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Review on Effects of Organic and Chemical Fertilizer on Chamomile (*Matricaria Chamomilla* L) Production.

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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. Therefore, organic products are being famous for all people around the world, due to the great global market demand; production of organic foods has rapidly increased. On this basis organic agriculture has become a great choice as means of organic product producing. As a staple product in the world, the high demand on organic medicinal plants has increased. Problems of the decline in the bio-environmental sustainability due to indiscriminative usage of chemical fertilizers can solve under organic fertilizer. In this review there were more research conducted to see the effects of synthetic and organic fertilizer on chamomile crop. Nitrogen, is the main yield increasing nutrient, significantly contributes to an increase in height, weight and yield of essential oil of chamomile. Comparatively, chamomile essential oil content and the amount of compounds in organic fertilizer were higher than chemical fertilizer and control. In all studies in this review the result showed that organic fertilizer increase the yield of chamomile than that of chemical fertilizer.

Keywords: Chamomile, Chemical fertilizer, Organic fertilizer

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INTRODUCTION

Chamomile (*Matricaria chamomilla L.*) is one of aromatic and medicinal crop which is under family of *Asteraceae.* Medicinal and aromatic plants are economically of paramount importance. This is because of the continuous and increased demand for their products from local and foreign markets. Chamomile is annual, aromatic, herbal plant (Baghalian *et al.,* 2008). *M. chamomilla* L *is* known as true chamomile or German chamomile. The optimum temperature for good seed germination lies between 10°C and 20°C. It is widely distributed in Europe, Asia, Africa and America, and it has both autumn and spring varieties. About 0.2–1.9% of its essential oil is usually extracted from flower head (Baghalian *et al.*, 2008). Chamomile has medicinal properties, anticonvulsant, anti-inflammatory, antispasmodic, relaxing, anti-rheumatic, carminative, antiseptic bandages, anti-bacterial, treatment of acne, insomnia, gastric ulcer prevention and treatment. It is used along with moisturizers, anti-aging and sunscreen (Mohammad *et al*., 2010). In addition to pharmaceutical uses, the oil is extensively used in perfumery, cosmetics, and aromatherapy, and in food industry. studied that the essential oil present in the flower heads contains chamazulene and is used in perfumery, cosmetic creams, hair preparations, skin lotions, tooth pastes, and also in fine liquors (Gowda *et al.*, 1991). The dry flowers of chamomile are also in great demand for use in herbal tea, baby massage oil, for promoting the gastric flow of secretion, and for the treatment of cough and cold. Chamomile as medical plant is allegedly compatible with a wide range of climates and soils (Das *et al.,* 1998). In addition to water deficit conditions, this plant is also suitable for planting in saline soils (Baghalian *et al.,* 2008).

The use of organic fertilizer for growing medicinal plants is widespread due its beneficial effects in the soil, providing organic matter, improving physical structure and directly influencing its water storage capacity and water availability for plants. Moreover, organic fertilizers contribute to greater stability of nutrients through mineralization process, are an energy source for soil microorganisms and provide macro and especially micronutrients for plants.

The management practices with organic materials influence agricultural sustainability by improving physical, chemical and biological properties of soils (Saha *et al.,* 2008). The use of organic amendments has long been recognized as an effective means of improving the structure and fertility of the soil, increasing the microbial diversity, activity and population, improving the moisture holding capacity of soils and crop yield (Frederickson *et al.,* 1997).

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. Organic fertilizer such as compost Vermicompost, animal manure, poultry manures can play a great role in organic agriculture. Composting is a biological process in which organic biodegradable wastes are converted into hygienic, hums rich product (compost) for using as a soil conditioner and organic fertilizers. Compost production can be as a suitable method of management for removing superfluous materials solid into materials with value and is considered as a tool in controlling different types of debris and the reduction in fertilizer consumption in agricultural products and mineral absorption elements increase low consumption by plants.

Vermicompost has large particulate surface area that provides many micro sites for the microbial activity and strong retention of nutrients. It contains plant growth regulators and other growth-influencing materials produced by microorganisms (Atiyeh *et al.,* 2002). Several studies have indicated the same results on some medicinal plants (Hadi *et al.,* 2011).

OBJECTIVE

✓ To review the effects of organic and inorganic fertilizer on chamomile crop production.

LITERATURE REVIEW

Inorganic fertilizers

Continuous usage of inorganic fertilizer affects soil structure. Hence, animal and plant manures, compost and Vermicompost can serve as alternative to mineral fertilizers for improving soil structure and microbial biomass (Suresh *et al*., 2004. Organic fertilizers in comparison of the chemical fertilizers have lower nutrient content and are slow release but they are as effective as chemical fertilizers over longer periods of use (Naguib, 2011). In chamomile essential oil content and the amount of compounds in organic farming conditions were far higher than conventional farming. According to research on rosemary plant, were compared to inoculation with nitrogen, phosphorus and potassium fertilizer higher oil yield showed the highest oil yield was related to a combination of compost and microorganisms that cause these increasing effects on increasing growth characteristics and chemical composition of rosemary (Abdelaziz, 2007). The increasing growth of chamomile by using the Integration of Vermicompost and ammonium nitrate fertilizer was reported by (Hadi et *al*., 2015). He found that Interaction between Se and organic residue gave a slight increase in fresh and dry weight in herbs and inflorescences as compared with Se or sheep manure as a sole. This increase may be due to the important role of organic matter on inducing vital process in plants.

Effects of NPK

Nitrogen uptake by plants from chemical sources is more than that from biofertilizers such as Vermicompost (Ghazi *et al.,* 2013). Letchamo (1993) explained that higher levels of nitrogen increased shoot vegetative growth and flower production and finally produced higher dry matter. Nitrogen, as the main yield increasing nutrient, significantly contributes to an increase in height, weight and yield of essential oil plants, thereby to an increase in oil yield.

The direct effects of nitrogen deficiency are decreasing or even prohibiting cell dividing, reduction in growth enzymes, cell walls and layers abnormalities, leaf area index decreasing, yellow and dried older leaves (because of nitrogen remobilization to vegetative organs) and finally growth reduction (Ahmadian *et al*., 2011).

Effects of different level of nitrogen, phosphorus and potassium fertilizers on dried flower yield

Means comparison results showed that the value of dried flower head was vary from 91.52 g/m^2 in N0 to 119.42 g/m^2 in N50. Also, P0 level produced 102.45 g/m^2 dry flowers but 120.41 g/m^2 dry flower obtained in P50 (Table 1).

Nitrogen had a significant effect on plant height, number of flowers per plant, and dry flower yield of chamomile (Dadkhah et *al*., 2012). Nitrogen being a nutrient element that promotes vegetative growth of plants increased the biomass of chamomile, which in turn increased the essential oil yield of the crop (Kumar *et al*., 2016; Niknejad *et al*., 2013).

Effect of different levels of nitrogen, phosphorus and potassium fertilizers on essential oil content (%)

Nitrogen, one of essential minerals, is used by plants to build many organic compounds: amino acids, proteins, enzymes, and nucleic acids. The highest essence percentage (0.38%) was obtained in using 50 kg/ha K_2O , whereas not using K_2O and using 25 kg/ha of it had the lowest percentage of 0.34% (Table 1). Nitrogen being a nutrient element that promotes vegetative growth of plants increased the biomass of chamomile, which in turn increased the essential oil yield of the crop (Kumar *et al*., 2016; Niknejad *et al*., 2013). Liuc and Pank, 2005 concluded that, increase levels of nitrogen fertilizer increased essential oil and maximum amount of essential oil of Roman chamomile plant. Essential oil content and yield in herbal plants are also modified by the rate of applied nitrogen (Arabaci et *al.,* 2004; Daneshian *et al*., 2009; Zheljazkov *et al*., 2010). Nitrogen, as the main yield increasing nutrient, significantly contributes to an increase in height, weight and yield of essential oil plants, thereby to an increase in oil yield. The positive effect of nitrogen on root characteristics and essential oil content and chamazulene of chamomile has also been reported (Rahmati et *al*., 2009). Abla *et al* (2004) finding phosphorus had pronounced effect on carbohydrates, soluble sugars, mineral contents and on the percentage of oil production from chamomile flowers compared with the control.

Effect of different levels of nitrogen, phosphorus and potassium fertilizers on chamazulene content (%)

Nitrogen effect made a variation range from 13.12% chamazulene in N50 to 13.43% in N0 (Table 1). Also, P25 had 13.04% chamazulene whereas P0 produced 13.67%. Potassium changed chamazulene percentage from 12.66% in K0 to13.62% in K25.The least percentage of chamazulene (10.32%) obtained in N50 P25 and the highest (15.39) was produced in N50P0 (Table 1 Using 50 kg/ha of nitrogen and 0 kg/ha of phosphorus fertilizer produced the highest chamazulene percentage in German chamomile and use of potassium cause decrease of flower yield and chamazulene percentage in most of treatments. On the other hand, using nitrogen more than 50 kg/ha did not increase chamazulene percentage, then, for the best flower producing and essence and chamazulene percentage, it is better to use 50 kg/ha nitrogen fertilizer and 25 kg/ha phosphorus fertilizer (Table 1). Letchamo (1993) reported that nitrogen increasing did not affect active substances of chamomile.

Effects of Organic fertilizer on chamomile production

Manure application is more beneficial for plants compared to chemical fertilizers (Loecke 2004). Chemical fertilizers just provide one or some essential elements, while organic fertilizer provides most of the micro and macro nutrients for plants (Saboor *et al*., 2004). Furthermore, manure can improve physiochemical properties of the soil as well as yield quality (Loecke *et al*., 2004).

Effects of Compost on chamomile production

Application of compost to improve soil structure, fertility and consequently development and productivity of medicinal plants were studied in several cases. In chamomile (*Matricaria chamomilla* L.), effect of chemical fertilizer and compost on soil productivity were studied and results showed that all compost + liquid compost treatments was increased essential oil content [% and g/plant] (Hendawy and Khalid, 2011). Similar results were obtained from *Cymbopogon winterianus* plants (Adholeya and Prakash, 2004).

Effect of animal manure on chamomile production

Organic material, such as cattle, sheep and chicken manure, improves soil physical properties (structure and aggregation) and soil chemical properties (decrease soil pH, increase cation exchange capacity and enhance most nutrients) that are important for plant growth (Snyman *et al*., 1998). Animal manures have been used for plant production *effectively* for centuries. Chicken manure has long been recognized as perhaps the most desirable of these natural fertilizers because of its high nitrogen content (Ghanbarian et *al*., 2008). In addition, manures supply other nutrients and serve as soil amendments by adding organic matter (Bin, 1983).

Table 1. Means comparison for effects of NPK fertilizer on chamomile.

Treatment	Number of flowers (per plant)	Plant wet weight (g)	Plant dry weight (g)	Dried flower yield (g/m2)	Essential oil content (%)	Chamazulene content (%)
			Nitrogen			
N0	16.25[b]	12.24[c]	3.34[b]	91.52[b]	0.32[b]	13.43[a]
N50	18.11[a]	17.09[b]	4.32[a]	119.42[a]	0.36[a]	13.12[b]
N100	18.84[a]	19.41[a]	4.25[a]	118.67a	0.36[a]	13.26[c]
			Phosphorus			
P0	17.64[a]	17.49[a]	3.88[a]	102.45[b]	0.35[a]	13.67[a]
P25	18.55[a]	16.11[b]	4.07[a]	106.72[b]	0.35[a]	13.04[b]
P50	17.01[a]	15.13[b]	3.97[a]	120.41[a]	0.34[a]	13.10[b]
			Potassium			
K0	19.71[a]	19.01[a]	4.26[a]	112.29[a]	0.34[b]	12.66[c]
K25	16.72[b]	14.95[b]	3.88[ab]	110.05[ab]	0.34[b]	13.62[a]
K50	16.77[b]	14.77[b]	3.77[b]	71.22[b]	0.38[a]	13.53[b]

Source: Naderidarbaghshahi *et al*., 2012

Organic matter persistence in soil will vary with temperature, drainage, rainfall and other environmental factors. Organic matter in soil improves moisture and nutrient retention and soil physical properties (Zane, *et al*., 1980).

Effect of FYM on Chamomile production

Farm yard manure is the most common organic manure used in most horticultural, medicinal and aromatic plants and vegetable crops for supplement the initial requirement of nutrients for better establishment and plant growth. Addition of organic matter increases the humus content of such soil and thereby improves the crop performance. The adequate fertilization, regular application of nutrients or alternatively use of nutrient enriched organic manures in integrated nutrient management results in quality flower production (Srivastava *et al.,* 2012). In most of the aromatic crops, organic cultivation is recommended to maintain the flower and oil yield. In case of chamomile few nutritional studies have been conducted under normal soil condition by earlier workers (Gowda *et al*., 1991).

Effects of Vermicompost on Chamomile Production

Vermicompost contains plant-growth regulators which increase growth and yield of the plants (Atiyeh *et al*., 2002; Canellas *et al*., 2002). Excreta of earthworm were rich of Micro-organism especially bacteria and contain large amounts of plant hormones (auxin, gibberellins and cytokinin) which affect plant growth and development (Atiyeh *et al*., 2002). Besides, vermicompost can affect on soil physical properties (Wang *et al*., 2010), it improves soil structure, texture, aeration, and water holding capacity. The application of Vermicompost favorably affects soil pH, microbial population and soil enzyme activities (Maheswarappa *et al*., 1999) which all of them can influence biosynthesis of compounds in plants.

Vermicompost contains most nutrients in plant available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium (Edwards, 1998). The uptake of nitrogen, phosphorus, potassium and magnesium can improve when fertilizer was applied in combination with vermicompost (Jadhav *et al*., 1997). This is supported by (Atiyeh *et al*., 2002, who reported that vermicompost is rich in macro and microelements, which are responsible for increased qualitative and quantitative yields of many crops. It provides all nutrients in readily available form and also enhances uptake of nutrients by plants.

Vermicompost has large particulate surface area that provides many micro sites for the microbial activity and strong retention of nutrients. It is rich in microbial population and diversity, particularly fungi, bacteria and actinomycetes (Edwards, 1998) Application of biofertilizers such as vermicompost in a sustainable agriculture system improves the yield and quality of active ingredient in medicinal plants Darzi *et al*., (2012). Azizi *et al.,* (2008) have found the positive influence of vermicompost on the essential oil and chamazulene contents of chamomile. The similar results showed that the rates and quality of essential oil of basil and Roman chamomile (Liuc and Pank., 2005), was increased by application of vermicompost.

Chand *et al.,* (2007) reported that growth parameters and herb yield of mint marginally enhanced with the application of 7.5 ton/ha Vermicompost. The study showed that Vermicompost results by increasing the

Table 2. Effects of Vermicompost and Fosfutren on some traits of chamomile (*Matricaria chamomilla*)

Treatment	Height (cm)	Flower head diameter (mm)	No. of flowers/plant	Fresh flower yield kg/ha	Dry flower yield (kg/ha)	Essential oil (%)
			Vermicompost			
V1	25.3^{d}	18.5^{b}	65.42^{d}	1800.77^{d}	352.95^{e}	0.34^{d}
V2	31.2^{c}	18.6^{b}	89.21^{c}	2311.23^{c}	462.42^{d}	0.37^{c}
V3	34.1^{bc}	18.9^{b}	95.76b^{c}	2733.5^{b}	535.77^{c}	0.38^{c}
V4	37.2^{b}	19.4^{b}	107.5^{ab}	3172.54^{a}	592.63^{b}	0.43^{b}
V5	41.8^{a}	21.5^{a}	110.23^{a}	3335.7^{a}	653.81^{a}	0.49^{a}
			Fosnutren			
F1	33.2^{b}	18.4^{b}	105.11^{a}	2528.48^{b}	510.18^{b}	0.35^{b}
F2	31.9^{b}	18.2^{b}	105.92^{a}	2315.68^{c}	493.07^{b}	0.36^{b}
F3	38.7^{a}	20.8^{a}	104.41^{a}	2868.09^{a}	572.15^{a}	0.39^{a}

Vermicompost levels: V1, 0 ton/ha (control); V2, 5 ton/ha; V3, 10 ton/ha; V4, 15 ton/ha; V5, 20 ton /ha. Fosfutren spraying F1, at budding stage; F2, at flowering stage; F3, at budding stage + at flowering stage. Mean values followed by the same letter are not significantly different at $P \leq 0.05$.
Source: - Hadi *et al.,* 2011

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 ., 1987). Singh (2003), indicated that compost was higher in ammonium, while vermicompost tended to be higher in nitrates, which is the more plant-available form of nitrogen (Atiyeh *et al*., 2002).

Effects of Vermicompost on flower head diameter

The study results have indicated that all measured traits were significantly affected by using Vermicompost and the spray of amino acids, except for the values of flower head diameter after the amino acid spray (Table 2). Interactions were significant only for the dried flower yield.

In table 2, the flower head diameter was significantly influenced by vermicompost treatment. Use of the vermicompost from 0 ton/ha to 10 ton/ha did not cause major differences in flower head diameter. The highest plant height, flower head diameter, fresh and dry flower yield and significant essential oil content were obtained by using 20-ton vermicompost per hectare. Effects of amino acids were similar to those seen in vermicompost treatment and all measured traits were seen to be significant after the spray of amino acids at the budding + flowering stage (Table 2).

Effects of Vermicompost on fresh and dry flower yield

Vermicompost had positive effects on the fresh and dry flower yield of chamomile (Table 2). Plants grown in the plots, treated with 20 t/ha, had significantly greater flower yield ($P \leq 0.05$). As increasing the vermicompost amounts, the flower yield increased nonlinearly (Table 2). The highest fresh and dry flower yields (3335.7 and 653.8 kg/ha, respectively) were recorded by using vermicompost of 20t/ha. The high flower yield of chamomile under vermicompost of 20t/ha might be due to higher number of flowers per plant and an increased flower head diameter (Table 2). This may be due to vermicompost contains large amounts of humic substances and some of the effects of these substances on plant growth have been shown to be very similar to those of soil-applied plant growth regulators or hormones (Muscolo *et al*., 1999). As a result, most nutrients are easily available such as; nitrates, phosphates, and exchangeable calcium and soluble potassium (Edwards, 1998), which are responsible for increased plant growth and crop yield. Mean comparison showed significant differences between various levels of fosnutren spraying. Foliar application of amino acids at F3 phase (Budding + Flowering stage) caused the greatest fresh and dry flower yield (Table 2). Vermicompost has been shown to increase the dry weight (Edwards, 1995) and nitrogen uptake efficiency of plants (Tomati *et al.,* 1994). Results of another research conducted on Chamomile revealed that the impact of different levels of Vermicompost were investigated on morphological traits and essential oil content of chamomile and found that of Vermicompost significantly improved the plant height, early flowering, flower yield, length, and diameter of receptacle Azizi *et al.,* (2008).

Effects of Vermicompost on essential oil content

Total essential oil content varied between 0.34 and 0.49% (Table 2), which was obtained from control 0 ton/ha and vermicompost of 20t/ha, respectively. There were significant differences in essential oil content between the plants sprayed with various levels of fosnutren treatments. Foliar application of fosnutren at F3 (Budding + flowering stage) resulted in the greatest essential oil content (Table 2). Hadi *et al.,* (2011) reported that Vermicompost have no detrimental but rather stimulatory effects on the growth, flower yield and essential oil content of chamomile and have thus considerable potential for providing nutritional elements in chamomile production, especially for the sustainable production systems. Other investigations have also shown that Vermicompost increases the essential oil of chamomile which reported by (Hadi *et al* (2015**)**. Thus, (Arancon *et al*., 2004) stated that chemical and physical properties of humic acid in an organic fertilizer (vermicompost) by increasing the capacity of nutrients, regulating growth hormones and activity of microorganisms enhanced accumulation of nitrogen in plant. The uptake of nitrogen, phosphorus, potassium and magnesium can improve when fertilizer was applied in combination with vermicompost (Jadhav *et al*., 1997).

CONCLUSION

Continuous usage of inorganic fertilizer affects soil structure. Hence, animal and plant manures, compost and vermicompost can serve as alternative to mineral fertilizers for improving soil structure and microbial biomass. Organic fertilizers in comparison of the chemical fertilizers have lower nutrient content and are slow release but they are as effective as chemical fertilizers over longer periods of use. In chamomile essential oil content and the amount of compounds in organic fertilizer conditions were higher than chemical fertilizer and control. Based on the above review, it can concluded that the application of organic fertilizer was found more beneficial and significantly improved morpho-physiological traits, growth parameters, biochemical constituents, yield and yield components and essential oil yield of chamomile plants. Totally, this review revealed that using organic fertilizer significantly improved the quantity and quality characters compared to chemical fertilizer and control. Organic fertilizer enhances soil organic carbon, available phosphorus content and microbial population / enzymatic activity of soil thus making it sustainable for organic medicinal plants production. Owing to positive influence of organic components medicinal plants cropping system, it is therefore, be assumed that those farmers who adopted organic fertilizer practices found a way to improve the quality of their soil, or at least stemmed the deterioration. The system is became long term productive by protecting soils and enhancing their fertility ensuring productive capacity for future generations.

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