Scientific Papers. Series A. Agronomy, Vol. LXVIII, No. 2, 2025
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

REVIEW ON FERTILIZATION IN ORGANIC PRODUCTION OF THE SPECIES *Lavandula angustifolia* Mill.

Gabriela OPREA (BUTNARIU), Monica Luminița BADEA, Adina NICHITA, Doru Ioan MARIN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, Bucharest, Romania

Corresponding author email: gabriela3020022002@yahoo.com

Abstract

Lavandula angustifolia Mill. (lavender), is an aromatic plant that is part of the Order Lamiales, Family Lamiaceae (Mint), Genus Lavandula L., having various uses among which we can mention: medical and therapeutic, cosmetic and pharmaceutical, dendrological and ornamental, food, industrial. The genus Lavandula includes approximately (47 species), and the most important in culture is Lavandula angustifolia Mill. This paper reviews the specialized literature and research conducted on the fertilization of the species Lavandula angustifolia Mill, under organic cultivation conditions.

Key words*: biological parameters, fertilization, Lavandula.*

INTRODUCTION

Medicinal and aromatic plants are widely studied worldwide (throughout the world), due to the advantage that the essential oils extracted from these plants represent a very important field in both the food industry and agriculture (Elguea-Culebras, 2022)

The genus *Lavandula* is the best known genus of the *Lamiaceae* family (includes/including 39 species) being (and) found in the Mediterranean Sea basin, in Southern Europe, North-East Africa, the Middle East, South-West Asia and South-East India, in the North Atlantic islands, the Arabian Peninsula (Benabdelkader et al., 2011; Camen, 2016, Giannoulis, 2020, Kıvrak, 2018; Tuttolomondo et al., 2015), but the most important species on which the (witch are also the subject of the) most research is done on the essential oil with aromatherapeutic and pharmaceutical values are: *Lavandula angustifolia* Mill., *Lavandula dentata* (lavender French), *Lavandula hybrida*, *Lavandula latifolia, Lavandula stoechas* (Castro-Vázquez et al., 2014)

Lavandula angustifolia Mill. (lavender), also known by the synonyms *Lavandula officinalis* L. Chaix et Vill., *Lavandula vera* DC (English lavender, true lavender), is part of the (belong to the) *Lamiaceae* family (formerly *Labiatae*) which includes over 236 genera (of which the genus *Lavandula* spp. is also part/including the genus *Lavandula* spp.), and over 7.000 species, where *Lavandula angustifolia* Mill. (lavender) known as a medicinal (aromatic) plant with an intense fragrance, is the most cultivated and traded (comercialized) species worldwide (Peçanha, 2021; Pirzad, 2018).

The *Lamiaceae* family is described in the specialized literature as the family of plants that are rich in essential oil (Giannoulis et al., 2020)

Lavandula angustifolia Mill., is a perennial, aromatic, Mediterranean shrub, known since ancient times for its multiple uses, especially in the field of alternative medicine or alternative medicine (*phytotherapy*) and aromatherapy (Mihalașcu, 2021), balms, creams, detergents, ointments, cosmetics, etc. (Chrysargyris et al., 2016), the food industry (special culinary properties) (Greff et al., 2023).

A rustic species (lavender), growing in areas where other plants cannot grow (thrive), while also having low nutritional requirements (Peçanha, 2021)

Medicinal and aromatic plant of particular importance for the pharmaceutical industry, the perfume industry, but also for landscaping (for land use), where the mineral content of the soil affects the yield and quality of medicinal plants (Chrysargyris et al., 2016).

Lavender (*Lavandula angustifolia* Mill.), an evergreen (woody) subshrub, with bush heights ranging from 20-60 cm, is a perennial species, with a typical productive lifespan of approximately 10 years (Giannoulis et al., 2020).

Aromatic plants from the *Lamiaceae* family represent a viable and safe ecological strategy for sustainable soil phytoremediation, due to their multiple benefits (ecological and socioeconomic) (Misha and Chandra, 2022)

Medicinal and aromatic plants are a rich source of nutrients and natural remedies, with some crops of these medicinal plants (*Lavandula angustifolia* Mill.) are becoming industrial crops worldwide due to their nutritional and medicinal effects (Bouzid et al., 2023).

***Fertilization of Lavandula angustifolia* Mill.**

Plants need nutrients to grow, and these (nutrients) are absorbed from the soil through the plant's root system (https://www.fertilizerseurope.com/fertilizers-in-europe/types-of-fertilizer/).

Fertilization is carried out both with (using both) chemical compounds (N, P, K) and with the application of biological compounds/ and biological compounds (compost, Cropmax, BlackJak).

Fertilization is applied radicularly (at the level of the root system - roots) and foliarly (at the level of the leaf system - leaves)/ Fertilizers are applied to the root system (roots) and foliage (leaves).

Advantages of using organic fertilizers

Organic fertilizers are currently widely used due to advantages such as: slow release, which means that fertilization is not carried out in excess and thus destroying plants (is not excessive and thus does not destroy the opplants); the risk of accumulation of toxins (toxin accumulation) in the soil is very low or even non-existent (when growing vegetables, fruits - food in general); they are renewable and biodegradable, sustainable and environmentally friendly; they improve the structure of the soil (soil structure) (where the organic fertilizer is applied) over time, together (along) with the microbial ecosystem (the one (found) in the soil); they include secondary nutrients and micronutrients that chemical (synthetic) fertilizers do not have. (https://mylittlegreengarden.com/organic-fertilizers/).

Ecological fertilization

Ecological fertilization integrates agricultural and environmental objectives and is adapted to current environmental conditions, based on the principle that it should only be applied to the soil only in the quantities needed (necessary) and at the optimal time of the crop, thus avoiding environmental damage. (https://link.springer.com/chapter/10.1007/978-94-007-0186-1_7)

Also, ecological soil fertilization (Organic soil fertilization) strictly (also) refers strictly to cultivating soil and plant health through natural processes and materials, thus avoiding synthetic inputs, while also representing a fundamental element of sustainable agriculture reflecting (that reflects) nature's methods of nutrient circulation (cycling) and soil enrichment. (https://energy.sustainability-directory.com/term/ecological-fertilization/)

At the same time, organic fertilization places great emphasis on practices that mimic natural nutrient cycles, and here we can mention (such as): the use of cover crops to fix nitrogen, the incorporation of organic matter into the soil (substrate) to improve its health.

The specialized literature shows us (The literature shows) that organic (ecological) fertilization integrates agricultural and environmental objectives and is adapted to current environmental conditions, based on the principle that it should be applied to the soil only in the quantities needed (necessary quantities) and at the optimal time of the crop, thus avoiding environmental damage. (https://link.springer.com/chapter/10.1007/978-94-007-0186-1_7)

Organic fertilizers

Organic fertilizers differ from mineral, organo-mineral and organic fertilizers.

Thus, organic (ecological) fertilizers can be classified into:

Organic fertilizers - include materials such as: compost, manure, sludge, and plant residues, which improve soil structure, water retention and nutrient availability.

Mineral fertilizers - can be used in an organic context only when they are derived from natural sources or formulated to release nutrients slowly, thus reducing the risk of nutrient runoff (leaching) and pollution (https://www.fertilizerseurope.com/fertilizers-in-europe/types-of-fertilizer/).

Organic fertilizers, organo-mineral fertilizers and mineral fertilizers, inhibitors, calcareous (limestone) materials, growing (growth) media and plant biostimulants can help farmers adapt their fertilization practices to environmental and crop conditions (https://www.fertilizerseurope.com/fertilizers-in-europe/types-of-fertilizer/).

Different crops and soil types may require specific (well-designed) fertilization strategies. For example, some soils may benefit from the addition of specific micronutrients, while others may require adjustments to the overall NPK ratio.

Thus, organic fertilization aims to reduce the use of synthetic fertilizers and pesticides, minimize greenhouse gas emissions and protect water quality.

Among the organic fertilizers we can list: compost, manure, vermicompost, blood meal, comfrey tea, fish emulsion, alfalfa meal, phosphate rock and azomite rock dust, liquid seaweed (https://mylittlegreengarden.com/organic-fertilizers/).

We will show in the table below (Table 1.) some examples of organic fertilization practices (lists several examples of ecological fertilization practices)

Table 1. Different organic fertilization practices

Name	Effect
No-till farming	Minimizing soil disturbance to improve soil structure and water retention
Biochar	Adding biochar (a coal-like substance produced from biomass) to the soil to improve fertility and water retention
Composting	Transforming (turning) organic waste into a nutrient-rich soil amendment
Cover crops	Planting crops to improve soil fertility and suppress weeds
Organo-mineral fertilizers	Combining organic and mineral fertilizers to provide (ensurre) a balanced supply of nutrients (nutrient supply)

Plant biostimulants

Plant biostimulants are any substance or microorganism applied to plants with the aim of improving (to improve) their nutritional efficiency, tolerance to abiotic stress and crop quality characteristics regardless of their nutrient content (Etesami et al., 2022)

The microflora found in the soil (naturally existing/occurring) attach to (attaches itself) the roots of plants, thus having a favorable effect on plant growth and productivity (Pole et al., 2022).

The use of organic fertilizers induces positive effects on soil organic carbon (Morugán-Coronado et al., 2020).

The incorporation of biostimulants into cropping systems is proving to be a very beneficial and ecological strategy at the same time for sustainable (and environmentally friendly strategy for both sustainable) agriculture and food security (food is no longer contaminated) (Etesami et al., 2023)

Compost

Composting is the controlled biological (aerobic - requires oxygen) decomposition of organic materials (plant waste/debris, grass, leaves, garden waste, food scraps) by microorganisms. (https://www.epa.gov/recycle/composting-home)

Vermicomposting (composting with worms) is a method of composting (is a composting method) that takes up little space, requires few materials, is cheap (inexpensive) and can be done very easily (both indoors and outdoors), improving the structure and health of the soil by adding organic matter, while also helping the soil to retain moisture and nutrients. (https://www.epa.gov/recycle/composting-home)

Research on compost fertilization (fertilization with compost) as organic fertilizers (Balkrishna et al., 2024) (results from wineries and distilleries (grape pomace/marc, citrus waste, manure), are beneficial for crops of species from the *Lamiaceae* family, adapting very well, strongly influencing the production of essential oil (essential oil productions), significantly increasing the concentration of volatile compounds as well as the total yield of volatile compounds.

Vermicompost can also be referred (defined) to as: it represents the operation (the process) by which waste from medicinal plants is transformed into vermicompost, which offers numerous benefits to agriculture at the present time (Balkrishna et al., 2024).

Vermicompost currently represents (is) a valuable source of fertilizers, significantly improving the physico-chemical (physical and chemical) composition of the soil (culture substrate/growing medium) in the case of agricultural work, due to the high level (content) of essential minerals, as well as those that lead to plant growth and development, while (it) also being able to mention the fact that it ensures good soil health, significantly increasing the yield of plant growth and development, both quantitatively and qualitatively (Balkrishna et al., 2024).

The effect of fertilization on antioxidant activity, essential oil production and plant height has not been widely (extensively) studied (Chrysargyris et al., 2016).

Lack of water in Lavandula angustifolia Mill. crops (Water shortage in lavandula angustifolia* Mill.*)

The effect of drought in agricultural crops on plant growth and development has been extensively studied, and previous studies show that irrigation has an effect on the morphological and physiological characteristics of plants, thus determining their yield (Pirzad and Mohammadzadeh, 2018).

Lavender (*Lavandula stoechas*) present in a research/wicch was part of the study (extensive green roofs) along with other Mediterranean plants, showed increased sensitivity to water availability, so the species was subjected to water stress (was stressed out by water), being the species that had a hard time adapted/adapting with difficulty to the total lack of water, which disadvantaged flowering/made it hardet to bloom (advancing the moment according to the specialized literature/ahead of the time specified in the literature) (Bellini A. et al., 2024).

In hydroponic cultures, high levels of P significantly affected plant growth, and if the level of N is low, it had a negative effect because it reduced the chlorophyll content in the plants (Chrysargyris et al., 2016).

It is known that plant fertigation, absorption and accumulation of minerals represent one of the most important factors in plant growth and development, this leads to very good quality and quality through high production of plants and vegetative mass plus inflorescences. It is well known that plant fertigation, mineral absorption, and accumulation are among the most important factors in plantt growt and development, leading to high quality and yield through high plant and vegetative mass production plus inflorescence (Chrysargyris et al., 2016).

Lavender plants subjected to water stress, showed reduced growth compared to those that did not suffer, but also a completely different chemical composition from plants that were not properly irrigated (Chrysargyris et al., 2016).

Chemical Fertilizers

The excessive use of chemical fertilizers in conventional agricultural crops (systems) has drastically reduced the efficiency of nutrient use, causing serious environmental problems by depleting soil minerals, acidifying (acidifying) the soil (through soil mineral depletion and soil acidification) (Ostadi et al., 2020).

Currently, new measures are being sought to replace the avoidance (use) of fertilizers and pesticides in agricultural work, offering an alternative through the use of beneficial microorganisms, thus avoiding soil pollution (Pole et al., 2022).

In the case of some plants belonging to the *Lamiaceae* family, phosphate-based fertilization (fertilizers) helps to increase the carbon fixation rates, water use efficiency, and improve the eco-physiological performance of plants (referring strictly to the genus *Lavandula* spp.), this being highlighted in the (as evidence by the) high productivity of lavender species (Crysargyris et al., 2019; Ruiz-Navaro, 2019).

Phosphorus fertilization was (has been) effective, resulting thus bringing the lavender crop a significantly higher production of plant mass production in lavender crops, as well as a much higher yield of extracted essential oil (Peçanha, 2021)

The excessive application (excessive application) of chemical fertilizers to crops (especially those with high levels of nitrogen

and phosphorus) can modify the plant structure of the plant (can alter the plants vegetative structure), thus reducing species diversity (Ostadi et al., 2020).
Nitrogen, phosphorus and potassium affect both growth and essential oil synthesis in medicinal plants, influencing the levels of enzymes that are very important in terpenoid biosynthesis (Chrysargyris et al., 2016).

Nutrient requirements for good soil fertility and beneficial plant growth and development

Plant growth requires a very good (excellent) compatibility between the plant, the atmosphere and the soil on which it is grown (cultivated), the latter providing the location, support, foundation, and nutrients necessary for growth and development. (https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/fertilization/elements).
Table 2 shows the elements necessary for the good development of a plant (https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/fertilization/elements).

Table 2. Chemical elements necessary for plant development and growth

Where are	Chemical Elements
Air	Carbon, Hydrogen, Oxygen
Soil	Boron, Calcium, Carbon, Cobalt, Chlorine, Copper, Iron, Phosphorus, Hydrogen, Magnesium, Manganese, Molybdenum, Nickel, Nitrogen,Oxygen, Potassium, Silicon, Sodium, Sulfur, Zinc

The present research was based entirely on the study (on studying) of the specialized literature on the fertilization of the *Lavandula angustifolia* Mill species.
Thus, the latest research was consulted, following the research (focussing on studies) carried (conducted) out by specialists in the field.
A study carried out in Greece shows that Lavender is sensitive to fungal infections with *Rhizoctonia* and *Fusarium*, which in most cases of infection with these diseases, the plants are completely destroyed (Giannoulis et al., 2020).
The waste generated (from plants of the *Lamiaceae* family) following the (after) harvesting, processing, or extraction (extracting) of the essential (volatile) oil can retain their nutritional value, and these can be transformed into compost and vermicompost with beneficial effects on crops.
Studies on medicinal (aromatic) plants show that they are very good candidates for the hyperaccumulation of heavy metals that they neutralize through chelation and soil phytoremediation (Mishra and Chandra, 2022)
Lavandula angustifolia Mill. is a species that presents increased interest in terms of the resulting plant mass, used in the production of essential oil and perfume, as well as the fact that it is useful in soil phytoremediation technologies (Lázaro et al., 2006)
The results obtained from the analysis of the specialist literature (te specialized literature) on the ecological fertilization of the *Lavandula angustifolia* Mill. species show that the species adapts very well to both types of fertilization, with excellent results in terms of production and quality.
Both plant development and essential oil production in medicinal plants can be affected both positively and negatively depending on the ratio and quantity of minerals applied to the crop.
Water deficit restricts both plant growth and development, with negative effects on production and especially of essential oils that are affected in terms of existing chemical compounds.
The use of biostimulants can increase both the production of inflorescences (spike/spices) and the production of essential oil, if the crop was (has been) infested with diseases and an organic (biological) culture (farming) was (has been) used.

CONCLUSIONS

The species *Lavandula angustifolia* Mill. it is very well suited to both organic and chemical fertilization, with very good results. Thus, production is higher in the case of fertilization where organic products are applied. The *Lavandula angustifolia* Mill. species adapts very well to both organic and chemical fertilization. Fertilization with organic products leads to very good productive results, in some cases even superior to conventional fertilization. The application of organic fertilizers contributes to obtaining high yields, highlighting their efficiency and the sustainability of organic practices in lavender cultivation. Fertilization contributes significantly to the growth and development of plants, and the type of fertilization chosen can directly influence their quality, development rate and productivity. Given the importance and multiple uses of the *Lavandula angustifolia* Mill. species, the increasingly widespread use of organic fertilization is recommended.

ACKNOWLEDGEMENTS

The research work was carried out within the Doctoral School of Plant and Animal Resources Engineering and Management - Faculty of Agriculture of U.S.A.M.V. Bucharest.

REFERENCES

Balkrishna, A. Srivastava, S., Srivastava, D., Sharma, N., Arya, V., Ajay K. Gautam, A.K. (2024). Unleashing the potential of medicinal and aromatic plant wastes with particular consideration of vermicomposting: A comprehensive review of literature. *Journal of Applied Research on Medicinal and Aromatic Plants, Volume 39*, 100527, ISSN 2214-7861,

Bellini, A., Bartoli, F., Kumbaric, A., Casalini, R.,Caneva, G. (2024). Evaluation of Mediterranean perennials for extensive green roofs in water-limited regions: A two-year experiment, *Ecological Engineering*, *Volume 209*, 107399, ISSN 0925-8574,

Bolechowski, A., Moral, R., M.A. Bustamante, M.A., Bartual, J., Paredes, C., Pérez-Murcia, M.D., Carbonell-Barrachina, A.A. (2015). Winery–distillery composts as partial substitutes of traditional growing media: Effect on the volatile composition of thyme essential oils. *Scientia Horticulturae, Volume 193*, Pages 69-76, ISSN 0304-4238,

Bouzid, H.A., Ibourki, M., Hamdouch, A., Oubannin, S., Asbbane, A., Hallouch, O., Laila Bijla, L. (2024). Jamal Koubachi, Khalid Majourhat, Said Gharby, Moroccan aromatic and medicinal plants: A review of economy, ethnobotany, chemical composition, and biological activities of commonly used plants. *Food and Humanity, Volume 2*, 100259, ISSN 2949-8244,

Camen, D., Hadaruga, N., Luca, R., Dobrei, A., Nistor, E., Posta, D., Dobrei, A., Velicevici, G., Petcov, A., Sala, F. (2016). Research Concerning the Influence of Fertilization on Some Physiological Processes and Biochemical Composition of Lavender (*Lavandula angustifolia* L.). *Agriculture and Agricultural Science Procedia, Volume 10*, Pages 198-205, ISSN 2210-7843, https://doi.org/10.1016/j.aaspro.2016.09.053.

Castro-Vázquez, L., Leon-Ruiz, V., Alañon, M.E., Pérez-Coello, M.S., González-Porto, A.V. (2014). Floral origin markers for authenticating Lavandin honey (*Lavandula angustifolia x latifolia*). Discrimination from Lavender honey (*Lavandula latifolia*), *Food Control, Volume 37*, 2014, Pages 362-370, ISSN 0956-7135,

Chrysargyris, A., Panayiotou, C., Tzortzakis, N. (2016). Nitrogen and phosphorus levels affected plant growth, essential oil composition and antioxidant status of lavender plant *Lavandula angustifolia* Mill.), Industrial Crops and Products, Volume 83, Pages 577-586, ISSN 0926-6690,

Chrysargyris, A., Petropoulos, S. A., Fernandes, A., Barros, L., Tzortzakis, N., & Ferreira, I. C. (2019). Effect of phosphorus application rate on Mentha spicata L. grown in deep flow technique (DFT). *Food chemistry*, *276*, 84-92

Chrysargyris, A., Laoutari, S., Litskas, V.D., Stavrinides, M.C., Tzortzakis, N. (2016). Effects of water stress on lavender and sage biomass production, essential oil composition and biocidal properties against *Tetranychus urticae* (Koch), *Scientia Horticulturae, Volume 213*, 96-103, ISSN 0304-4238

Elguea-Culebras, G.O., Bravo, E.M., Sánchez-Vioque, R. (2022). Potential sources and methodologies for the recovery of phenolic compounds from distillation residues of Mediterranean aromatic plants. An approach to the valuation of by-products of the essential oil market – A review. *Industrial Crops and Products, Volume 175*, 114261, ISSN 0926-6690

Etesami, H., Jeong, B.R., Glick, B.R. (2023). Potential use of Bacillus spp. as an effective biostimulant against abiotic stresses in crops-A review. *Current Research in Biotechnology, Volume 5*, 100128, ISSN 2590-2628,

Giannoulis, K.D., Evangelopoulos, V., Gougoulias, N., Eleni Wogiatzi, E. (2020). Could bio-stimulators affect flower, essential oil yield, and its composition in organic lavender (*Lavandula angustifolia*) cultivation?. *Industrial Crops and Products, Volume 154*, 112611, ISSN 0926-6690

Greff, B., Nagy, Á., Posgay, M., Sáhó, A., Lakatos, E. (2023). Chapter 6 - Composting of medicinal and aromatic plant waste: challenges and opportunities, Editor(s): Balasubramani Ravindran, Sanjay Kumar Gupta, Sartaj Ahmad Bhat, Puneet Singh Chauhan, Neha Tyagi, In Advances in Pollution Research, Recent Trends in Solid Waste Management, Elsevier, Pages 115-136, ISBN 9780443152061

Lázaro, J.D., Kidd, P.S., Martínez, C.M. (2006). A phytogeochemical study of the Trás-os-Montes region (NE Portugal): Possible species for plant-based soil remediation technologies. *Science of The Total Environment, Volume 354*, Issues 2–3, Pages 265-277, ISSN 0048-9697,

Mishra, B., Chandra, M. (2022). Evaluation of phytoremediation potential of aromatic plants: A systematic review. *Journal of Applied Research on Medicinal and Aromatic Plants, Volume 31*, 100405, ISSN 2214-7861,

Morugán-Coronado, A., Linares, C., Gómez-López, M.D., Faz, A., Zornoza, R. (2020). The impact of intercropping, tillage and fertilizer type on soil and crop yield in fruit orchards under Mediterranean conditions: A meta-analysis of field studies, *Agricultural Systems, Volume* 178, 102736, ISSN 0308-521X,

Mihalașcu, C. (2021). Studiul comportării și productivității unor genotipuri de lavandă (*Lavandula angustifolia* Mill. în zona periurbană a Bucureștiului. Teză de doctorat.

Ostadi, A., Javanmard, A., Machiani, M.A., Morshedloo, M.R., Nouraein, M., Rasouli, F., Maggi, F. (2020). Effect of different fertilizer sources and harvesting time on the growth characteristics, nutrient uptakes, essential oil productivity and composition of *Mentha x piperita* L. *Industrial Crops and Products, Volume 148,* 112290, ISSN 0926-6690

Peçanha, D.A., Mendonça Freitas, M.S., Vieira, M.E., Cunha, J.M., Assistone Costa de Jesus, A. (2021). Phosphorus fertilization affects growth, essential oil yield and quality of true lavender in Brazil. *Industrial Crops and Products, Volume 170*, 113803, ISSN 0926-6690

Pirzad, A., Mohammadzadeh, S. (2018). Water use efficiency of three mycorrhizal Lamiaceae species (*Lavandula officinalis, Rosmarinus officinalis and Thymus vulgaris*). *Agricultural Water Management, Volume 204*, 1-10, ISSN 0378-3774,

Pole, A., Srivastava, A., Zakeel, M.C.M., Sharma, V.K., Suyal, D.C., Singh, A.K., Ravindra Soni, R. (2022). 12 - Role of microbial biotechnology for strain improvement for agricultural sustainability, Editor(s): Ravindra Soni, Deep Chandra Suyal, Ajar Nath Yadav, Reeta Goel, In Developments in Applied Microbiology and Biotechnology. Trends of Applied Microbiology for Sustainable Economy, Academic Press, Pages 285-317, ISBN 9780323915953,

Ruiz-Navarro, A., Fernandez, V., Abadia, J., Abadia, A., Querejeta, J. I., Albaladejo, J., & Barbera, G. G. (2019). Foliar fertilization of two dominant species in a semiarid ecosystem improves their ecophysiological status and the use efficiency of a water pulse. *Environmental and Experimental Botany*, *167*, 103854.

https://www.epa.gov/recycle/composting-home

https://link.springer.com/chapter/10.1007/978-94-007-0186-1_7

https://energy.sustainability-directory.com/term/ecological-fertilization/

https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/fertilization/elements

https://www.fertilizerseurope.com/fertilizers-in-europe/types-of-fertilizer/

https://mylittlegreengarden.com/organic-fertilizers/