

INFLUENCE OF ECOLOGICAL FOLIAR FERTILIZERS ON YIELD AND MORPHOMETRIC PARAMETERS IN CULTIVATED MEDICINAL AND AROMATIC PLANTS (BASIL, MARIGOLD, ARTICHOKE)

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Abstract

The significance of cultivating aromatic and medicinal plants in ecological settings derives also from the fact that the usage of such species implies direct contact with humans, through consumption or otherwise. Enhanced knowledge of herbs and spices and their ecological cropping is required for a better exploitation of their outstanding properties and which are based on biologically active substances such as alkaloids, phenolic compounds or essential oils.

This paper includes the results of the research conducted within UASVM Iasi, Faculty of Agronomy, focused on the influence of ecological foliar fertilizers (Fylo®, Geolino Plants&Flowers®, Cropmax®, Fitokondi®) on the yield and morphological indices on medicinal and aromatic plants: basil, marigold and artichoke.

Our results showed positive effects of ecological foliar fertilizers on the investigated plant species, especially on the yield of fresh herbs.

Key words: *Ocimum basilicum* L., *Calendula officinalis* L., *Cynara scolymus* L., *Phytotherapy*, *Ecological foliar fertilization*

The alimentary role of vegetables has seen constant interest, but the therapeutic uses knew both ascending and descending periods. However, in the last decades, plants are increasingly used as medicinal agents and considered as a safer and friendlier alternative to synthetic products (Farnsworth R.N., Soejarto D.D., 1991). Synthesizing a plethora of bioactive compounds, largely grouped as alkaloids, phenolic and volatile oils (Harborne J.B. *et al*, 1999; Rai M., Chikindas M., 2011), plants are regarded as preventive and curative agents, when used raw or cooked in alimentation, as extracts of various kinds or in purified forms as commercial products. Plants offer stimulation or regulation of various physiological functions, effect anti-inflammatory, antimicrobial, antioxidative activities or bring essential nutrients and elements in the human nutrition (Grusak M.A., Penna D. D., 1999).

Considering the importance held by plants for humans, the constant increases in population numbers has been accompanied by corresponding increases in plant cultivated plant areas. This also led to the use of fertilizers, insecticides, herbicides

and fungicides, growth stimulators etc. to sustain production. However, synthetic agents usage in agriculture brought awareness about effects of these substances on the environment and humans, such as eutrophication, resistance, toxicity (Rembiałkowska E., 2007; Brown C.R., Brown T.R., 2014).

As such, alternatives are needed, to allow sustainable and ecological production. Many solutions have been proposed, which range from manual weeding, intercropping, mulching to the use of organic fertilizers or growth stimulators and biocontrol of pests. As a whole, the use of such techniques is intended to reduce the amounts of synthetic products in agricultural practices while providing high yields and quality.

Among cultivated plants, major categories are alimentary species and medicinal ones, with significant overlapping for many cases. Medicinal plants can be found in practically any family, with particular species being adapted to certain climatic conditions. In Romania, medicinal plants cultivation has a long tradition, some species being endemic for the territory. An established place in

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cultivation of such species is held by taxa such as *Calendula*, *Ocimum*, *Cynara*, which are grown for their therapeutic properties as well as for a culinary value (Robu T., Milică C., 2004; Păun E. *et al.*, 1988; Honermeier B. *et al.*, 2013).

Similar to global trends, medicinal plants cultivation in our country is expanding, however the agriculture has to meet global standards, which mainly relate to environmental friendly and sustainable practices. Therefore, research is needed to improve cultivation techniques by characterization of effects of organic, natural products which complement or replace synthetic variants which are used for fertilization to achieve higher yield and thus, to optimize terrain usage.

The aim of the current paper is to summarize some published results of research conducted at UASVM Iasi, regarding the influence of foliar ecological fertilizers on the yield and morphological parameters of basil, marigold and artichoke, with comparative approach.

MATERIAL AND METHOD

Plant material consisted of seeds of studied species which were obtained from different sources: the Botanical Garden – Chisinau, Republic Moldova (*Ocimum basilicum* L. cv "Cretisor"), the Ecological Farmer BioFarmland, Arad, Romania (*Calendula officinalis* L. cv. Orangefarbige) the collection of medicinal plants of University of Agricultural Sciences and Veterinary Medicine Iași, (UASVM) (*Cynara scolymus*). The experiment was located on the research field of the UASVM and established on April 16, 2015 (for *Cynara scolymus* L.), on 8th of May, 2015 (for *Calendula officinalis* L.) and on 12 June, 2015 (for *Ocimum basilicum* L.).

The latin square method was used for the cultivation of plants, in a complete randomized design with 3 replications.

The experimental field is located at 47°15' N and 27°30' E with the pedochemical parameters as follows: loamy chernozem, with medium granulation, higroscopicity index between 7.01 and 8.29 and a C/N ratio < 15 in the upper horizon, organic matter 3-4.1%, N 0.17-1.94 %, available P 38 ppm, available K 143-181 ppm, pH 7-7.3. The climatic conditions for 2015 were: 19.2°C mean temperature, 55.8% relative humidity and 180.6 mm precipitations as recorded by the local weather station.

Four different ecological foliar fertilizers were used: Fylo®, Geolino Plants&Flowers®, Cropmax®, Fitokondi®. 1) FYLO is a liquid fertilizer based on biological extracts that is free of pesticides and phyto-hormones. The physico-chemical parameters are: 32.33% N, 1.28% P (P₂O₅), 1.04% K, pH 4.37 Geolife (2004). 2) GEOLINO is also made from vegetal extracts. The

physico-chemical parameters are: 18.72% N, 0.64% P (P₂O₅), 7.2 K, pH 4.94 Geolife (2004). 3) Cropmax is a foliar fertilizer with the following physico-chemical parameters: 0.2% N, 0.4% P, 0.02% K, hollandfarming.ro (2015). 4) Fitokondi is an aqueous solution prepared from medicinal plants, bio-humus, vegetal and essential oils. It has a brown color, specific odor, with a density close to the one of the water. The physico-chemical parameters are: 0.02% N; 0.01% P₂O₅, 0.26% K₂O, pH 4.5, fitokondi.ro (2015).

The fertilization was performed twice, at the beginning of the vegetative stage and before the bloom (basil, marigold) or 3 times (artichoke), at the beginning of the vegetative stage, during the vegetative stage and at the beginning of blooming.

Plants were harvested in technological maturity between 10.00-15.00 h when the plants have the highest content of the biologic active principals.

The investigated morphological parameters were: plant height, leaf width and length, number of nodes, number of flowers, fresh leaf mass, dry substance and water content (%), fresh and dry yields, loss on drying, for different plants per repetition per treatment.

RESULTS AND DISCUSSIONS

Ocimum basilicum L.

The ecological fertilizer treatment (Fitokondi) positively influenced the crop of *Ocimum basilicum* L., causing significant increases of the investigated parameters. Plant height, was increased by approximately 11 cm compared to control ones. The number of lateral stems and the fresh mass (106 g) of fertilised plants increased with more than 100% compared to the control plants (48g) (Onofrei *et al.*, 2016).

Similar studies support our finding concluding that basil plants that were organically fertilized were more productive than the conventional ones (Berbec *et al.*, 2003; Succop *et al.*, 2004; Taie *et al.*, 2010). Such bio-fertilizers can be recommended to increase agro productivity of *Ocimum Basilicum* L. and the results from this study recommend further analyses regarding productivity parameters and volatile oil content yield under ecological fertilization of basil.

Calendula officinalis L.

Calendula is an important medicinal plant with antiphlogistic, choleric, antibacterial, antimicrobial, antidermatitic, antimutagenic and anticancer effects. Therapeutic properties are determined by a diverse range of biologically active substances they contain (carotenoids, triterpenoids, flavonoids, glycosides, volatile oil,

coumarins, mucilages, vitamin C, cholesterol esters.

The highest flower yield was recorder for all treatments, at the end of July and at the end of August. The highest average yield was obtained in Fylo treatment (249.2 kg/ha) followed by Cropmax (227.1 kg/ha), Fitokondi (213.7 kg/ha) and Geolino (200.8 kg/ha) treatments, all fertilizers increasing yield compared to control plants (188.6 kg/ha) (Onofrei *et al.*, 2016).

Our results are similar to other research, (Rafie *et al.* 2013), foliar application of Humiforte 1.5 l/ha caused an increase of flower dry weight with 36.92%. Foliar fertilizers treatments influenced the culture of *Calendula officinalis* L. in the first year of cultivation. These partial results are the starting point for future analysis and experiments regarding quality and yield of marigold. Such foliar fertilizers can be recommended for ecological cultivation of marigold as a medicinal plant with important therapeutic properties.

Cynara scolymus L.

The artichoke is an important medicinal and culinary herb containing many active principles: quinic acid, cryptochlorogenic acid, cynarin, cynaroside, scolymoside, tannins, triterpenoids, sterols, saccharydes, mucilage, pectins (Bruneton, 1993; Schipor, 2001; Robu *et al.* 2004; Neagu, 2009; Stănescu *et al.* 2014).

The morphological traits represented by plant height, leaf width and length, revealed a minor influence of the applied fertilizers on *Cynara scolymus* L. plants comparing to the control plants. Regarding the number of nodes, all plants of artichoke from all fertilization treatments recorded similar values, between 4 and 5 nodes per plant. Regarding the number of inflorescences and the mass of leaves, some treatments recorded higher values, Cropmax (1.6 flowers/plant, 161 g/leaf) and Fitokondi (4.1 flowers/plant and 175 g/leaf) while plants from Fylo and Geolino treatments had similar values compared to control ones, but without a statistical significance. The fresh and dry yields of artichoke were not statistically influenced by the foliar fertilizers. Cropmax, caused a small increase in fresh yield (19962 kg/ha) compared to control (19935 kg/ha). Regarding the dry mass, Fitokondi treated plants had the highest values and the best loss on drying while Geolino treated plants had the highest water content. In our experiment, artichoke plants treated with some foliar fertilizers (Fylo and Fitokondi) recorded higher values for dry matter and loss on drying compared to the control plants. This

findings can be important from an economic point of view (Onofrei *et al.* 2016).

Other foliar fertilizers, such as ones based on salicylic acid, when applied on artichoke, lead to an increase in dry substances amounts (Hosseinzadeh *et al.* 2013) as we found for Fitokondi fertilizer. Foliar fertilization can lead to improvement of yield as found for artichoke (Ierna *et al.* 2006, Fateh *et al.* 2009, Ierna *et al.* 2013).

CONCLUSIONS

These partial results are the starting point for future analysis and experiments regarding quality and yield of medicinal plants. Such foliar fertilizers can be recommended for ecological cultivation of artichoke, basil and marigold as a medicinal plants, with important therapeutic properties.

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