

Effect of organic fertilizer and foliar application of humic acid on some quantitative and qualitative yield of Pot marigold

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ABSTRACT: This study aimed to evaluate the effect of organic fertilizer and foliar application of humic acid on quantitative and qualitative yield of marigold which was performed in randomized complete block design with three replications. Factors in this study consisted of four levels of manure application vermicompost in 0, 5, 10 and 15 tons per hectare and humic acid at three levels: 0, 250 and 500 milligrams per liter. Some traits were investigated at the end of the experiment such as height, fresh flower performance, number of flowers per plant, grain yield, petals yield, seed weight, carotenoid content, total phenols and percentage of mucilage. Based on the analysis of variance was determined that the effect of vermicompost and humic acid on all studied traits were significant at the 1 or 5 percent levels. Based on the results of this test, it can be stated that the application of vermicompost had a positive impact in marigold. With an increase in the amount of compost in the range between zero and 15 tons per hectare, this herb also increases the amount of morphological and biochemical, and a maximum of 15 tons was achieved with treatment. The application of vermicompost 15 tons per hectare recommended in the growing marigold. Effect of humic acid on the parameters was significant and 500 mg had highest significant effect, therefore the use of humic acid is also recommended.

Keywords: Fertilizers, foliar application, marigold, Nutrients, Yield.

INTRODUCTION

Pot marigold (*Calendula officinalis* L.) is from Asteraceae family and complete capitulum or separated florets from floral receptacle compose the medicinal part of this plant. This plant has medicinal properties and it is used for treatment of skin diseases [rafee et al., 2013]. One of the used organic-mineral fertilizers is humic acid. The supplementation of chemical fertilizers with cheaper lignitic coal derived humic acid could reduce cost of production without compromising on yield. Humic acid is a commercial product contains many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield. [Moraditochae, 2012]. Humic substances are formed through the process of humification of organic materials as by-product of microbial metabolism and are found in soil, coal, sediments water, peat, and organic matter. The mechanisms showed that humic substances enhanced the growth by increasing the uptake of micronutrient [Lee and Bartlett, 1976]. The beneficial effects of humic substances on plant growth may be related to their indirect (enhance of fertilizer efficiency or reducing soil compaction), or direct (progress of the overall plant biomass) effects [Nardi et al., 2002]. Also, humic substances increase the growth rate of many forms of beneficial microorganisms in part, by stimulating enzyme activities [Pouneva, 2005; Burkowska and Donderski, 2007]. Humic acid effectively improves soil fertility and crop production especially in poor soils and alkaline-calcareous soils (Rajpar et al., 2011). The humic acid based on fertilizers causes yield increase (Mohamed et al., 2009), stimulation of plant enzymes and hormones and soil fertility (Sarir et al., 2005; Mart, 2007). Several research works have been prominently shown the positive benefits of application of humic acid on higher plants (Ashraf et al., 2005; Susilawati et al., 2009). The use of natural organic manure and biofertilizers are recommended by several investigators to substitute the chemical fertilizers as they

improve physical and chemical properties of soil and they are the way of clean agriculture with minimum pollution effects and reduce agricultural cost (El-Akabawy, 2000). Aim of this study was evaluation of organic fertilizer and foliar application of humic acid on some quantitative and qualitative yield of Pot marigold.

MATERIALS AND METHODS

This study was designed in RCBD experimental design with three replications in field condition. Treatments included vermicompost (0, 5, 10 and 15 ton/ha) and humic acid (0, 250 and 500 mg/L). After deep plowing, determination of plots and according to treatments, compost added to plots. After four-leaf stage, humic acid treatment sprayed in three stages and it was repeated once every 20 days. Some traits were investigated at the end of the experiment such as height, fresh flower performance, dry weight, number of flowers per plant, grain yield, petals yield, seed weight, chlorophyll content, carotenoid content, the content of carbohydrates, total phenols, the percentage of mucilage. Data was analyzed by using SAS software and the means were compared by Duncan's multiple range test (DMRT) and the charts were drawn by Excel software.

RESULTS AND DISCUSSION

Height: Generally, application of various level of vermicompost in marigold had a remarkable growth in height. Utilization of 5, 10 and 15 ton/ha vermicompost increased height 11, 17 and 26 percent, respectively. The data in table 1 revealed that the highest amount of this treat was obtained by 500 mg/L humic acid. Meanwhile, there was no significant difference in amount between application of 250 and 500 mg/L humic acid observed in marigold. The pronounced effect of Organic fertilizer application improves the soil structure and soil moisture content, provides plant with essential elements, increases growth and biological yield and finally led to increase seed yield (Ahmadian et al., 2011).

Fresh flower yield: According to results, application of 10 and 15 ton/ha vermicompost increased Fresh flower yield 3 and 6 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of Fresh flower yield were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased Fresh flower yield 2 and 4 percent respectively. Effects of vermicompost on growth and flowering satin in a greenhouse were investigated by Chamani et al. (2008). Results showed that vermicompost had a significant positive effect on flower number, leaf growth, and shoot fresh and dry weight as compared with grown plant in soil without vermicompost.

Number of flowers per plant: Result showed that application of 5, 10 and 15 ton/ha vermicompost increased Number of flowers per plant 11, 24 and 47 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of Number of flowers per plant were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased Number of flowers per plant 2 and 3 percent respectively. Application of organic improving material such as thermophilic composts results in amendment of soil structure, soil productivity, increased variation of microbial population, increased bacterial activity (Zinc and Allen, 1998) and improvement of water retention capacity of soil and improvement of crop yield.

Grain yield: Application of 5, 10 and 15 ton/ha vermicompost increased Grain yield 13, 31 and 45 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of Grain yield were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased Grain yield 4 and 5 percent respectively. Atiyeh et al. (2000) showed that 10-20% vermicompost significantly increased the weight of tomato seedlings and fruit yields compared to control.

Petals yield: Application of 5, 10 and 15 ton/ha vermicompost increased Petals yield 8, 14 and 25 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of Petals yield were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased Petals yield 3 and 7 percent respectively. Krishnamoorthy and Vajrabhiah, (1986) reported that cytokinins and auxines are produced from organic residues processed by earth worms. Vermicompost has been reported to have effects similar to plant growth regulating substances and hormones.

1000 Seed weight: Application of 5, 10 and 15 ton/ha vermicompost increased 1000 Seed weight 1.5, 2.2 and 2.4 fold in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of 1000 Seed weight were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased 1000 Seed weight 14 and 22 percent, respectively. Kholghi et al., 20114 reported that humic fertilizer increase yield and yield components of barley.

Chlorophyll content: Application of 5, 10 and 15 ton/ha vermicompost increased Chlorophyll content 14, 31 and 31 percent in compare to control, respectively. According to results in Table 1, humic acid didn't show significant effects on Chlorophyll content. Cangi et al. (2006) indicated that foliar spraying of humic acid on plants increase uptake of macro and micro elements in shoot and root has increased carbohydrates production, chlorophyll and carotenoids in stems. Enhancing the quantitative and qualitative characteristics as a result of increased respiration, photosynthesis and total protein in the plants, due to humic acid and folic acid application has also been reported by Nardi et al. (2002).

Total phenols: Application of 5, 10 and 15 ton/ha vermicompost increased Total phenols 13, 7 and 41 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of Total phenols were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased Total phenols 6 and 135 percent respectively.

The percentage of mucilage: Application of 5, 10 and 15 ton/ha vermicompost increased the percentage of mucilage 13, 48 and 65 percent in compare to control, respectively. The presented results in Table 1 showed that the highest and the lowest amount of the percentage of mucilage were observed in the sprayed plants by 500 mg/L humic acid and control treatments respectively. Application of 250 and 500 mg/L humic acid increased the percentage of mucilage 12 and 25 percent respectively. It can be stated that the application of vermicompost had a positive impact in marigold. With an increase in the amount of compost in the range between zero and 15 tons per hectare, this herb also increases the amount of morphological and biochemical, and a maximum of 15 tons was achieved with treatment. The application of vermicompost 15 tons per hectare recommended in the growing marigold. Effect of humic acid on the parameters studied were significant and meaningful and by increasing the use of the average yield in most cases showed an increasing trend, therefore, the use of humic acid is also recommended.

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