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Research Paper

Investigation The Effect of Iron Chelate and NPK on Yield of Rosa damascena for The First Time in Iran

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Abstract: As regards, optimum nutrition is considered one of the most important requirements for the successful production of herbal product. In order to investigate nutritional needs of *Rosa damascena*, this project was conducted in Forest and Rangelands Research Institute, Karaj, Iran in 2011. This research was performed as split plat with 3 replications. Main factors included combined fertilizer in 5 levels (1: N0, P0 & K0kg/ha + manure 0ton/ha, 2: N40, P40 & K0kg/ha + manure 15ton/ha, 3: N40, P40 & K40kg/ha + manure 15ton/ha, 4: N80, P80 & K40kg/ha + manure 30ton/ha & 5: N120, P120 & K80kg/ha + manure 40ton/ha) and sub factors were micronutrients consumption in 3 levels (0, 8 & 12g). Analysis of variance showed that the effect of Main and sub factor were different for all measured traits ($\alpha \leq 0.01$). The lowest number of flowers per bush (1921n/plant) and hectare (2134231n/ha) belonged to control treatment. Micronutrients intake of 12g had the highest amount of flower yield per bush and hectare with 4.41kg/plant and 4903.28kg/ha, respectively. The highest percent (0.105%) and yield of essential oil (5595.42g/ha) observed in treatment4*micronutrients intake of 12g. According to results, simultaneous use of combined fertilizers and microelements make increase in yield of *Rosa damascena* and this method can be used to improve production and export of the plant.

Keywords: *Rosa damascena*, microelements, chemical fertilizer, nutrition, yield.

Introduction

Rosa damascena is considered one of the most aromatic species in the world and Iran. Therefore, relatively wide researches and projects has been done with the purpose of *Rosa* culture development, decreasing problems of producers, identification superior genotype of quality and quantity yield of flower, essential oil and length of flowering period. Different traits have been investigated like amount of yield (Tabaei-Aghdaei *et al*., 2003), selection for increasing yield (Tabaei-Aghdaei *et al*., 2009), relationship between yield and various traits (Tabaei-Aghdaei *et al*., 2010), morphological and phonological traits (Babaei *et al*., 2008; Danyaie *et al*., 2011) and the quality of active substance in essential oil (Jaimand *et al*., 2010), but the studies of *Rosa* nutrition are negligible. Numerous studies have not been conducted in relation to effect of organic and chemical fertilizer. Medicinal plants such as *Rosa damascene* are rich of secondary metabolites for many herbal medicines. Although producing secondary metabolites affected by genetic characteristics of the plant, but a significantly higher rate of production is affected by environmental factors such as nutrition. Different amount of nitrogen, potassium and their interaction were significantly different for number and fresh weight of flower and essential oil percent ($\alpha \leq 0.01$). The highest amount of flowering and fresh weight of flower obtained in use of 60kg/ha nitrogen and 60kg/ha potassium. The highest amount of oil yield observed in consumption of 30kg/ha nitrogen and 30kg/ha potassium (Daneshkhah *et al*., 2007).

Although micronutrients are required at its minimum, but play essential role in plant nutrition, enzymatic reaction, metabolic processes including: carbohydrates metabolism, nitrogen and plants resistance against disease and adverse condition (Farahat *et al*., 2007; Nahed and Balba, 2007). Consumption 50mg zinc sulfate per kg of soil increased plant height, dry yield of plant and zinc concentration in shoots of *Matricaria recutita* (Grejtovsky *et al*., 2006). Application iron, zinc, boron and magnesium led to significant increase in the umbels number of *Coriandrum sativum* and umbels per plant had the highest correlation with seed yield. Moreover, zinc had significant effect on increasing seed yield, shoots and leaves dry weight, plant height and sub stems number (Rahimi *et al*., 2008). According to Hadgson's results on *Glycine max*, iron application in the soil before planting increased the shoot dry weight as much as 46 percent at the beginning of growing season (Hodgson *et al*., 2007).

This project was conducted to determine the most appropriate fertilizer treatment (microelements + NPK+ manure fertilizer) of *Rosa damascena* for the first time in Iran. So, by using right amount of nutrient elements can improve product (flower and oil) quality and quantity, reduce production costs and side effects of chemical fertilizer on human health.

Material and methods

This project was performed at Forest and Rangelands Research Institute, Karaj, Iran as split plot with 3 replications. The main and sub factors were combined fertilizers and micronutrients consumption, respectively.

Combined fertilizers with known amounts (table 1) were used in the form of deep placement with the seedlings transferred to the main field simultaneously.

Table 1. Different levels of combined fertilizers

Fertilizer treatment	1(control)	2	3	4	5
N (kg/ha)	0	40	40	80	120
P (kg/ha)	0	40	40	80	120
K (kg/ha)	0	0	40	40	80
Manure (ton/ha)	0	15	15	30	40

In the beginning of flowering (1 May 2011), Fertilizer treatment from the source of Khazra Iron Chelate (Fe 8.9, Zn 0.92 & Mn 0.92% by weight) was used in broad caste application with watering (table 2).

Table 2. Time and amount of iron chelate

treatments	Consumption time
0g (control)	Beginning of flowering
8g	Beginning of flowering
12g	Beginning of flowering

After daily harvesting of opened flowers, flowers number of per plant was counted and petal was isolated from other parts of the flower (sepals, receptacle, pistil and a small portion of the pedicle) and weighted. After weighting prepared petals (200-300g per repetition), they was poured in the pot. 1liter of water for per 100g fresh petal was added to the pot and oil was extracted by water distillation for 2 hours. Data were analyzed using SAS and means were compared according to the Duncan's multiple range test.

Results and discussion

Analysis of variance showed that block had significant effect on oil percent. Combined fertilizers and microelements significantly affected all measured traits. Interaction effect of combined fertilizers and microelements were different for flowers number in bush and hectare ($\alpha \leq 0.05$) (table 3).

Table 3. Analysis of variance of the effect of the treatments on the measured traits

SOV	DF	Mean Squares (MS)					
		Flower number per bush	Flower number per hectare	Flower yield per bush	Flower yield per hectare	Oil percent	Oil yield
Block	2	550290.69ns	679235353400ns	1554035.44ns	1.91ns	0.0003**	1936965.81ns
Combined fertilizers (A)	4	3847266.08**	4.74**	8015282.21**	9.89**	0.0022**	13274592.84**
Block error × (A)	8	175034.08	216048237917	370189.45	456932606079	0	397697.99
Microelements (B)	2	4508993.89**	5.56**	5700825.63**	7.03**	0.0015**	10709751.66**
(A) × (B)	8	1281554.94*	1.58*	1514590.22ns	1.86ns	0.0005**	1233309.43ns
Error	20	438846.17	541677039286	797779.60	984716109951	0	718400.7
CV(%)		22.48	22.48	23.57	23.57	9.34	30.87

ns, non significant; *, significant at P≤0.05; **, significant at P≤0.01.

Comparisons result indicated that the highest flowers number of bush and hectare, flower yield of bush and hectare, oil percent and yield belonged to treatment 4 (N80, P80 & K40kg/ha + manure 30ton/ha) with 3600.6n/plant, 4000217n/ha, 4.73kg/plant, 5257/31kg/ha, 0.078% and 4199g/ha, respectively. The lowest flowers number of bush (1921n/plant) and hectare (2134231n/ha), flower yield of bush (2.34kg/plant) and hectare (2600.49kg/ha), oil percent (0.036%) and yield (965.3g/ha) observed in control treatment (table 4).

Table 4. Effect of combined fertilizer on measured traits

Combined fertilizer	Flower number per bush (n/plant)	Flower number per hectare (n/ha)	Flower yield per bush (kg/plant)	Flower yield per hectare (kg/ha)	Oil percent (%)	Oil yield (g/ha)
1	1921c	2134231c	2.34c	2600.49c	0.036d	965.3d
2	2724b	3026364b	3.4b	3771.61b	0.058c	2233.9c
3	3197.1ab	3551990ab	4.15ab	4612.32ab	0.069b	3218b
4	3600.6a	4000217a	4.73a	5257.31a	0.078a	4199a
5	3290.2ab	3655437ab	4.33a	4806.37a	0.063c	3110.5b

Means in a column followed by the same letter are not significantly different at P≤0.01.

According to results, micronutrients intake of 12g had the highest flowers number of bush and hectare, flower yield of bush and hectare, oil percent and yield with 3528.1n/plant, 3919756n/ha, 4.41kg/plant, 4903.28kg/ha, 0.069% and 3521.4g/ha, respectively. Although there was no significant difference of flowers number of bush and hectare between micronutrients intake of 0 and 8g, but treatment 0g had the lowest amount with 2439.1n/plant and 2709877n/ha. The lowest flower yield of bush (3.2kg/plant) and hectare (3533.73kg/ha), oil percent (0.050%) and yield (1845.2g/ha) belonged to micronutrients intake of 0g (table 5).

Table 5. Effect of microelements consumption on measured traits

Microelements amount	Flower number per bush (n/plant)	Flower number per hectare (n/ha)	Flower yield per bush (kg/plant)	Flower yield per hectare (kg/ha)	Oil percent (%)	Oil yield (g/ha)
0g	2439.1b	2709877b	3.2b	3533.73b	0.05c	1845.2c
8g	2872.5b	3191310b	3.77ab	4191.92ab	0.064b	2869.4b
12g	3528.1a	3919756a	4.41a	4903.28a	0.069a	3521.4a

Means in a column followed by the same letter are not significantly different at P≤0.01.

Mean comparison of interaction between combined fertilizer and microelements consumption stated that treatment 2 (N40, P40, K0kg/ha + manure 15ton/ha)* micronutrients intake of 12g had the highest flowers number per bush and hectare with 4331n/plant and 4811741n/ha. The highest flower yield per bush (5.38kg/plant) and hectare (5981.84kg/ha) obtained in treatment 4 (N80, P80, K40kg/ha + manure 30ton/ha)* micronutrients intake of 8g. The highest percent and yield of essential oil observed in treatment 4 (N80, P80, K40kg/ha + manure 30ton/ha)* micronutrients intake of 12g with 0.105% and 5595g/ha. The lowest amount of all traits belonged to treatment 1(N0 P0 K0kg/ha + manure 0ton/ha)* micronutrients intake of 0g with 1167.7n/plant, 1297278n/ha, 1.6kg/plant, 1735.32kg/ha, 646g/ha (table 6).

Table 6. Effect of interaction of combined fertilizer*microelements consumption on measured traits

treatments	Flower number per bush (n/plant)	Flower number per hectare (n/ha)	Flower yield per bush (kg/plant)	Flower yield per hectare (kg/ha)	Oil percent (%)	Oil yield (g/ha)
10	1167.7e	1297278e	1562f	1735326f	0.036gh	646e
11	2122cde	2357542cde	2510.1def	2788721def	0.032h	922.3e
12	2473.3bcd	2747873bcd	2950cdef	3277435cdef	0.04gh	1327.6de
20	2288.7cde	2542709cde	2903.9cdef	3226207cdef	0.058de	1889.8cde
21	1552.3de	1724642de	2299.4ef	2554578ef	0.059de	1519.2de
22	4331a	4811741a	4981.1ab	5534047ab	0.059de	3292.6bc
30	3055abc	3394105abc	4123.9abcd	4581627abcd	0.043fg	1982.8cde
31	3341abc	3711851abc	4213.7abcd	4681465abcd	0.085b	3983.6b
32	3195.3abc	3550015abc	4116.9abcd	4573893abcd	0.08b	3687.5b
40	3107.3abc	3452247abc	4036.5abcd	4484564abcd	0.061de	2834.6bcd
41	3983a	4425113a	5384.2a	5981846a	0.068cd	4167.3ab
42	3711.3ab	4123291ab	4775.4ab	5305519ab	0.105a	5595a
50	2577bcd	2863047bcd	3277.2bcde	3640914bcde	0.05`ef	1872.6cde
51	3364abc	3737404abc	4458.2abc	4953016abc	0.075bc	3854.7b
52	3929.7a	4365860a	5243.2a	5825190a	0.063d	3704.2b

Means in a column followed by the same letter are not significantly different at P≤0.01

Correlation between traits results indicated that there was significant positive correlation between flowers number per bush with flowers number per hectare (r=1**). Flower yield per bush had significant positive correlation with flowers number per bush (r=0.97**) and hectare (r=0.97**). Flower yield per hectare showed significant positive correlation with flowers number per bush (r=0.97**), hectare (r=0.97**) and flower yield per bush (r=1**). Oil percent had significant positive correlation with flowers number per bush (r=0.51**), hectare (r=0.51**), flower yield per bush (r=0.53**) and hectare (r=0.53**). There was significant positive correlation between oil yield with flowers number per bush (r=0.84**), hectare (r=0.84**), flower yield per bush (r=0.86**), hectare (r=0.86**) and oil percent (r=0.85**) (table 7).

Table 7. Effect or correlation between measured traits

Traits	Flower number per bush	Flower number per hectare	Flower yield per bush	Flower yield per hectare	Oil percent	Oil yield
Flower number per bush	1					
Flower number per hectare	1**	1				
Flower yield per bush	0.97**	0.97**	1			
Flower yield per hectare	0.97**	0.97**	1**	1		
Oil percent	0.51**	0.51**	0.53**	0.53**	1	
Oil yield	0.84**	0.84**	0.86**	0.86**	0.85**	1

ns, non significant; *, significant at P≤0.05; **, significant at P≤0.01.

Discussion

Different amounts of nitrogen, potassium, phosphorus and their interaction dramatically affect qualitative and quantitative features of *Rosa damascena* such as flowers number, yield of flower and oil. These results were consistent with other results on *Rosa damascene* (Daneshkhah *et al*., 2007; Rezaie *et al*., 2003), *Amaranthus retroflexus* (Amir-Rezaie, 2011) and *Coriandrum sativum* (Rahimi *et al*., 2008). It seems that iron by making good vegetative growth has been increased flowers number. Fresh weight of flower increased due to photosynthesis increased, making more carbohydrates and store it in the flowers as reproductive organs. There were significant changes in flower yield and oil present because both of them affect by flowers number and fresh weight. This results matched by others result on *Rosa damascena* (Tabaei-Aghdaei *et al*., 2011) and *Zea mays* (Farajzadeh *et al*., 2010).

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