



Application of Organic and Inorganic Fertilizers on Medicinal Plants and Its Impact on Environmental Sustainability: A Literature Review

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ABSTRACT

Organic farming enhances farm productivity, profitability, and soil health. The use of organic fertilizers and microbial symbiosis with species of medicinal and aromatic plants under organic agriculture helps in the improvement of yield and plant quality. However, the debate on the relative benefits of conventional and organic farming systems has, recently, gained significant interest. Thus, developing more sustainable farming practices on a large scale is of utmost importance.

Keywords : Medicinal Plants; Aromatic Plants; Fertilizers; Environmental Sustainability

1 INTRODUCTION

HUMANS have used medicinal and aromatic plants, and researchers continue to uncover new facts about how plants and people interact. The majority of people in the world—roughly three-quarters—use medicinal plants to meet their healthcare requirements. Numerous therapeutic herbs are used in the traditional medical systems that have evolved over many years. Numerous higher plants have been identified as having great therapeutic potential and serving as a key supplier of raw materials for the food, medicine, and cosmetic industries. More than 9,000 native plants have been proven to offer medicinal benefits, and over 1500 species are recognized for their flavor and aroma (Nagar et al., 2017).

In a study by Annon (2014), 80% of the population in poor nations uses conventional plant-based medications. The role that medicinal and aromatic plants have in addressing global health issues is becoming more and more prominent. The current study of new therapeutic plant drugs takes a multifaceted strategy combining botanical, phytochemical, biological, and molecular methods (Sastry et al., 2015).

Majority of growers of medicinal and aromatic plants are aware of the value of organic farming and are thus better equipped to make decisions about growing their operations under this type of farming (Malik, 2014). Therefore, it makes sense that to nutrient and other criteria under the organic farming system, the choice to expand the cultivation of medicinal and aromatic plants to wider regions would need to be made by an integrated farming system (Malik, 2014). Studies on medicinal plants show that the highest yield and quality are possible when using biological and organic fertilizers. With the implementation of an organic crop management system, a global and sustainable approach to improving the quality of medicinal and aromatic plants is conceivable. Few studies comparing the effects of organic and inorganic fertilizers on the development and yield of medicinal plants (Hosein Sartip et al., 2015).

In this paper, several studies related to organic farming are reviewed to know the impact of the organic production on medicinal and aromatic crop development, productivity, and quality.

2 ORGANIC FARMING SYSTEMS AND MEDICINAL PLANTS

Organic agriculture has grown the best possible relationship between the earth and human being. Soil organic matter content is the direct measure of soil fertility. Organic farming systems emphasize on the use of organic matter for maintaining soil health, growth and multiplication of beneficial microbes, and minimizing health hazards associated with food. Medicinal and aromatic crops have great demand in modern civilization to extract various natural products for human welfare. It's gained global significance and is sought after by pharmaceutical companies and flavor and fragrance industries all over the world. The physical and chemical properties of the compound extracted from the organically grown medicinal and aromatic plants are superior as compared to the traditional system. But designing an organic farming system to tie together principles of sustainability and productivity is complex in these crops (Mendez et al., 2010).

Organic farmers must consider how the various components of their system - rotations, pest and weed management, and soil health - will maintain both productivity and profitability. Although practices vary from farm to farm and region to region, at the core of any successful annual organic farming system is crop rotation. As the main management tool for all aspects of the farming system - including weeds, pests, insects, soils, and crop production - a well-planned rotation is more than the sum of its parts, addressing the connections between all of those factors. Along with developing a successful rotation, ensuring healthy soil is imperative to a profitable and successful organic system (Mendez et al., 2010).

Irrespective to the type of crops, the concept of organic agriculture builds on the idea of the efficient use of locally available resources as well as the usage of adapted technologies (e.g. soil fertility management, closing of nutrient cycles as far as possible, control of pests and diseases through management and natural antagonists). It is based on a system-oriented approach and can be a promising option for sustainable agricultural intensification in the tropics because it may provide several potential benefits, including increased yield stability in risky tropical ecosystems, higher yields, and incomes in traditional farming systems once they are improved and the adapted technologies are introduced, improved soil fertility and long-term sustainability of farming systems, a reduced need for external inputs, and a decrease in environmental impact (Watson et al., 2008).

3 THE USE OF ORGANIC NUTRIENTS

Today, it is well known that improper use of natural resources and the use of manmade materials containing explosives, such as all types of mineral fertilizers, is a fundamental cause of the destruction of the environment and the biological balance (Tomati, 1987). Thus, by utilizing locally available resources, in-situ compost preparation of organic fertilizers can be a very suitable method of management or removal of surplus solid materials with value addition and is regarded as a tool in controlling various types of debris. Additionally, the reduction in fertilizer consumption in crop production and mineral absorption elements increases low consumption by medicinal and aromatic crop plants (Shata et al., 2007). Vermicomposting is a valuable approach that has been described in the literature as being quick and efficient (in terms of both cost and time) for the management of organic residues (Garg, 2006). Composting is a successful method for recovering food chain remnants, especially in confined spaces like dirt. The resulting substance is known as vermicompost and has a completely different texture and state than the original material (Dickerson, 1994). Senna (*Cassia angustifolia*) (*Azospirillum* seed treatment) boosted root development and weight, which resulted in higher production of dry leaves, pods, and overall dry matter, as seen by Arumugam et al (2001).

In the case of weeds (*Tripura bispinosa*), the results showed that the application of vermicompost alters the soil pH to the neutral concentration of nitrogen, phosphorus, potassium, and calcium available (Chaudhuri, 2001). Aromatic crops spent grass and spent wash are a good organic source of nutrient supply to the other crop and in nutrient recycling for the fertilizer economy.

In Basil, using organic fertilizers combined with inorganic and mineral fertilizers helps to increase in plant height as compared to using mineral fertilizers alone. Whereas, the application of organic fertilizers alone treatments showed better quality products as compared to inorganic (Kandeel, 2002).

Vermicompost contains nutrients that are easily absorbed by plants, such as phosphorus, potassium, calcium, and magnesium (Atiyeh et al., 2002). About 80% of the present cultivation was used in an experiment on fertilizer use in organic mint pepper plant performance (Kalra, 2003). Application of *Azotobacter* with or without mineral fertilizers considerably boosted the production of rainfed palmaris plants without having any negative effects on the oil quality (Rao et al., 2003). According to Kapoor et al. (2004), the number of umbels in the plant, seed weight, phosphorus concentration, biomass percentage of AM root colonization, and amount of essence was all significantly improved by fennel root symbiosis with two species of *mycorrhizal fungi*, including *Glomus macrocarpum* and *Glomus fasciculata*.

Mishra and Nayak (2004) reported that vermicompost contains biologically active substances that act as growth regulators. Moreover, the use of organic fertilizers increases the biological performance of the cumin crop in terms of more umbrellas in the crucible, the number of seeds in umbrella height, and bushes (Sydnzhad and Rezvan, 2009).

The application of vermicompost favorably affects soil pH, microbial population and soil enzyme activities thereby affecting biosynthesis of compounds.

4 ENVIRONMENTAL IMPACT OF THE USE OF FERTILIZERS

Technological advances in agriculture are helping to meet the food needs of an ever-increasing world population. Although the population has been growing and available land for agriculture has been shrinking, intensive agriculture that involves heavy and continuous use of fertilizers has ensured high crop productivity. An example is the increase in food production after the green revolution (Tilman 1998). But it is reported that intensive and extensive use of fertilizer, is a major factor that aggravates the negative environmental effects (Barlog and Grzebisz 2004). Over 50% of the applied N can be lost from agricultural systems as N₂, trace gases, or leached nitrate (Vitousek et al., 1997; Tilman, 1998; Kennedy et al., 2004), and the impacts are usually long-term and global in scope (Vitousek et al. 1997, Rabalais et al. 1998).

Similarly, phosphorous (P) fertilization the second essential macronutrient, also precipitated even more than 90% (Rodriguez and Fraga, 1999; Gyaneshwar et al., 2002) and later causes P pollution (Rodriguez and Fraga 1999; Sharpley et al. 2003).

In addition to chemical fertilizers, many regions of the world also employ amendments of alternative fertilizers, such as organic manure, compost, compost extract, and compost tea to improve crop output and/or reduce pathogens (Adesmoye and Kloepper 2009). According to a research by Akanbi et al. (2007), foliar application of extracts from the peels of Mexican sunflower (*Tithonia rotundifolia*) and cassava (*Manihot esculent*) helps grow fluted pumpkin (*Telfairia occidentalis*) plants with growth that is comparable to that of plants that received NPK fertilizer. Compost tea increased the uptake of the majority of macronutrients and micronutrients in strawberry plants in proportions comparable to inorganic mineral fertilizers, according to a different study by Hargeaves et al. (2009).

5 ORGANIC CHEMICAL FERTILIZERS: THEIR AGRO-ENVIRONMENTAL IMPACT

Using manures and compost along with chemical fertilizers might also cause agro-environmental issues (Mitchell and Tu, 2006). Chemical fertilizers and animal excrement both have the potential to pollute the environment (McLaughlin and Mineau 1995, Jarecki et al. 2008). In the medium to long term, organic manures (fertilizers) can greatly increase soil fertility because they contain N-rich materials and high levels of extractable minerals (P, K, calcium (Ca), magnesium (Mg), copper (Cu), and zinc (Zn) (McLaughlin and Mineau, 1995; Mitchelle and Tu, 2006). According to Mitchelle and Tu (2006), continual application of poultry manure will raise soil nutrient levels, increase the risk of some nutrients building up, and induce nutrient loss to the environment.

As a result, even though the world has the technology to sustainably feed a population of 10 billion people, the massive acceleration in the use of artificial fertilizers around the world has resulted in a host of environmental problems, including eutrophication of terrestrial and aquatic systems, global acidification, effect on biodiversity, production of greenhouse gasses, and global warming (McLaughlin and Mineau 1995, Mosier et al, 1996; Tilman 1998; Rabalais et al, 1998, Frink et al. 1999, Gyaneshwar et al. 2002, Sharpley et al. 2003). Here, there is a brief overview of a few environmental occurrences that have been connected to the usage of fertilizers.

6 CONCLUSION

Medicinal and aromatic plants perform better in terms of yield and quality under the organic farming system. At present, the imbalanced application of chemical fertilizer caused decreases in the quality of the products not only inferior but also residual effect leads to enter the food chain and threat to human health and other creatures. However, switching over from modern farming to organic farming is not so feasible at present.

It has been provoked that the quality of medicinal and aromatic plants deteriorates with chemical fertilizers. Therefore, the assumption in medicinal and aromatic plants based on other crops may not be proved. Most of the medicinal and aromatic crop response with manures and fertilizers is not on a soil test basis. Therefore, results are not comparable with various locations, and sometimes it is misled for recommendations of manure doses and that has to be taken care of with proven facts.

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