Effect of Organic Fertilization and AMF Inoculation on Yield and Floral Quality Parameters of Common Marigold

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Abstract

In Greece common marigold is one of the major medicinal plants widely used in cosmetics, perfumes and the pharmaceutical industry. A field experiment was conducted at Komotini, Greece, to compare the effect of organic and conventional fertilization combined with arbuscular mycorrhizal fungi inoculation on yield and floral qualitative characteristics of the common marigold during the 2015 growing season. The experiment was set up as a split plot design with three replicates, three main plots (fertilization treatments, inorganic, organic and untreated) and two sub-plots (addition/non-addition of commercial mycorrhiza of the genus *Glomus* spp.). Floral fresh and dry weight as well as total phenolic and flavonoid content of the dried flowers were recorded. Data analysis confirmed no significant correlation between fresh/dry floral yield, total phenolic and flavonoid content of the dried flowers and type of fertilization. The results also demonstrate a tendency of increase of the fresh or dry weight of the flowers when the commercial mycorrhiza is applied but it is not statistically significant.

Keywords: *arbuscular mycorrhiza, calendula officinalis, fertilization, flavonoids, polyphenols*

Introduction

The common marigold (*Calendula officinalis* L.) is a commercially cultivated annual aromatic and pharmaceutical plant because of the wide range of its potential pharmaceutical and cosmetic usages, since extensive investigation has confirmed the abundance of various active phytochemical compounds responsible for the properties of the plant. The species have been reported to contain a variety of phytochemicals, including carbohydrates, lipids, phenolic compounds, steroids, terpenoids, tocopherols, carotenoids and quinones with potential health benefits (Muley *et al.*, 2009). On the other hand only a limited scientific knowledge has been gathered related to the optimum cultural practices, the efficacy of organic cultivation and the correlation of production methods with the quality characteristics of this species. The aim of this study was to evaluate the effects of

organic and conventional fertilization combined with arbuscular mycorrhizal fungi inoculation on yield and floral qualitative characteristics of the common marigold during the 2015 growing season.

Materials and methods

The research was carried out at a private organic farm, certified as “organic” since 1995, located in Komotini (northern Greece: latitude 41°02′ N, longitude 25°12′ E, altitude 16 m above sea level) from April to October 2015. The soil was sandy clay (40.5 % clay, 9.0 % silt and 50.5 % sand) with pH 7.43, NO₃-N 12.0 mg kg⁻¹ soil, available P 18.0 mg kg⁻¹ soil, available K 460 mg kg⁻¹ soil and 1.61 % organic matter. The experiment was set up as a split plot design with three replicates, three main plots (fertilization treatments, inorganic, organic and untreated) and two sub-plots

Fig. 1. and 2. Response of fresh and dry weight of flowers to fertilization and mycorrhiza treatments. Different low case letters indicate significant differences ($p < 0.05$).

Fig. 3. Total phenolic (TP) and flavonoid (TF) content of marigold flowers.

(addition/non-addition of commercial mycorrhiza of the genus *Glomus* spp.). Seeds of a local cultivar from a native wild population were placed in a plastic tray containing a mixture of sand:organic substrate:soil in the proportion of 1:1:1. When the seedlings reached 15 cm, they were replanted in the experimental field on 10 May. The experimental plots were 7 m × 2 m and consisted of 2 rows 1 m apart. For both organic and inorganic fertilization the fertilizers applied provided the soil with 10 units of N/P/K. Marigold inflorescences were harvested in the full bloom phase, every 7 days from 25/6 to 22/10. Floral fresh and dry weight as well as total phenolic and flavonoid content of the dried flowers were recorded. The total phenolic content of the extract was determined by the Folin-Ciocalteu method (Blainski *et al.*, 2013) and the aluminum chloride colorimetric method was used for the determination of the total flavonoid content of the sample (Chang *et al.*, 2002). The data were subjected to statistical analysis according to the

split-plot design (STATGRAPHICS Plus 5.1 logistic package). Differences between treatment means were compared at $P=5\%$ with ANOVA in order to find the statistically significant differences.

Results and discussion

The results indicate no statistically significant differences in the fresh/dry floral yield, total phenolic and flavonoid content of the dried flowers under the different treatments of fertilization (Fig. 1, 2 and 3). The results also demonstrate a tendency of increase of the fresh or dry weight of the flowers when commercial mycorrhiza is applied but it is not statistically significant (Fig. 1 and 2). Our results are in accordance with previous studies (Hosseinzadah *et al.*, 2011, Fernandes *et al.*, 2013). In addition, the results obtained by Borella *et al.* (2011) indicated that calendula exhibits hardiness and adapts well to the soils that are relatively poor in organic material, but when organic fertilization was applied, it could prolongate the vegetative

development of this species. However, the organic fertilizer releases nutrients to the plants slower and in a higher constant manner, bringing the benefits of chemical and physical properties of the soil. The organic fertilization improves the soil structure, aeration, drainage and water retention. Thus, total flavonoid content in *C. officinalis* might depend on the cultivar and the environmental conditions during the cultivation period.

Conclusion

Based on the results obtained in the first experimental year, we demonstrated that organic fertilization of the *C. officinalis* is not inferior to inorganic fertilization of the specific species for the characteristics of fresh/dry flower mass, total flavonoid and polyphenolic content. This statement needs to be confirmed by future research regarding the effect of fertilization management on yield and floral quality parameters of common marigold.

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