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THE EFFECT OF *TRICHODERMA* ON POLIANTHES QUALITATIVE AND QUANTITATIVE PROPERTIES

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ABSTRACT

The study was aimed to assess the effect of *Trichoderma harzianum Bi* on qualitative and quantitative traits of polianthes, including stem length and diameter, inflorescence floret number and leaf length of the main and lateral bulbs; an experiment with completely randomized design having four treatments and seven replications was completed in greenhouse conditions. Enriched coco peat with *Trichoderma* in different concentrations (0, 20, 50 and 100%) of pot total coco peat, were applied as treatments. Main media mixture was 40% of coco peat+ 40% of field soil+ 20% of perlite. Enriched coco peat with 100% concentration significantly increased stem length and diameter, floret number and leaf length in both main and lateral bulbs compared with control sample. There were no significant differences between treatments for stem length and diameter, neither for floret number. Also, treatments of 50% and 20% enriched coco peat for stem length and diameter, and floret number, did not significantly differ from control variant. By applying 50% enriched coco peat the floret number and leaf length of the main and lateral bulbs significantly increased compared with control variant. The data obtained from the experiment showed that *Trichoderma* enhanced qualitative and quantitative traits of polianthes cut flowers.

Key words: culture medium, enriched coco peat, cut flower, growth regulator.

INTRODUCTION

Trichoderma harzianum is a saprophytic fungus which is generally used as a biological control agent against a wide range of economically important aerial and soil borne plant pathogens (Papavizas, 1985) and has been extensively studied as potential biocontrol agents (Lynch, 1990; Papavizas, 1992). However, some studies have also shown that it can stimulate the growth of a number of vegetable and bedding plant crops (Baker, 1989; Lynch *et al*., 1991a,b). Lynch *et al*. (1991a,b) investigated the effect of *Trichoderma spp.* on the growth of lettuce, and its ability to control damping off diseases caused by *Rhizoctonia solani* and *Pythium ultimum*. They also showed that a number of *Trichoderma* strains had a direct effect on lettuce establishment and it's growth ratio in the absence of pathogens. They found that the fungal treatments of seeds reduced the emergence time of seedlings compared to the controls. From their results, and those of Ousley *et al*. (1994), it was concluded that some *Trichoderma* strains have the potential to consistently increase plant growth (Lynch *et al*., 1991a) and influence its phenology.

Various species of *Trichoderma* were also effective in the promotion of growth and yield of various crops (Bal and Altintas, 2006a). *T. harzianum* and *T.virens* promoted growth of cucumber, muskmelon and cotton seedlings (Hanson, 2000; Poldma *et al*., 2000; Yedidia *et al*., 2001, Kaveh *et al*., 2011). Root and shoot growth of sweet corn were considerably increased (Bjorkman *et al*., 1998). Cucumber, bell pepper and strawberry yields were increased significantly following the application of *T. harzianum* at the root zone (Poldma *et al.*, 2002; Altintas and Bal, 2005; Bal and Altintas, 2006b; Elad *et al*., 2006). However, application of *Trichoderma spp.* was not conducive to increase yields on tomato culture (Bal and Altintas, 2006c). For onion, yield and quality characteristics were not enhanced by the application of *Trichoderma spp.* (Poldma *et al*., 2001). *Trichoderma* species can improve plant growth and development (De Souza *et al*., 2008; Gravel *et al*., 2007). Growth stimulation is evidenced by increases in biomass, productivity, stress resistance and increased nutrient absorption (Hoyos-Carvajal, 2009). The treated plant benefited by the presence of *Trichoderma spp.*, suggesting an interaction as a virulent symbionts (Yedidia *et al.*, 1999; Howell *et al*., 2000; Harman *et al*., 2004). *Trichoderma spp.* can also produce metabolites with activities analogous to plant hormones (Cutler *et al*., 1989).

In an earlier study we tested effects of five isolates of *Trichoderma* (*Trichoderma harzianum Bi*, *T. virens* Et4, *T. virens* Rabi, *T. virens* Et6, *T. virens* 65Amar) and concluded that *T. harzianum* was more effective on qualitative traits like fresh and dry weight, stem length and flower diameter of *Tagetes*, *Gaillardia* and *Zinnia* (Mazhabi, 2010). In this study we aimed to find if *Trichoderma spp.* had additional and promoting effects on vegetative and qualitative traits of polianthes bulbs and cut flowers.

MATERIAL AND METHODS

Inoculum preparation: *T. harzianum Bi* was obtained from Ferdowsi University fungi collection. The isolate Bi was cultured on PDA and incubated at 25˚C for 5 days. Four discs of 1.5 cm diameter were cut from the margin of *Trichoderma* colony and added to 1 lit Erlenmeyer containing 250 g. of boiled wheat grain and autoclaved for 30 minutes. The extracts were then kept for 15 days at 25˚C until the complete cover of the grains by *Trichoderma*. The grains were then mixed at the rate of 10 % (V.V) with peat, autoclaved in polyethylene bags (resistant to high temperatures) for 30 minutes, and placed at 25˚C ± 5, in laboratory condition. Ten days later, when the peat was covered by *Trichoderma*, the contents of the bags were used as *Trichoderma* inoculums.

Culture medium: The prepared inoculums were added to the main potting mixture (40% coco peat+ 40% fertile soil+ 20% perlite) at the rate of 0 (as control), 20, 50 and 100% of used coco peat. No manure or nutritional solutions were used during this survey. Weed control and irrigation were similar in all treatments.

Bulb preparation: Polianthes bulbs were supplied commercially; within which 28 mature bulbs with 12±0.5 cm perimeter were selected. The bulbs were disinfected using sodium hypochlorite and desiccated, before sowing. To ensure broken bulb dormancy and germination in a uniform period after planting, the bulbs were soaked for 72 hours in wipes. After root tip emergence, the bulbs were cultivated in pots with 20 cm in diameter.

Experimental design and data analysis: To asses the effect of *Trichoderma harzianum Bi* on qualitative and quantitative traits of polianthes, an experiment was performed in situ using completely randomized design with four treatments and seven replications.

The data was analyzed with MSTATC software. Duncan's multiple range test at P<1% and P<5% was used for grouping and comparing the means.

RESULTS

In this study the application of *T.harzianum Bi* to culture medium was statistically effective on promotion of vegetative and qualitative traits of polianthes. The analysis of variance for mean square of the studied traits denoted that between different *Trichoderma* concentrations applied on bulbs, significant differences were observed for stem length and diameter, at P<5% while for floret number and leaf length of main and lateral bulbs the differences between treatments were significant at P<1% (Table.1). These results indicated that treatments containing *Trichoderma* significantly increased qualitative and quantitative traits in polianthes.

Between different concentrations of *Trichoderma*, maximum stem length was related to 100% treatment, which had a significant difference compared with the control variant. For this trait there were no significant differences between treatments with 20, 50 and 100% (Table 2). Lower levels of *Trichoderma* were also effective on making *Polianthes* stem, longer (Figure 1). For stem diameter the most effective treatment was with 100% enriched coco peat, which was significantly thicker than the one with 20% *Trichoderma* and the control variant (Table 2). Floret number had the highest range in the 100% enriched coco peat. There were no significant differences between 20, 50 and 100% treatments for this trait (Table 2). Figure 2 clearly showed the difference among different concentration those changed floret number.

The Longest leaf appeared in the 100% treatment, with a significant difference between the one obtained in the 50% treatment, however, no significant differences were observed between the 50% and 20% treatments (Table 2).

DISCUSSION

The significant differences observed for different qualitative and quantitative trait due to application of Trichoderma could have occurred because of one or more proven functions of *Trichoderma.* Several mechanisms, by which *Trichoderma spp.* influences plant development have been suggested, such as production of growth hormones, solubilization of insoluble minor nutrients in soil (Altomare *et al*., 1999) and increased uptake and translocation of less-available minerals (Kleifeld and Chet, 1992; Inbar *et al.,* 1994). Uptake of certain minerals, such as P and N, is of key importance considering their role in plant growth (Kim *et al*., 1997; Johansen, 1999). Promotion of growth and yield by *Trichoderma* spp. may also be a result of increased root area, allowing the roots to explore larger volumes of soil and by this to access nutrients, increased solubility of insoluble compounds as well as increased availability of micronutrients (Altomare *et al*., 1999; Yedidia *et al.,* 2001). However, initially *Trichoderma* must be able to establish an interaction with the root system. The ability of a *Trichoderma* species to colonize the root system of a plant depends also on the plant species.

Positive effects of *T. harzianum* on plant growth depends on the rhizosphere conditions and the ability of the fungus to survive and develop in it (Kleifield and Chet, 1992). Availability of water in the soil may play an important role in facilitating establishment and effectiveness of *Trichoderma* in the soil (Altintas, 2008). Among the positive effects of *Trichoderma* on different plants that have been noted over the past five to ten years in studies conducted by so many authors (Harman, 2006) and results of *T.harzianum* on traits studied in this

experiment, it has been concluded that promotional effects of *Trichoderma* may be due to the following reasons:
• Control of root and foliar pathogens
o Induced resistance
o Biological control of diseases by direct attack of plant pathogenic fungi
• Changes in the microfloral composition of the roots
• Enhanced nutrient uptake, including but not limited to nitrogen
• Enhanced solubilization of soil nutrients
• Enhanced root development
• Increased root hair formation
• Deeper rooting

Plant growth hormone production is an important mechanism by which strains of *Trichoderma* can enhance plant growth. Auxins, which can be produced by some fungi species in both symbiotic and pathogenic interactions with plants, are the key hormones influencing plant growth and development (Losane and Kumar, 1992; Shayakhmetov, 2001; Patten and Glick, 2002; Gravel *et al.,* 2007). Akter *et al.,* reported that secretion of gibberellins, auxins or ethylene hormones due to *Trichoderma* application increased seed germination in cucumber (Akter *et al.,* 2007).

Table.1, Mean square analysis of variance for the studied traits in mature polianthes bulbs treated with different *T. harzianum Bi.* concentrations

C.V.	d.f	Stem length	Stem diameter	Floret number	Leaf length
Trichoderma	3	125.83	0.80*	56.14**	145.23**
Error	28	32.71	0.17	14.59	15.58

**:significant at P<1% , *:significant at P<5%

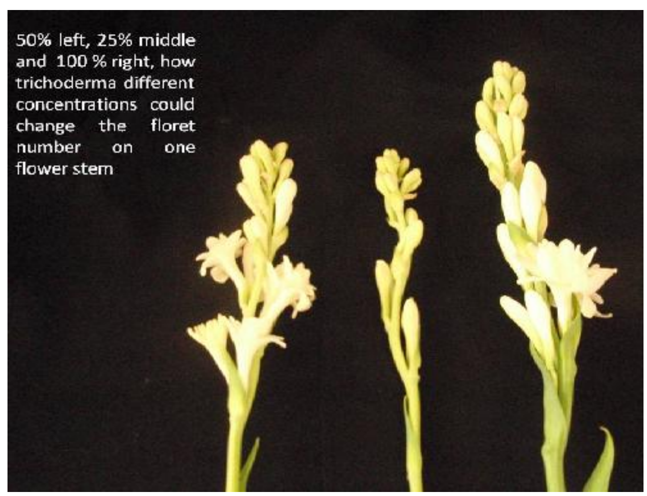
Table.2, The effect of *T. harzianum Bi.* on the studied traits in mature bulbs of polianthes.

Leaf length	Floret number	Stem Diameter	Stem length	Eiched cocopeat treatments (%)
100	68.43^{a}	2.65 ^{a}	28.43 ^{a}	27.71^{a}
50	64.21^{ab}	2.39 ^{ab}	25.86 ^{a}	22.57^{b}
20	4.750^{b} 62.50^{ab}	2.02 ^{b}	25.00 ^{ab}	19.29^{bc}
control	58.19^{b}	1.92 ^{b}	21.57 ^{b}	*17.29^{c}*

Means with different letter have significant difference at P<5%, Duncan's Multiple range test.

T. harzianum ability in colonization of interior roots and presence of exogenous IAA in the rhizosphere , enhanced root development and increased root hair formation and could be stimulus in nutrient transfer from soil to root exactly in soils relatively poor in nutrients (Kleifield and Chet 1992; Rabeendran *et al.,* 2000). The results reported by Vinale *et al.,* in 2008, clearly indicated that some *Trichoderma* secondary metabolites are directly involved in the Trichoderma-plant interactions, and particularly that the compound 6PP may be considered to act as an auxin-like compound and/or may act as an auxin inducer (Vinale *et al.,* 2008).

Control left and 25% treatment right, low level of trichoderma can affect height of flowering stem.



Conclusion: In conclusion, some *Trichoderma spp.* can be determining factors influencing the microbial community in the rhizosphere, which can enhance or even inhibit plant growth, and occasionally establishing a positive interaction within plant roots as an endophyte. The latter association may be the most predictive for the selection of specific strains that can be used as bioinculants to improve crop health and productivity, since direct plant-fungi interactions induce changes in both the fungus and plant. The identification of new molecular effectors may support the application of new biopesticides and biofertilizers based on *Trichoderma* metabolites to be used instead of the living microbes as elicitors of plant defense mechanisms and plant growth stimulants In this study we found that *Trichoderma harzianum* strain *Bi* stimulated the growth of stem, leaf and bulb in polianthes.

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