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Organic fertilizer management in cultivation of medicinal and aromatic crops: a review

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Abstract

Medicinal and aromatic plants constitute a major segment of the flora, which provides raw materials for use in the pharmaceuticals, cosmetics and drug industries. Looking into the important role of medicinal plants in different industries, it is great significance to increasing production of biomass produced without the use of harmful chemical. The use of organic fertilizers and microbial symbiosis with species of medicinal and aromatic plants under organic agriculture helps in improvement of yield and quality. However, the debate on the relative benefits of conventional and organic farming systems has in recent time gained significant interest. So far, global agricultural development has focused on increased productivity rather than on a holistic natural resource management for food security. Thus, developing more sustainable farming practices on a large scale is of utmost importance. Organic farming helps to enhance farm productivity and profitability, soil health (soil fertility & productivity) *etc.* This review has mainly been focused on contemplating and prospecting the work done so far to know the impact of organic farming system on growth and yield of medicinal and aromatic crops.

Keywords: Bio fertilizers, Medicinal and Aromatic Plants, Organic Farming System, Organic fertilizers and Pharmaceuticals.

Introduction

Human being has been using medicinal and aromatic plants from ancient time and research workers are constantly brings to light additional information on the relationship between plants and man. About three-quarters of the world's population use medicinal plants to cover all or part of their health care needs. The indigenous systems of medicines, developed in India for centuries, make use of many medicinal herbs. These systems include Ayurveda, Siddha, Unani, and many other indigenous practices. Thousands of higher plants have been reported to be of high medicinal value and constitute a major source of raw material for pharmaceuticals, cosmetics, and drug industries. More than 9,000 native plants have established and recorded curative properties and about 1500 species are known for their aroma and flavour (Nagar *et al.*, 2017) [1]. The 80 per cent of the population of developing countries relies on traditional plant based medicines for their health requirements (Annon., 2014) [2]. There is a rising focus on the significance of medicinal and aromatic plants in health systems, solving the health care problems of the world. Present research in drug innovation from medicinal plants involves a versatile approach combining botanical, phytochemical, biological and molecular techniques (Sastry *et al.*, 2015) [4]. A number of medicinal plants also produce essential oils as well as being used for perfumery (El-Hennawy, 2018) [5]. The decision on area allocation by a cultivator for a given crop, more so for a new crop, is influenced by several factors about some of which the cultivator may have had little or no knowledge when he first started its cultivation. Having once decided to cultivate the crop, the decision on its cultivation under organic farming system is influenced by the experience the cultivator and availability of resources and more deterministic information about the other complementary factors (Afaq *et al.*, 2013) [6]. Most of the cultivators of medicinal and aromatic crops have know the importance of cultivation of crop under organic condition and were better equipped to take a more informed decision about expanding its cultivation under organic system of production (Malik, 2014) [7]. So one would expect that the decision about expanding cultivation of medicinal and aromatic plants to under organic condition to the larger areas they need to

follow the integrated farming system to meet out the nutrients and other requirements under organic farming system. With whatever little experience the farmers have had with its cultivation, are willing to bring still larger area under the cultivation of medicinal and aromatic plants while the further the area under organic cultivation of these crops has to increase (Malik, 2014)^[7]. Studies on medicinal plants indicate that maximum yield and quality in the use of organic fertilizers and biological achieved. The global and sustainable approach for the improvement in medicinal and aromatic plants quality is possible with the establishment of the organic system of management of crops. Few studies have compared the organic and inorganic fertilizers on the growth and yield of medicinal plants has been done (Hosein Sartip *et al.*, 2015)^[8]. To achieve sustainable development and the realization of the goals agricultural policies and the use of a solution suitable for providing food in the form of needs of organic agriculture will be necessary that the use of the fertilizer and biological organic solution can be effective. In this paper several studies related to organic farming are reviewed to know the impact of organic system of production on growth, yield and quality of medicinal and aromatic crops. The main objective of this review is to provide information to help in future research and development in organic medicinal and aromatic plants cultivation (Aishwath and Tarafdar, 2017)^[9].

Relationship between organic farming systems and medicinal & aromatic 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 system emphasise on the use of organic matters 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 are sought after by pharmaceutical companies and flavour and fragrance industries all over the world. The physical and chemical properties (quality) of the compound extracted from the organically grown medicinal and aromatic crop plants are superior as compared to traditional system. But designing an organic farming system to tie together principles of sustainability and productivity is complex in these crops. 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 the crop rotation. Enhance soil conservation and build soil organic matter, provide weed, disease and insect control, enhance water quality and conservation, biological diversity and wildlife habitat and ensure economic profitability for the farming system. 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)^[10].

Irrespective of 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, as it may offer several potential benefits (Watson *et al.*, 2008)^[11] viz., a greater yield stability in risk-prone tropical ecosystems, higher yields and incomes in traditional farming systems, once they are improved and the adapted technologies are introduced, an improved soil fertility and long-term sustainability of farming systems, a reduced dependence of farmers on external inputs, the restoration of degraded or abandoned land, the access to attractive markets through certified products and new partnerships within the whole value chain, as well as a strengthened self-confidence and autonomy of farmers.

Role of Organic Nutrients in Medicinal and Aromatic Crops

The green revolution has brought about a series of technological achievements in agricultural production, particularly in Asia. Worldwide cereal harvests tripled between 1950 and 2000, making it possible to provide enough dietary calories for a world population of six billion by the end of the 20th century (Trewavas, 2002)^[12]. So far, global agricultural development has rather focused on increased productivity than on a more holistic natural resource management for food security and sovereignty. The increase in food production has been accompanied by a multitude of challenges and problems such as the exploitation and deterioration of natural resources, *i.e.* loss of soil fertility, strong decline of agro-biodiversity, pollution of water (Badgley *et al.*, 2007)^[13] and health problems associated with the use of synthetic plant protection products. At present, more comprehensive system-oriented approaches are gaining momentum and are expected to better address the difficult issues associated with the complexity of farming systems in different locations and cultures (Seufert *et al.*, 2012)^[14].

Today wrong use of natural resources and use artificial materials with explosives like all kinds of mineral fertilizers in order to produce and more units of agricultural lands and the existing as a basic problem of destruction of the environment and the biological balance is known (Tomati, 1987)^[15]. Therefore by using naturally available materials in-situ preparation of organic fertilizers like compost can be very much suitable method of management or removing superfluous solid materials with value addition and is considered as a tool in controlling different types of debris and the reduction in fertilizer consumption in crop production and mineral absorption elements increase low consumption by medicinal and aromatic crop plants (Shata *et al.*, 2007)^[16].

Vermicomposting is a valuable technique, fast and effective (in terms of cost and time) for the management of organic residues have been reported in the literature (Garg, 2006)^[17]. The production of compost is the successful technique to recover the remains of the food chain, even in small places like soil. The resulting material is known to be a substance called vermicompost completely different appearance and condition of the material itself (Dickerson, 1994)^[18]. Azospirillum seed treatment enhanced root growth and weight, which lead to increased production of dry leaf, pod and overall dry matter production of senna (*Cassia angustifolia*) as observed by Arumugam *et al.* (2001)^[3]. In the case of weeds (*Tripura bispinosa*), the results showed that application of vermicompost alters the soil pH to the neutral concentration of nitrogen, phosphorus, potassium and calcium

are available (Chaudhuri, 2001)^[19]. Aromatic crop spent grass and spent wash are good organic source of nutrient supply of to the other crop and in nutrient recycling for fertilizer economy. The spent by product can also used as mulch for moisture conservation and weed control. Incorporation of palmarosa distilled grass at the rate of 5 t ha⁻¹ along with N decreased weed biomass, conserved soil moisture and increased the rainfed palmarosa biomass and oil yield Hosein Sartip *et al.*, 2015)^[18]. Citronella spent grass and menthol mint used for mulching along with 180 kg N after the sprout of menthol mint rhizomes enhanced the yield of main and ratoon mint crop. The result of data showed that vermicompost results by increasing the water-holding capacity, nutrient supply and production of plant hormones that have beneficial effects on seed germination, plant growth and development could be improved, especially ornamental plants (Tomati *et al.*, 1987)^[15]. In Basil, use organic fertilizers combined with inorganic and mineral fertilizers helps to increases in plant height as compared to use mineral fertilizers alone. Whereas, application of organic fertilizers alone treatments shown better quality products as compared to inorganic (Kandeel, 2002)^[20].

Vermicompost have nutrients such as phosphorus, potassium, calcium and magnesium in a form that is readily available for plant uptake, respectively (Atiyeh *et al.*, 2002)^[21]. In an experiment on fertilizer use in organic mint pepper plant performance was done in organic cultivation about 80 per cent of current Cultivation (Kalra, 2003)^[22]. Azotobacter application with or without mineral fertilizers significantly increased the yield without any adverse impact on oil quality of rainfed palmarosa (Rao *et al.*, 2003)^[23]. Kapoor *et al.* (2004)^[24] reported that fennel root symbiosis with two species of mycorrhizal fungi, including *Glomus macrocarpum* and *Glomus fasciculatum* significantly improved properties as are followed the number of umbels in plant, seed weight, phosphorus concentration, biomass percentage of AM root colonization and amount of essence.

It was also reported that vermicompost containing biologically active substances that act as growth regulators (Mishra and Nayak, 2004)^[25]. The increase in dry weight figure air plant pepper with the increase in swelling levels has been reported (Atiyeh *et al.*, 2002)^[21]. Moradi (2009)^[26] in the study of organic fertilizers and biological characteristics of the quantitative and qualitative plant medicine applying fennel juice report to use organic materials has increased the number of seeds in an umbrella. It seems that improving the situation plant and increase plant available water in the soil physical properties improve consumption of fertilizers in organic cattle and increase power plant growth, increasing the number of umbrellas in the crucible and the number of seed in umbrella and consequently the number of seeds in the crucible has increased. In cumin plant the organically produced plants thousand seed weight is higher as compared with thousand seed weight inorganically produced plants (Sydnzhad and Rezvan, 2009)^[27]. And also use of organic fertilizers increases the biological performance of the cumin crop in terms of more number of umbrellas in the crucible, the number of seed in umbrella height and bushes (Sydnzhad and Rezvan, 2009)^[27]. In Sweet Marjoram when soil treated with 15 and 30 per cent aqueous extracts of compost, essential oil percentage and yield per plant and herbage biomass have been increased. While the chemical composition of marjoram essential oil did not change due to the compost treatment or level (Fatma *et al.*, 2009)^[28]. Similar results were obtained from marjoram and Cymbopogon winterianus plants

(Maheshwari, 2011)^[29]. Increasing in the levels of phenols Chand *et al.*, (2012)^[30] reported that growth parameters and herb yield of mint marginally enhanced with the application of 7-5 t ha⁻¹ vermicompost. The medicinal plant vinca (*Caharanthus roseus*) plants inoculated with the bacterium *Pseudomonas fluorescense* increased biomass production and alkaloid content of the plant was under stress conditions. Increased plant height in Psyllium was recorded by use of bio fertilizers (Thimmarayappa *et al.*, 2013)^[31] and in turmeric (Vishwanath *et al.*, 2014)^[32]. The application of vermicompost favorably affects soil PH, microbial population and soil enzyme activities thereby affect biosynthesis of compounds. Phenolic compounds are a large group of plant secondary metabolites (Rajeswara Rao, 2015)^[33]. One of the main factors determining plant height, providing food elements needed plant, treatments organic fertilizer with slow elements provide food as a good and caused the increase plant height (Tanwar *et al.*, 2016)^[34]. Some of the medicinal and aromatic plants exhibited pesticidal and antimicrobial properties can be used as bio pesticide in organic farming. All the plant parts of pink and white periwinkle (*Catharanthus sps.*) can be used in control of nematodes and this crop is also used as a trap crop for the controlling of root knot nematodes (*Meloidogyne incognita*) and (*Meloidogyne javanica*) in many a crops and reduces infection in Okra. Essential oil of cymbopogon species (*C. Martinii*, *C. flexuosus* and *C. winterianus*) their major constituents geraniol, citrol and citronellol were toxic to nematode species like *Anguina tritici*, *Meloidogyne javanica* and *Heterodera avenae* (Sodavadiya, 2017)^[1].

Conclusion

Medicinal and aromatic plants perform better in terms of yield and quality under organic farming system. At present the imbalanced application of the chemical fertilizer caused decreases in quality of the products not only inferior but also in residual effect leads to enter the food chain and threat to human health and other creatures. But the organic manures along with improvement in the yield and also controls weeds and provide the organic matter and nutrients to the soil, ultimately improve the soil health. However, switching over from modern farming to organic farming in Indian perspective is not so feasible at present. Many of the studies were carried out with biofertilizers in pot culture and organic or biopesticides tested in the laboratory. These need to be confirmed at field level in natural environment for the comparable results. It has been provoked that quality of medicinal and aromatic plants deteriorates with chemical fertilizers. Therefore, 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 soil test basis. Therefore, results are not comparable with various locations, and sometimes it misled for recommendations of manures doses and that has to be taken care with proven facts.

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