microelements were determined using ICP-OES method.

Microelements content in leaves lowered in next order: iron > manganese > zinc > copper, and in stems as follows: iron > manganese ≈ zinc > copper, independent on term of harvest. Microelements content in herb depended on studied factors. Pruning resulted in an increase of the content of iron, manganese and zinc, and to a lesser extent copper in leaves of first harvest. In next harvest this relation was confirmed only in case of copper, and manganese and zinc content was lower after pruning. There was no such visible relationship in the case of stems. Microelements contents, especially iron and copper, were generally higher in herb of control plants and lower in herb of plants from other objects. Leaves contained by around 2–6 times more iron, 2–4.5 times more manganese, 1.3–2 times more zinc and 1–1.8 times more copper than stems. Pruning widened these relations.