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The Effect of Organic Media and Fertilization Method on the Yield and Nutrients Uptake of *Bellis perennis* L.

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Abstract

In order to investigate the effect of growth media and nutrition method on the growth of *Bellis perennis* L. and nutrients uptake, a factorial experiment was conducted with two factors: growth media (municipal waste compost, Azolla compost, tea wastes compost) and nutrition method (without fertilizer, soil application, foliar spray) in comparison to the control medium (60% soil + 20% manure + 10% composted leaves + 10% sand) based on RCD with 45 treatment and three replications. Plant growth indices during growth and after plant harvest were measured. The total nitrogen, phosphorous, potassium, calcium, magnesium, iron, zinc and manganese were measured in the shoot of plant. The results showed that the height of plant increased in medium "control, municipal waste compost, Azolla" through foliar spray and soil application of fertilizer. The growth medium "control, municipal compost and Azolla" increased plant height, shoot dry weight and flower number and uptake of nitrogen, potassium, zinc, calcium, iron and magnesium in plant shoot.

Keywords: Azolla, Foliar spray, Growth indices, Municipal waste compost, Tea waste.

INTRODUCTION

Bellis perennis L. is annual plant to grow in Europe and the west of Asia widely in bushes, wet lands and forest region (Vaziri Elahi, 1987). It grows to the 1800-2000 height (Zargari, 1989). Easy cultivation, lack of high care and also many flowers are the invariants of mentioned plant (Vaziri Elahi, 1987). Color of petals is varied from red, red-purple, white or pink colors (Kavalcioglou *et al*., 2010). Nutritional management has an important role at the increase of production and quality of ornamental plants. Nowadays, different matters are used as growth media of ornamental plants (Raviv *et al.,* 2002). The cultivation of plants on soilless media started in 1960 by using organic media, especially peat (Shi *et al*., 2002). Peat is the most public matter used as basis at growth media and in many countries in the world it constitutes the most part of greenhouse soil, but its removal from ecosystems is a global problem (Vaughn *et al*., 2011). Many researches about the effect of compost produced from different resources of agricultural on the growth of ornamental plants has been done in the world that denotes their beneficial effects at improvement of physical, chemical condition and soil fertility (Levy and Taylor, 2003).

Growth media may be provided from different matters with optimized physical and nutritional characteristics, but suitable organic matters was expensive and providing them is difficult (Dibenedetto *et al*., 2004). The positive effect of using municipal waste compost in many agricultural, garden and pasture products has been reported (Marcote *et al*., 2001; Mbarki *et al*., 2008; Ostos *et al*., 2008; Almasiyan *et al*., 2006; Cala *et al*., 2005; Eghball *et al.,* 2004; Somare *et al*., 2003; Garcy Gil *et al*., 2000). Using compost at growth of marigold had positive effect on growth indices and uptake macronutrients by plant (Sharifi *et al*., 2010). Papafotiou *et al.* (2004) used olive wastes compost as alternative of peat to cultivate some ornamental plants and suggested that this compost can be replaced amounted 25%, 75% and 75% v/v instead of peat for cultivating *Ficus benjamina* L., *Cordyline* and *Syngonium podophyllum* L., respectively.

Grigatti *et al.* (2007) showed that the peat can be replaced by the composition of waste compost of plant pruning and sewage sludge (20:80) at growth media of seasonal transplant (marigold, sage, and begonia) at the rations 25 and 50 percent. The aim of this research was determining suitable media for the growth of *Bellis perennis* and increasing uptake of nutrients by using tea waste, Azolla and municipal waste compost.

MATERIALS AND METHODS

A factorial experiment (two factors) was conducted to evaluate impact of growth media and nutrition method on *Bellis perennis* L. Factor A was the different growth media obtained from organic wastes in 15 treatments. Factor B was nutrition method including soil fertilization, foliar spray and without fertilization. *Bellis perennis* L. seeds was bought from Farid seed company and was planted in plot provided by garden soil (60% soil + 20%manure + 10% composted leaves + 10% sand) and the produced transplant with the same size were transferred to the pots having different media at the five or six leaves step. Municipal waste compost was prepared from the factory of recycling municipal waste in Rasht, tea waste compost from Tea Research Station of the north of Iran and Azolla compost were bought from Rice Research Center of Agriculture Ministry in Rasht. After preparation compost, firstly they were passed through 5mm sieve and were combined as volume with the proportion that is mentioned in Table 1. Then the composition was poured into 4 liters pot and transferred to the field and arranged according to the experiment design. After transferring the seedlings to the pots and after one month, they were sprayed. Two plants in each pot were maintained until the end of the growing season. Liquid fertilizer of Megafol was used for fertilization whose its compound is shown in Table 2. Fertilization was done three times at intervals 15 days in both soil and spray. The plant height monthly during growing season and flowering stem was measured.

Table 1. The compounds of organic wastes used in different treatments

Treatment symbol	Treatment
A_1	Control (60% v/v soil+ 20% v/v manure+ 10% sand, 10% composted leaves)
A_2	100% Tea wastes compost
A_3	100% Municipal wastes compost
A_4	100% Azolla compost
A_5	50% Control+50% Tea wastes compost
A_6	50% Control+50% Municipal wastes compost
A_7	50% Control+ 50% Azolla compost
A_8	50% Tea wastes compost+ 50%Municipal wastes compost
A_9	50% Tea wastes composte+50% Azolla compost
A_{10}	50% Municipal wastes compost +50%Azolla compost
A_{11}	33.3% Control+33.3%Tea wastes composte+33.3%Municipal wastes compost
A_{12}	33.3% Control + 33.3% Tea wastes compost+ 33.3% Azolla compost
A_{13}	33.3% Control+ 33.3%Municipal wastes composte+33.3%Azolla compost
A_{14}	33.3% Tea wastes compost+ 33.3%Municipal wastes composte+33.3% Azolla compost
A_{15}	25% Control+ 25%Tea wastes compost+ 25%Municipal wastes compost+ 25%Azolla

Means having same letter (s) in a column are not significantly different from each other

Table 2. The compounds of nutrient solution used in experiment

P_2O_5 (%)	C Organic (%)	N Organic (%)	Fe (%)	Amino acides (%)	K_2O (%)
4.5-5.6	2.9-3.6	28-35	0.05-0.06	4.5-5.6	0.04-0.05

Table 3. Some chemical properties of the used media

Treatment	Nitrogen (%)	Phosphorus (mg/kg)	Potassium (mg/kg)	C/N ratio	pH	EC (dS/m)
Control	0.25	6	24	17.72	6.9	0.85
Tea wastes compost	2.80	120	82	6.44	4.8	5.69
Municipal wastes compost	3.22	208	660	7.11	8.0	16.36
Azolla compost	2.73	26	102	8.58	6.1	3.94
Control + Tea wastes compost	2.99	80	62	3.91	5.1	1.64
Control + Municipal wastes compost	1.89	72	320	8.25	7.7	8.55
Control + Azolla compost	0.70	14	56	13.93	6.5	1.47
Tea wastes compost + Municipal wastes compost	3.71	156	540	5.91	7.6	11.73
Tea wastes compost + Azolla compost	3.50	44	146	5.29	4.9	7.65
Municipal wastes compost + Azolla compost	2.94	248	290	7.13	7.6	10.74
Control + Tea wastes compost + Municipal wastes compost	1.96	80	300	7.96	7.1	8.52
Control + Tea wastes compost + Azolla compost	1.89	48	104	5.16	4.9	2.6
Control + Municipal wastes compost + Azolla compost	1.94	56	420	4.53	7.6	5.23
Tea wastes compost + Municipal wastes compost + Azolla compost	2.85	104	510	7.53	7.3	8.8
Control + Tea wastes compost + Municipal wastes compost + Azolla	2.17	88	340	8.54	7.2	6.28

At the end of the growth period, the plants were removed from pots. Shoots from the crown removed and their fresh weight was recorded. The harvested shoot were dried at 70°C for 48 h. Sub samples of dry shoot were ground and then dry-ashed in a furnace at 550°C and then extracted with 2M HCl. The concentrations of Ca, Mg, Fe, Mn and Zn were measured in the extracts by atomic absorption (Ali Ahyaei, 1994), K by flame photometry and P by spectrophotometry (Paye *et al.*, 1982). The chemical properties of beds were measured. For measuring total N of media, method of Kjeldahl was used (Paye *et al.*, 1984). For measuring phosphorus and potassium, first the beds were extracted by the ammonium bicarbonate-DTPA. Then in produced extract, the phosphorus was measured with the phosphomolybdate method and by Spectrophotometer model Apel-PD-303 UV in the wave 470 nonometer. Potassium was measured by a flame photometer model Jenway. The pH and EC were measured in extract 1:5 dried material to water. The pH was measured with pH meter model elmetron and EC was measured with Jenway. Organic carbon was measured by walkey-black method (Paye *et al.*, 1984) Table 3 shows some chemical properties of the used media.

The experiment was a completely randomized design in three replications and MSTATC software was used for variance analysis of data by Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

The effect of treatment on the growth indices

The results of variance analysis in Table 4 showed that the effect of growth media and nutrition method on shoot dry matter, plant height and flower number were significant. The interaction impact of treatments on shoot dry matter was not significant at 5% level.

Table 5 shows that the highest shoot dry weight and flower number was observed in control + municipal waste compost. Municipal waste compost in combination with control could be effective at increasing plant growth. Chen *et al.* (1988) introduced mixture of manure and composted

Table 4. The ANOVA results of the treatments effect on growth of Bellis perennis L.

Variation sources	Mean Squared			
	Freedom degree	Plant height	Flower number	Shoot dry matter
Growth medium (A)	14	16.7**	412.1**	180.6**
Nutrition method (B)	2	8.6**	176.4*	74.4*
A × B	28	3.1*	190.9*	13.6 ^{ns}
Error	90	1.2	67.3	18.165

**, * significant at 1 and 5% level, respectively, ^{ns} not significant at 5% level.

Table 5. The impact of growth media on the growth indices of *Bellis perennis* L.

Treatment	Shoot dry matter (g)	Plant height (cm)	Flower number
Control	11.8 ^{de}	7.9 ^{ef}	30.7 ^{cd}
Tea wastes compost	16.6 ^{bc}	9.5 ^{bcd}	34.2 ^{bcd}
Municipal wastes compost	15.1 ^{cd}	8.9 ^{cde}	26.1 ^{de}
Azolla compost	9.6 ^{e}	7.3 ^{f}	20.8 ^{e}
Control + Tea wastes compost	17.3 ^{bc}	8.4 ^{def}	34.2 ^{bcd}
Control + Municipal wastes compost	23.8 ^{a}	10.9 ^{a}	46.3 ^{a}
Control + Azolla compost	13.7 ^{cde}	7.5 ^{f}	28.0 ^{de}
Tea wastes compost + Municipal wastes compost	20. 5 ^{ab}	11.0 ^{a}	37. 7 ^{abc}
Tea wastes compost + Azolla compost	14.2 ^{cd}	8.9 ^{cde}	32.8 ^{bcd}
Municipal wastes compost + Azolla compost	20.7 ^{ab}	10.5 ^{ab}	43.9 ^{a}
Control + Tea wastes compost + Municipal wastes compost	22.6 ^{a}	10.1 ^{abc}	34.6 ^{bcd}
Control + Tea wastes compost + Azolla compost	14.6 ^{cd}	8.2 ^{def}	28.0 ^{de}
Control + Municipal wastes compost + Azolla compost	22.2 ^{a}	11.3 ^{a}	40.1 ^{ab}
Tea wastes compost + Municipal wastes compost + Azolla compost	22.0 ^{a}	10.8 ^{a}	32.1 ^{bcd}
Control + Tea wastes compost + Municipal wastes compost + Azolla	22.0 ^{a}	10.5 ^{ab}	37.9 ^{abc}

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

Table 6. The impact of nutrition method on the growth indices

Nutrition method	Shoot dry matter (g)	Plant height (cm)	Flower number
B_1	16.46 [b]	9.16 [b]	31.69 [b]
B_2	19.03 [a]	9.97 [a]	35.60 [a]
B_3	17.84 [ab]	9.28 [b]	34.18 [ab]

B_1: Without fertilization, B_2: Soil application of fertilizer, B_3: Foliar spray of fertilization Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

grape as a suitable replacement for peat at producing ornamental plants. Ikeda *et al*. (2001) reported that organic media have higher yield than mineral media. Results of Tables 3 and 5 showed that *Bllis perennis* L. could tolerate EC more than 8 dS/m. The greatest height of plants is observed in the medium 33.3% control, 33.3% municipal wastes compost + 33.3% Azolla compost (11.3 cm). Municipal waste compost because of high pH and EC can't be a good bed for plant growth, but municipal waste compost in combination with Azolla compost and garden soil can be a suitable combination for plant growth because of stabilizing pH and EC, increasing nutrition material. Garcia-Gomez *et al*. (2001) reported that medium including 20 to 50% municipal waste compost will increase growing index and over 50% will decrease growing. Some beds including municipal waste compost, increases growing of English daisy because of pH 7-8, this plant prefers a pH about 7.5 to 8.5 (Mitich, 1997).

Results of Table 6 showed that the soil application of fertilizer increased plant height, shoot dry weigh and flower number in compared foliar spray application and without fertilization. Base on Table 7, the most flower number obtained in a mixed medium of control + municipal wastes compost in soil application of fertilizer. Interaction influence of bed and nutrition method of flower index is significant so the most number of flowers is in 50% control+50% municipal wastes compost and nutrition method of soil fertilization. Interaction influence of medium and nutrition method on plant height was significant and the most amount of height was shown in "control + municipal wastes compost + Azolla compost" and nutrition method of spraying leaves and soil consumption. A suitable result of medium in relation with plant height is the combination of municipal wastes compost with Azolla compost and garden soil. Municipal wastes compost because of high pH and EC can't be a good bed for plant growth, but municipal waste compost in combination with Azolla compost and garden soil (control+ municipal wastes compost + Azolla compost) can be a suitable combination for plant growth because of stabilizing pH and EC, increasing nutrition material. Garcia-Gomez *et al*. (2001) reported that medium including 20 to 50% municipal waste compost will increase growing index and over 50% will decrease growing. Some beds including municipal waste compost increases growing of English daisy because of pH 7-8 which is needed for English daisy. This plant prefers a pH about 7.5 to 8.5 is preferred (Mitich, 1997).

The effect of treatment on nutrients uptake

The ANOVA result showed that the effect of various growth media on nutrients uptake by plant shoot was significant at 1% level (Table 8). Results showed that tea waste, municipal compost and Azolla medium increased the nitrogen uptake in plant shoot (Table 9). The increase in nitrogen uptake is due to high yield and the high concentration of nitrogen in plant. The highest C/N ration and the least concentration of nitrogen were seen in substrates control and control + Azolla in media (Table 3). If C/N in organic matter is high, microorganisms obtain the nitrogen from media so the concentration of media nitrogen decreases that this process is called immobilization. In medium of control + tea wastes + Azolla, low uptake of nitrogen was seen (Table 9) so in plant shoot the lowest uptake of nitrogen was measured. Researchers believe that adding organic matters to soil may be accompanied by decrease of nitrogen uptake for the plant so when using organic

Table 7. The interaction effect of growth media and nutrition method on the growth indices

Growth medium	Nutrition method	Shoot dry matter (g)	Plant height(cm)	Flower number	Growth medium	Nutrition method	Shoot dry matter (g)	Plant height (cm)	Flower number	Growth medium	Nutrition method	Shoot dry matter (g)	Plant height(cm)	Flower number
A_1	B_1	11.50 ^{a}	7.27 $^{c-f}$	23.0 ^{fgh}	A_6	B_1	25.13 ^{a}	12.10 ^{a}	38.7 $^{b-f}$	A_{11}	B_1	19.43 ^{a}	10.1 ^{ab}	33.3 $^{c-g}$
A_1	B_2	13.10 ^{a}	9.07 $^{a-d}$	37.7 $^{b-f}$	A_6	B_2	22.2 ^{a}	11.27 ^{ab}	57.7 ^{a}	A_{11}	B_2	21.10 ^{a}	8.7 $^{a-e}$	35.0 $^{c-g}$
A_1	B_3	10.80 ^{a}	7.47 $^{b-f}$	31.3 $^{c-g}$	A_6	B_3	23.9 ^{a}	9.40 ^{abc}	42.7 $^{a-e}$	A_{11}	B_3	27.26 ^{a}	11.4 ^{ab}	35.3 $^{c-g}$
A_2	B_1	16.90 ^{a}	9.43 ^{abc}	31.7 $^{c-g}$	A_7	B_1	12.76 ^{a}	7.03 ^{def}	27.3 $^{e-h}$	A_{12}	B_1	12.63 ^{a}	7.8 $^{a-f}$	26.7 $^{e-h}$
A_2	B_2	19.26 ^{a}	10.10 ^{ab}	29.7 $^{c-g}$	A_7	B_2	15.33 ^{a}	8.90 $^{a-d}$	29.0 $^{c-h}$	A_{12}	B_2	15.40 ^{a}	9.2 $^{a-d}$	29.7 $^{c-g}$
A_2	B_3	13.73 ^{a}	8.83 $^{a-d}$	41.3 $^{b-e}$	A_7	B_3	13.0 ^{a}	7.00 ^{def}	27.7 $^{d-h}$	A_{12}	B_3	15.93 ^{a}	7.7 $^{b-f}$	27.7 $^{d-h}$
A_3	B_1	14.13 ^{a}	8.10 $^{a-f}$	27.0 $^{e-h}$	A_8	B_1	19.20 ^{a}	10.47 ^{ab}	35.7 $^{c-g}$	A_{13}	B_1	22.83 ^{a}	10.3 ^{ab}	42.7 $^{a-e}$
A_3	B_2	18.33 ^{a}	9.67 ^{ab}	28.7 $^{c-h}$	A_8	B_2	20.16 ^{a}	11.40 ^{ab}	32.7 $^{c-g}$	A_{13}	B_2	20.83 ^{a}	11.7 ^{ab}	42.3 $^{b-e}$
A_3	B_3	12.170 ^{a}	9.00 $^{a-d}$	fgh $^{22.7}$	A_8	B_3	22.0 ^{a}	11.27 ^{ab}	44.7 ^{abc}	A_{13}	B_3	22.90 ^{a}	11.8 ^{a}	35.3 $^{c-g}$
A_4	B_1	7.06 ^{a}	6.57 ^{ef}	13.0 ^{h}	A_9	B_1	13.33 ^{a}	8.60 $^{a-e}$	33.0 $^{c-g}$	A_{14}	B_1	20.93 ^{a}	10.7 ^{ab}	29.7 $^{c-g}$
A_4	B_2	13.86 ^{a}	9.30 ^{abc}	29.0 $^{c-h}$	A_9	B_2	15.73 ^{a}	9.60 ^{ab}	31.7 $^{c-g}$	A_{14}	B_2	22.06 ^{a}	10.9 ^{ab}	34.3 $^{c-g}$
A_4	B_3	7.93 ^{a}	6.00 ^{f}	20.3 ^{gh}	A_9	B_3	13.46 ^{a}	8.70 $^{a-e}$	32.7 $^{c-g}$	A_{14}	B_3	23.0 ^{a}	10.7 ^{ab}	32.3 $^{c-g}$
A_5	B_1	15.50 ^{a}	8.80 $^{a-d}$	28.0 $^{c-h}$	A_{10}	B_1	17.13 ^{a}	9.90 ^{ab}	44.3 $^{a-d}$	A_{15}	B_1	18.50 ^{a}	10.2 ^{ab}	41.3 $^{b-e}$
A_5	B_2	19.60 ^{a}	8.07 $^{a-f}$	40.3 $^{b-e}$	A_{10}	B_2	23.36 ^{a}	11.03 ^{ab}	35.0 $^{c-g}$	A_{15}	B_2	25.63 ^{a}	10.5 ^{ab}	41.3 $^{b-e}$
A_5	B_3	17.40 ^{a}	8.33 $^{a-e}$	34.3 $^{c-g}$	A_{10}	B_3	21.63 ^{a}	10.60 ^{ab}	52.3 ^{ab}	A_{15}	B_3	21.96 ^{a}	10.8 ^{ab}	31.0 $^{c-g}$

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

Table 8. The ANOVA results of the treatments effect on the uptake of nutrients by plant.

Variation sources	Freedom degree	Nitrogen	Phosphorous	Potassium	Calcium	Magnesium	Iron	Zinc	Manganese
Growth medium (A)	14	839354.61**	30600.48**	198922.68**	9948.29**	160.37	197.72**	0.86**	2.41**
Nutrition method (B)	2	205718.34**	18432.49*	63585.44*	3691.72**	129.80	137.15**	0.53**	2.09**
A × B	28	98351.42**	7412.6*	42361.6*	859.85**	10.07^{ns}	21.33^{ns}	0.07^{ns}	0.50**
Error	88	30950.42	3502.2	18074.4	345.90	13.63	14.49	0.05	0.11

**, * significant at 1 and 5% level, respectively, ns not significant at 5% level.

Table 9. The effect of growth media on the uptake of nutrients (mg/pot)

Treatment	Nitrogen	Phosphorous	Potassium	Calcium	Magnesium	Iron	Zinc	Manganese
A_1	358.8^{g}	149.9^{de}	259.2^{fg}	48.9^{e}	9.1^{d}	4.7^{gh}	0.29^{de}	0.51^{g}
A_2	624.0^{de}	216.7^{abc}	504.6^{bcde}	19.9^{fg}	17.9^{ab}	5.5^{fgh}	0.28^{de}	1.09^{de}
A_3	562.8^{ef}	49.9^{f}	427.3^{cde}	73.7^{cd}	8.0^{de}	9.3^{c-f}	0.85^{abc}	0.67^{fg}
A_4	446.7^{efg}	119.4^{dc}	197.8g	24.0^{fg}	5.1^{e}	2.5^{h}	0.17^{e}	0.66^{fg}
A_5	420.1^{fg}	108.2^{ef}	512.4^{bcd}	37.8^{ef}	20.3^{a}	11.9^{bcd}	0.68^{c}	1.80^{b}
A_6	575.1^{ef}	185.5^{bcd}	610.2^{ab}	73.2^{cd}	16.4^{bc}	20.4^{a}	0.90^{abc}	1.20^{cde}
A_7	402.3^{fg}	145.0^{de}	365.0^{ef}	37.6^{ef}	9.3^{d}	7.5^{efg}	0.43^{d}	0.51^{g}
A_8	928.5^{bc}	227.0^{abc}	554.8^{abc}	82.6^{cd}	17.1^{abc}	8.9^{def}	0.84^{bc}	0.93^{def}
A_9	449.5^{efg}	216.5^{abc}	407.3^{de}	17.2^{g}	15.1^{bc}	3.9^{gh}	0.29^{de}	1.24^{cd}
A_{10}	1072.6^{b}	238.7^{ab}	566.6^{abc}	126.2^{a}	13.7^{c}	10.1^{b-e}	1.09^{a}	0.73^{fg}
A_{11}	607.6^{de}	257.3^{a}	605.7^{ab}	90.9^{bc}	15.6^{bc}	11.9^{bcd}	0.95^{ab}	1.49^{bc}
A_{12}	271.2^{g}	147.0^{de}	368.1^{ef}	32.2^{efg}	13.4^{c}	7.0^{efg}	0.41^{d}	1.20^{cde}
A_{13}	981.3^{b}	125.8^{de}	686.4^{a}	86.7^{bcd}	16.6^{abc}	13.3^{bc}	0.96^{ab}	0.85^{dfg}
A_{14}	1345.5^{a}	168.1^{de}	662.7^{a}	103.5^{b}	15.8^{bc}	13.0^{bc}	0.86^{abc}	2.28^{a}
A_{15}	778.9^{cd}	226.4^{abc}	640.2^{ab}	67.7^{d}	15.9^{bc}	14.1^{b}	0.89^{abc}	1.72^{b}

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

Table 10. The effect of nutrition on the uptake of nutrients (mg/pot)

Nutrition method	Nitrogen	Phosphorous	Potassium	Calcium	Magnesium	Iron	Zinc	Manganese
B_1	577.3^{b}	151.3^{b}	450.7	51.0^{b}	12.3^{c}	7.7^{b}	0.542^{b}	0.88^{b}
B_2	700.9^{a}	191.7^{a}	525.0^{a}	67.1^{a}	15.6^{a}	11.0^{a}	0.75^{a}	1.3^{a}
B_3	686.8^{a}	173.4^{ab}	497.9^{ab}	66.3^{a}	14.04^{b}	10.2^{a}	0.701^{a}	1.2^{a}

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

wastes for preventing nitrogen deficiency, we should use nitrogen chemical fertilizer (Mkhabela and Warman, 2005).

The most uptake of phosphorous was measured in medium of control + tea waste + municipal compost. Some researchers reported that organic matters increases available phosphorous of plants and indirectly it prevents phosphate precipitation at pH 6-9 (Baure and Balck, 1992). Sarwar *et al.* (2009) reported that when Azolla compost is used, nitrogen and phosphorous in rice seed increases. Increase in potassium uptake obtained in treatment containing control + municipal compost + Azolla (Table 9). Municipal waste compost due to high organic matters can improve the capacity of water conservation in medium (Levy and Taylor., 2003), because water stress decreases the nitrogen, phosphorous and potassium uptake (Younesi *et al.*, 2010).

According to the Table 9, substrate municipal compost + Azolla increases uptake of calcium in plant shoot and also the highest uptake of magnesium was observed in substrate control + tea waste. The highest uptake of iron was observed in the medium containing substrates control + municipal waste compost. The highest uptake of manganese at plant shoot was observed in substrates tea waste + municipal compost + Azolla. In a study, the highest Mn uptake by elephant foot tree had been observed in substrates including Azolla (Kholghi *et al.*, 2009). Galardo-Lara *et al*. (2006) reported the increase of manganese at *lectuca sativa* L. and decrease of manganese in *Hordeum vulgare* L. in calcareous soil amended with municipal waste compost. Increase of zinc uptake at substrates 50% municipal waste compost and 50% Azolla compost was observed (Table 9). Uptake and transference of elements in different plants is not equal. Many studies showed that the type of plant is one important factor affecting transfer of elements at systems of soil and plant (Erikson and Soderstorm, 1996; Twining *et al.*, 2004).

Tables 10-12 show the effect of growth media and nutrition methods on nutrients uptake by plant. The maximum nitrogen uptake obtained at method of soil application of fertilizer and

Table 11. The interaction effect of growth media and nutrition method on the uptake of nitrogen, phosphorus and potassium.

Growth medium	Nutrition method	N	P	K	Growth medium	Nutrition method	N	P	K	Growth medium	Nutrition method	N	P	K
A_1	B_1	313.9^{jk}	128.7^{e-l}	224.6^{jkl}	A_6	B_1	463.8 $^{h-k}$	252.6^{a-e}	644.8^{a-e}	A_{11}	B_1	521.7^{f-k}	207.8^{a-h}	511.9^{a-j}
A_1	B_2	357.6^{ijk}	202.1^{a-h}	327.1^{f-l}	A_6	B_2	825.0^{b-g}	132.7 $^{d-l}$	586.2 $^{a-h}$	A_{11}	B_2	565.9^{e-k}	262.4^{a-d}	550.7^{a-i}
A_1	B_3	404.9^{h-k}	118.9^{g-l}	225.7^{jkl}	A_6	B_3	436.4 $^{h-k}$	171.1 $^{b-k}$	599.5 $^{a-g}$	A_{11}	B_3	735.2^{b-h}	301.6^{a}	754.3^{a}
A_2	B_1	631.6^{d-j}	186.1^{a-j}	471.0^{a-j}	A_7	B_1	288.8^{jk}	90.3^{h-l}	297.3^{h-l}	A_{12}	B_1	233.5^{k}	153.1^{b-l}	308.4^{g-l}
A_2	B_2	72316^{b-h}	270.9^{abc}	591.5^{a-h}	A_7	B_2	448.0^{h-k}	170.3^{b-k}	424.8^{c-l}	A_{12}	B_2	285.1^{jk}	194.8^{a-i}	390.9^{e-l}
A_2	B_3	517.3^{f-k}	193.1^{a-i}	451.4^{b-k}	A_7	B_3	469.9^{g-k}	174.4^{b-k}	372.8^{e-l}	A_{12}	B_3	294.9^{jk}	93.1^{h-l}	404.9^{c-l}
A_3	B_1	527.5^{f-k}	37.9^{l}	366.9^{e-l}	A_8	B_1	387.3^{h-k}	250.3^{a-e}	526.9^{a-i}	A_{13}	B_1	944.7^{bcd}	139.3^{d-l}	728.3^{ab}
A_3	B_2	685.1^{c-i}	51.1 ^{kl}	553.8^{a-i}	A_8	B_2	1044.3^{b}	184.1^{a-j}	554.1^{a-i}	A_{13}	B_2	946.5^{bcd}	81.9^{h-l}	642.7^{a-e}
A_3	B_3	475.7^{g-k}	60.9^{jkl}	361.2^{e-l}	A_8	B_3	1353.9^{a}	246.5^{a-f}	583.6^{a-h}	A_{13}	B_3	1052.7^{b}	156.2^{b-l}	688.1^{a-d}
A_4	B_1	337.8^{ijk}	71.8^{i-l}	150.4^{l}	A_9	B_1	490.2^{f-k}	189.2^{a-i}	401.4^{d-l}	A_{14}	B_1	1545.8^{a}	111.9^{g-l}	653.9^{a-e}
A_4	B_2	525.5^{f-k}	180.5^{a-j}	272.2^{i-l}	A_9	B_2	429.6^{h-k}	277.3^{ab}	420.5^{c-l}	A_{14}	B_2	1011.9^{bc}	193.4^{a-i}	635.7^{a-e}
A_4	B_3	476.6^{g-k}	105.9^{g-l}	170.9^{kl}	A_9	B_3	428.9 $^{h-k}$	183.0^{a-j}	399.9^{d-l}	A_{14}	B_3	1478.8^{a}	199.0^{a-h}	698.5 ^{abc}
A_5	B_1	354.9^{ijk}	102.5^{h-l}	434.3^{b-l}	A_{10}	B_1	939.5^{bcd}	199.2^{a-h}	499.3^{a-j}	A_{15}	B_1	679.1 $^{c-i}$	148.0 $^{c-l}$	541.4 $^{a-i}$
A_5	B_2	434.9^{h-k}	123.8^{f-l}	552.7^{a-i}	A_{10}	B_2	1394.6^{a}	248.3^{a-f}	608.0^{a-f}	A_{15}	B_2	835.7 $^{b-f}$	301.2 ^{a}	764.0 ^{a}
A_5	B_3	470.4^{g-k}	98.1^{h-l}	550.2^{a-i}	A_{10}	B_3	883.7^{b-e}	268.7 ^{abc}	592.4 $^{a-g}$	A_{15}	B_3	822.0^{b-g}	229.90 $^{a-g}$	615.13 $^{a-f}$

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

Table 12. The interaction effect of growth media and nutrition method on the uptake of calcium, magnesium and zinc.

Growth medium	Nutrition method	Ca	Mg	Zn	Growth medium	Nutrition method	Ca	Mg	Zn	Growth medium	Nutrition method	Ca	Mg	Zn
A_1	B_1	45.63 $^{k-q}$	8.46 ^{a}	0.15 ^{a}	A_6	B_1	84.33 $^{c-j}$	17.27 ^{a}	0.966 ^{a}	A_{11}	B_1	89.43 $^{c-i}$	12.00 ^{a}	0.67 ^{a}
A_1	B_2	45.53 $^{k-q}$	10.91^{a}	0.456 ^{a}	A_6	B_2	66.6 $^{f-m}$	15.32 ^{a}	0.82 ^{a}	A_{11}	B_2	86.93 $^{c-j}$	17.35 ^{a}	1.10 ^{a}
A_1	B_3	55.53 $^{i-n}$	7.95 ^{a}	0.266 ^{a}	A_6	B_3	68.6 $^{g-m}$	16.69 ^{a}	0.91 ^{a}	A_{11}	B_3	96.43 $^{c-h}$	17.47 ^{a}	1.08 ^{a}
A_2	B_1	18.60 ^{opq}	18.20 ^{a}	0.253 ^{a}	A_7	B_1	37.70 $^{k-q}$	9.40 ^{a}	0.376 ^{a}	A_{12}	B_1	25.36 $^{n-q}$	11.35 ^{a}	0.28 ^{a}
A_2	B_2	23.83 $^{n-q}$	21.18 ^{a}	0.350 ^{a}	A_7	B_2	46.23 $^{k-q}$	11.31 ^{a}	0.400 a	A_{12}	B_2	34.30 $^{l-q}$	13.46 ^{a}	0.33 ^{a}
A_2	B_3	17.23 ^{pq}	14.56 ^{a}	0.256 ^{a}	A_7	B_3	28.90 $^{m-q}$	7.22 ^{a}	0.540 ^{a}	A_{12}	B_3	37.13 $^{k-q}$	15.58 ^{a}	0.62 ^{a}
A_3	B_1	60.60 $^{h-n}$	7.92 ^{a}	0.496 ^{a}	A_8	B_1	42.10 $^{k-q}$	15.12 ^{a}	0.843 ^{a}	A_{13}	B_1	70.60 $^{e-l}$	14.31 ^{a}	0.76 ^{a}
A_3	B_2	86.83 $^{c-j}$	10.30 ^{a}	1.31^{a}	A_8	B_2	99.83 $^{c-g}$	16.61 ^{a}	0.676 ^{a}	A_{13}	B_2	103.36 $^{c-f}$	18.83 ^{a}	0.96 ^{a}
A_3	B_3	73.63 $^{d-k}$	6.05 ^{a}	0.760 ^{a}	A_8	B_3	106.03 ^{cde}	19.61 ^{a}	1.00 ^{a}	A_{13}	B_3	86.16 $^{c-j}$	16.73 ^{a}	1.18 ^{a}
A_4	B_1	15.20 ^{pq}	3.36 ^{a}	0.106 ^{a}	A_9	B_1	16.86 ^{pq}	11.53 ^{a}	0.226 ^{a}	A_{14}	B_1	54.36 $^{i-o}$	13.55 ^{a}	0.61 ^{a}
A_4	B_2	39.43 $^{k-q}$	7.81 ^{a}	0.276 ^{a}	A_9	B_2	25.0 $^{n-q}$	18.50 ^{a}	0.353 ^{a}	A_{14}	B_2	113.06 ^{bc}	17.27 ^{a}	1.16 ^{a}
A_4	B_3	17.40 ^{pq}	4.19 ^{a}	0.153 ^{a}	A_9	B_3	9.73 ^{q}	15.41 ^{a}	0.303 ^{a}	A_{14}	B_3	143.26 ^{ab}	16.85 ^{a}	0.81 ^{a}
A_5	B_1	38.30 $^{k-q}$	17.16 ^{a}	0.680 ^{a}	A_{10}	B_1	115.36 ^{bc}	10.50 ^{a}	1.04 ^{a}	A_{15}	B_1	51.26 $^{j-p}$	13.77 ^{a}	0.64 ^{a}
A_5	B_2	38.33 $^{k-q}$	22.45 ^{a}	0.806 ^{a}	A_{10}	B_2	108.63 ^{cd}	15.25 ^{a}	1.18 ^{a}	A_{15}	B_2	89.36 $^{c-i}$	18.27 ^{a}	1.04 ^{a}
A_5	B_3	36.90 $^{k-q}$	21.36 ^{a}	0.576 ^{a}	A_{10}	B_3	154.6 ^{a}	15.3 ^{a}	1.04 ^{a}	A_{15}	B_3	89.43 $^{c-i}$	12.00 ^{a}	1.00 ^{a}

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

Table 13. The interaction effect of growth media and nutrition method on the uptake of iron and manganese (mg/pot)

Growth medium	Nutrition method	Fe	Mn	Growth medium	Nutrition method	Fe	Mn	Growth medium	Nutrition method	Fe	Mn
A_1	B_1	2.80^{a}	0.433^{jkl}	A_6	B_1	19.39^{a}	1.28^{e-h}	A_{11}	B_1	4.46^{a}	0.86^{g-l}
A_1	B_2	7.87^{a}	0.563^{i-l}	A_6	B_2	19.73^{a}	1.06^{e-j}	A_{11}	B_2	15.29^{a}	1.92^{a-d}
A_1	B_3	3.64^{a}	0.543^{i-l}	A_6	B_3	22.14^{a}	1.25^{e-h}	A_{11}	B_3	16.13^{a}	1.69^{b-e}
A_2	B_1	6.00^{a}	1.12^{e-i}	A_7	B_1	3.47^{a}	0.316^{kl}	A_{12}	B_1	3.78^{a}	0.44^{i-l}
A_2	B_2	6.10^{a}	1.28^{e-h}	A_7	B_2	13.12^{a}	0.813^{g-l}	A_{12}	B_2	6.93^{a}	1.08^{e-j}
A_2	B_3	4.63^{a}	0.880^{g-k}	A_7	B_3	5.86^{a}	0.423^{jkl}	A_{12}	B_3	10.38^{a}	2.09^{abc}
A_3	B_1	8.05^{a}	0.526^{i-l}	A_8	B_1	10.20^{a}	0.510^{i-l}	A_{13}	B_1	11.15^{a}	0.96^{f-k}
A_3	B_2	12.20^{a}	0.973^{f-k}	A_8	B_2	7.25^{a}	1.04^{e-j}	A_{13}	B_2	16.63^{a}	0.95^{f-k}
A_3	B_3	7.81^{a}	0.513^{i-l}	A_8	B_3	9.42^{a}	1.25^{e-h}	A_{13}	B_3	12.37^{a}	0.64^{h-l}
A_4	B_1	1.42^{a}	0.200^{l}	A_9	B_1	2.84^{a}	0.736^{g-l}	A_{14}	B_1	9.95^{a}	2.30^{ab}
A_4	B_2	3.83^{a}	0.543^{i-l}	A_9	B_2	4.79^{a}	1.38^{d-g}	A_{14}	B_2	12.55^{a}	2.25^{ab}
A_4	B_3	2.27^{a}	1.24^{e-h}	A_9	B_3	4.36^{a}	1.61^{c-f}	A_{14}	B_3	16.59^{a}	2.28^{ab}
A_5	B_1	7.05^{a}	0.800^{g-l}	A_{10}	B_1	11.33^{a}	0.556^{i-l}	A_{15}	B_1	13.41^{a}	2.15^{abc}
A_5	B_2	14.70^{a}	2.19^{abc}	A_{10}	B_2	8.06^{a}	0.916^{g-k}	A_{15}	B_2	16.57^{a}	1.99^{abc}
A_5	B_3	14.0^{a}	2.41^{a}	A_{10}	B_3	11.1^{a}	0.723^{g-l}	A_{15}	B_3	12.35^{a}	1.03^{e-j}

Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference)

foliar spray, also the most phosphorus, potassium uptake in soil application. The highest calcium uptake was measured at soil application method and foliar spray application. The method of soil application increased magnesium uptake. The highest uptake of iron, zinc and manganese was obtained at method of soil application and foliar spray application. Foliar spray application can be assure nutrient availability to plants. The foliar spray application is more acceptable, because it provides lower nutrients for immediate consumption by plants (Stampar *et al.*, 1998). Necessity nutrients foliar spray application was reported by Pierre *et al.* (2007) and Ryan *et al*. (2007) in compensation deficiency nutrients through roots or leaves of reproductive stage.

The highest uptake of nitrogen at growth media "tea waste, municipal compost and Azolla" was measured without fertilization. Results showed that the highest uptake of phosphorous in growth medium of "control, tea waste and municipal compost" is measured in foliar spray application. The least uptake of phosphorous in municipal compost medium was observed without fertilization. Mkhabela and Warman (2005) reported that the use of municipal waste compost in a potato field leads to the significant increase of phosphorous of soil. They said that municipal waste compost like chemical fertilizers can be effective in increasing available phosphorous. This can be due to increase in microbial activity after application of compost and consequently to release phosphorus during mineralization organic matter.

In this experiment it was shown that the highest uptake of potassium in plant shoot was obtained at growth medium "control, tea waste, municipal compost and Azolla" in soil application nutrition method. The highest calcium uptake was observed from media of "municipal compost and Azolla" at foliar spray application method. Akbarinia *et al*. (2003) investigated effect of different nutrition systems on soil properties, nutrients uptake and concentration by a medicinal plant and stated that the nutrient uptake in the plant shoot at different fertilizer treatments had significant difference compared to control (without fertilizer).

The highest uptake of iron was measured from "control, municipal compost" at foliar application method that didn't have significant difference with soil application and without fertilization method. The highest manganese uptake was measured at growth media "control and tea waste" at foliar spray application method. Organic fertilizer consumption, increases organic matters of soil and improves microbial activities, consequently it provides micro and macro nutrients required for plant (Yadav *et al.*, 2000; Yadvinder *et al.*, 2004). Tombacz and Rise (1999) showed that organic matters by complexion nutrients increase their uptake by plants. The effect of foliar application in lilium, a significant increase at the uptake of nitrogen, phosphorous, potassium and zinc in the leaf was observed (Sadeghi Cherveri *et al.,* 2012). Organic fertilizer has significant effect on increase in available iron and zinc (Sharifi *et al.*, 2010).

Different studies showed that organic waste has considerable amount of micronutrients to form organic chelates caused to increase their solubility and availability (Mohammadinia, 1994; Razavi Toosi, 2000). Using chemical fertilizer through soil application or foliar application is one of the most common approaches to reduce the deficiency of micronutrients in plants. Using chemical fertilizer has some problems including deficiency of micronutrients fertilizers, high expenses and biological pollutions (Hamoon Yek, 2011).

CONCLUSION

The result showed that the growth medium mixed of control (garden soil), municipal wastes compost and Azolla increased plant height, shoot dry weight and flower number and uptake of nitrogen, potassium, zinc, calcium, iron and magnesium in plant shoot. Municipal waste compost because of high pH and EC can't be an appropriate medium for plant growth, but municipal waste compost in combination with Azolla compost and garden soil can be a suitable combination for plant because of stabilizing pH and EC, increasing nutrition material.

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