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# Yield and Quality of Damask Rose (*Rosa damascena* Mill.) Genotypes under Irrigated Conditions

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## ABSTRACT

Damask rose (Rosa damascena Mill.) is a member of Rosaceae family, with great variability in yield, quality, phenology and morphology of different genotypes. This experiment was conducted in two years (2010-11), at Homand Research Station of Upland Farming, Absard-Damavand, Iran, to study the adaptability and flowering capacity of 12 damask rose genotypes under irrigated conditions. The origin of the genotypes was Ardebil, Ilam, Tehran, Chaharmahal-o-Bakhtiari, Fars, Kerman, Kermanshah, Arak, Hormozgan and Esfehan (all in Iran). The experiment was conducted in the form of a randomized complete block design with three replications. The two factors of the experiment were genotype and year. Results indicated that genotype and the interaction of genotype × year significantly affected all the measured traits. The effect of year was also significant on all the measured traits except for petal yield, receptacle yield and essential oil percentage. Mean comparison on the genotypes indicated that Fars had the highest (810 flowers) and Tehran had the lowest (180 flowers) number of flowers in plant. Fars had also the highest flower yield (2465 kg/ha), however, essential oil yield was the highest in Esfehan 8 (346.7 g/ha).

Keywords: essential oil, medicinal plant, flower yield.

#### INTRODUCTION

Damask rose (*Rosa damascena* Mill.) is a member of Rosaceae family. This shrub plant is probably a hybrid from *R. gallica* and *R. canina*. Different genotypes of this plant present in Iran [7], widely distributed from 300 to 3500 m above the sea level [8]. This genus has about 5000 varieties, only a limited number are aromatic. Different genotypes varies greatly in their flower yield [6], essential oils percentage [7], propagation and rooting [4], essential oils content and composition, morphology and phenology, resistance to abiotic [5] and biotic stresses.

Damask rose is the third plant with high essential oils content [2]. The main compounds in damask rose essential oils are geraniol and citronellol [1, 3]. The essential oil of this plant is highly valuable and is used to cure depression, insomnia and for stress reduction [9]. Bulgaria is the first producer of damask rose essential oil; other countries include Turkey, India, China, France and Iran [1-3]. This experiment was conducted to evaluate different damask rose genotypes for their yield, flower quality, essential oils content and the length of flowering period.

## MATERIALS AND METHODS

This experiment was conducted in two years (2010-11), at Homand Research Station of Upland Farming, Absard-Damavand, Iran (35° 40' N, 52° 5' E, 1960 m above the sea level, 65 km East of Tehran). Homand Research Station is a plain area with 4% grade, brown alluvial soil and pH of 7.7. The soil type at the upper soil layer was loam, and

at the lower soil layers contained calcareous layers. The area is classified as cold climates with mean annual temperature of +10.5 °C.

The experiment was conducted in the form of a randomized complete block design with three replications. The two factors of the experiment were genotype and year. The 12 genotypes were indigenous to Ardebil, Ilam, Tehran, Chaharmahal-o-Bakhtiari, Fars, Kerman, Kermanshah, Arak, Hormozgan and Esfehan provinces, Iran.

In June 2007, planting was conducted in 60 cm deep  $\times$  50 cm wide hollows, filled with sand, field soil, manure and 100 g ammonium phosphate. Irrigation was repeated weekly by drip method. The measured traits included the number of flowers, fresh flower yield, petal yield, receptacle yield, the number of flowering days, essential oils percentage and yield. To measure the essential oils, receptacles were detached from petals, and essential oils were extracted by hydrodistillation method using a clevenger.

Finally, data were tested for their normality, courtosis and skewness, and then were analyzed by MSTAT-C. Means were compared according to Duncan's multiple range test.

#### **RESULTS AND DISCUSSION**

Analysis of the variances indicated the significant effects of year, genotype and their interaction on the number of flowering days, the number of flowers / plant, weight of flowers / plant, flower yield, receptacle / petal ratio and essential oils yield (Table 1).

Results of mean comparison of the genotypes indicated that the number of flowering days was the highest (13.83 days) in Esfehan 8 and the lowest (9.67 days) in Kerman genotype. Fars had the highest number of flowers / plant (810) and Tehran had the lowest (180). Weight of flowers in a plant, flower yield and petal yield were the highest in Fars genotype and the lowest in Tehran genotype. Receptacle yield was the highest in Fars (394 kg/ha) and the lowest in Kerman (84 kg/ha). Esfehan 6 had the highest essential oil percentage (0.035%) and essential oil yield (346.7 g/ha) (Table 2).

Mean comparison of the interaction of year  $\times$  genotype indicated that in 2010, Esfehan 8 and Chaharmahal-o-Bakhtiari had the highest number of flowering days (15 days). The number of flowers / plant was the highest in Fars in 2010 (1057) and the lowest in Kerman in 2011 (148). Weight of flowers in a plant was the highest in Fars genotype in 2010 (1970 g) and the lowest in Kerman in 2011 (192 g). The highest essential oils percentage (0.036%) was achieved in Esfehan 6 and Esfehan 3 in 2011, and the highest essential oils yield (524 g/ha) was achieved in Esfehan 8 in 2010 (Table 3).

Mean comparison of the years indicated that the number of flowering days, the number of flowers / plant, weight of flowers in a plant, flower yield, receptacle / petal ratio and essential oils yield were the highest in 2011 (Table 4).

The significant differences between the evaluated genotypes represent that studying different genotypes is important for the selection of superior genotypes with higher yield and quality. Moreover, the significant differences between the two years of experiment indicate that yield and quality of this plant is affected by environmental factors and soil nutrients. Higher value of the measure traits in the first year is probably related to higher content of mineral nutrients in soil; this shows the need for long term experiments on the effect of nutrition on damask rose. In the first year, Esfehan 8 and Esfehan 6 and also Chaharmahal-o-Bakhtiari were better than the other genotypes. Esfehan 8 and 6 had high flower yield and essential oils percentage. On the other hand, although Chaharmahal-o-Bakhtiari had lower essential oils percentage; however, had high essential oil yield because of producing high flower yield.

In the second year, Esfehan 6 and 8 had higher essential oil percentage, but had lower flower yield and essential oil yield. This indicates that essential oil yield is mainly affected by flower yield rather than by essential oil percentage. Tabaei Aghdaei et al. [10] studied six genotypes from central areas of Iran and concluded that the highest essential oil percentage occurred in Yazd (0.020%) and Esfehan (0.019%). Yazd had the highest essential oil yield (632.33 g/ha). Their results indicated that the number of flowers was significantly the same in all genotypes.

Results our experiment briefly indicated the significant differences between genotypes and years.

				·						
SOV	df	Number of flowering	Number of flowers in	Flowers weight /	Flower	Potel wield	Receptacle	Receptacle / petal	Essential oils	Essential oils
		days	plant	plant	yield	retai yielu	yield	ratio	percentage	yield
Year	1	**	**	**	**	ns	ns	**	ns	**
Error	4	4.05	27629.11	109151.47	356235.82	215029.47	13296.16	0.05	0.000	3429.68
Genotype	11	*	**	**	**	**	**	*	**	**
Year ×	11	*	**	*	**	*	**	**	*	*
Genotype	11						404	1.11		
Error	44	4.88	24363.68	67610.18	208027.57	110458.41	6232.50	0.45	0.000	9353.38

## Table 1. Analysis of the variances for the measured traits

ns, nonsignificant; \*\*, significant at  $P \leq 0.01$ ; \*, significant at  $P \leq 0.05$ .

#### Table 2. Variations in the measured traits of the evaluated genotypes

Construngs	Number of	Number of flowers	Flowers weight /	Flower yield	Petal yield	Receptacle yield	Receptacle / petal	Essential oils	Essential oils yield
Genotypes	flowering days	in plant	plant (g)	(kg/ha)	(kg/ha)	(kg/ha)	ratio	percentage	(g/ha)
Esfehan 8	13.83a	800a	1111b	1776b	1098ab	242bc	4.56a	0.031ab	346.7a
Esfehan 6	13.00ab	596bcd	816bcd	1306bcd	789bcd	192bc	4.12a	0.035a	268.9ab
Esfehan 3	13.50ab	579bcd	752cd	1203bcd	736bcd	169bcd	4.61a	0.030bc	195.7bcd
Hormozgan	11.50abc	474cd	750cd	1068cde	667bcd	154cd	4.45a	0.020ef	118.2cde
Arak	12.67ab	406de	668cd	1069cde	635cd	144cd	4.74a	0.031ab	203.6bcd
Kermanshah	12.00abc	422de	594de	951def	567cd	148cd	4.38ab	0.021ef	108.8cde
Kerman	9.67c	272ef	346e	554ef	351d	84d	4.61a	0.018fg	60.2e
Fars	12.50abc	810a	1541a	2465a	1417a	394a	3.52b	0.015g	249.5ab
Chaharmahal-o- Bakhtiari	12.67ab	658abc	1003bc	1592bc	860bc	193bc	4.66a	0.026cd	234.3abc
Tehran	10.50bc	180f	320e	464f	346d	77d	4.61a	0.023de	89.8de
Ilam	13.17ab	689ab	1118b	1755b	1086ab	268b	4.26ab	0.023de	217.9bcd
Ardebil	11.33abc	423de	827bcd	1323bcd	767bcd	204bc	3.91ab	0.028bc	208.3bcd

*Means in a column followed by the same letter are not significantly different at*  $P \leq 0.05$ *.* 

Treatments	Number of	Number of flowers	Flowers weight /	Flower yield	Petal yield	Receptacle yield	Receptacle / petal	Essential oils	Essential oils yield
Treatments	flowering days	in plant	plant (g)	(kg/ha)	(kg/ha)	(kg/ha)	ratio	percentage	(g/ha)
Esfehan 8 × 2010	15.00a	1007ab	1395b	2233b	1616ab	240bcde	6.74bc	0.033ab	524a
Esfehan 6 × 2010	14.67ab	777bcd	1094bcd	1750bcde	1216bcde	208cdef	6.17bcd	0.033ab	398abc
Esfehan 3 × 2010	14.33ab	691cdef	899b-f	1438b-g	1059b-h	148def	7.07ab	0.023de	242cdef
Hormozgan $\times$ 2010	14.33ab	681cdef	923b-f	1477b-g	1076b-g	156def	7.17ab	0.016f	166defg
Arak $\times$ 2010	14.00ab	425f-j	694d-i	1111c-h	793d-j	123def	6.56bc	0.030bc	251b-f
Kermanshah × 2010	13.67abc	504c-h	717d-h	1148c-h	838c-i	120def	7.06ab	0.020ef	147defg
Kerman × 2010	13.67abc	396f-j	501e-i	801fgh	603e-k	77f	8.14a	0.016f	102efg
Fars $\times$ 2010	13.67abc	1057a	1970a	3152a	2100a	410a	5.11d	0.020ef	425ab
Chaharmahal-o-Bakhtiari × 2010	15.00a	795abc	1115bcd	1731bcde	1269bcd	180cdef	6.95abc	0.023de	314bcd
Tehran $\times 2010$	11.67abc	182ii	355ghi	589gh	526f-k	68f	7.31ab	0.016f	129defg
Ilam $\times$ 2010	14.33abc	732bcde	1236bc	1911bc	1427bc	214cdef	6.54bc	0.030bc	288bcde
Ardebil $\times$ 2010	12.33abcd	476d-i	1007bcde	1612b-f	1094b-f	202cdef	5.73cd	0.026cd	257b-f
Esfehan 8 × 2011	12.67abcd	592c-g	825c-g	1319c-g	579e-k	245bcd	2.38e	0.030bc	169defg
Esfehan 6 × 2011	11.33abcd	416f-j	538e-i	861efgh	362ijk	175cdef	2.08ef	0.036a	139defg
Esfehan 3 × 2011	12.67abcd	467e-i	605d-i	968d-h	414hijk	190cdef	2.16ef	0.036a	148defg
Hormozgan $\times$ 2011	8.67de	267hij	578e-i	658gh	258ijk	152def	1.73ef	0.023de	70efg
Arak $\times 2011$	11.33abcd	388f-j	642d-i	1028c-h	477f-k	164def	2.92e	0.033ab	155defg
Kermanshah × 2011	10.33bcd	341g-j	472fghi	755fgh	296ijk	175cdef	1.71ef	0.023de	70fg
Kerman × 2011	5.66e	148j	192i	307h	100k	92def	1.08f	0.020de	18g
Fars $\times$ 2011	11.33abcd	564c-h	1111bcd	1778bcd	733d-k	377ab	1.94ef	0.010g	73fg
Chaharmahal-o-Bakhtiari × 2011	10.33bcd	522c-h	891cdef	1452b-g	451fg	206cdef	2.36ef	0.030bc	154defg
Tehran $\times$ 2011	9.33cde	179ij	286hi	338h	166f-k	86ef	1.92ef	0.030bc	50g
Ilam $\times$ 2011	12.00abcd	647cg	999bcde	1599b-f	744d-k	321abc	1.99ef	0.016f	146defg
Ardebil $\times$ 2011	10.33bcd	370ghij	647d-i	1035c-h	440g-k	206cdef	2.10ef	0.030bc	159defg

Table 3. The effects of interaction of year  $\times$  genotype on the measured traits

Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$ .

## Table 4. Variations in the measured traits in two years of the experiment

Tearsdaysplantplant (g)(kg/ha)(kg/ha)ratiopercentage(g/ha)201013.88a643a992a1135a179a278a6.71a0.024a270a201110.50b408b649b418b199a146b2.03b0.027a112b	Vaara	Number of flowering	Number of flowers in	Flowers weight /	Flower yield	Petal yield	Receptacle yield	Receptacle / petal	Essential oils	Essential oils yield
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	rears	days	plant	plant (g)	(kg/ha)	(kg/ha)	(kg/ha)	ratio	percentage	(g/ha)
2011 10.50b $408b$ $649b$ $418b$ $199a$ $146b$ $2.03b$ $0.027a$ $112b$	2010	13.88a	643a	992a	1135a	179a	278a	6.71a	0.024a	270a
2011 10.500 400 0470 4100 177a 1400 2.050 0.027a 1120	2011	10.50b	408b	649b	418b	199a	146b	2.03b	0.027a	112b

*Means in a column followed by the same letter are not significantly different at*  $P \leq 0.05$ *.* 

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