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Araştırma Makalesi/Research Article

The effect of bulb sizes on the bulb yield and some plant characteristics of *Narcissus tazetta* subsp. *tazetta* L.

Soğan iriliklerinin Narcissus tazetta subsp*. tazetta L.'da soğan verimi ve bazı bitkisel özelliklere etkisi*

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ABSTRACT

This study was conducted to determine the effect of different bulb sizes on the yield and some plant characteristics of *Narcissus tazetta* subsp. *tazetta* L. (bunch-flowered daffodil) under the conditions of Harran Plain, during 2003-2004 and 2004-2005 winter crop production periods, in accordance with randomized blocks design, with 3 replications. Three different bulb sizes (8-10 cm, 10-12 cm and 12-14 cm circumferences) of Viransehir ecotype were used. In the study, the plant height (18.40-30.82 cm), number of scape (leafless stem) (0.38-2.63 number plant^{-1}), number of flowers (1.48-4.67 number scape^{-1}), main bulb sizes (12.80-13.90 cm), main bulb weights (44.58-51.78 g), increase ratio of the main bulb size (2.05-43.70 % (cm cm^{-1})), number of bulbils (0.48-4.88 numbers plant^{-1}), bulbil sizes (6.67-9.60 cm) and bulb yields (9.99-11.89 kg m^{-2}) were investigated. Statistical analyses indicated that all properties studied were affected by the bulb size. The bulb size with 12-14 cm was found to be suitable for cut flower production and the bulb sizes with 10-12 cm and lower size were suitable for bulb production and landscaped areas.

Key Words: Phenological characters, Bulb yield, Bulb weight, Bulbil size, Flower number

ÖZ

Nergis (*Narcissus tazetta* subsp. *tazetta* L.)'te, farklı soğan iriliklerinin verim ve bazı bitkisel özelliklere etkisinin belirlenmesi amacıyla bu çalışma, 2003-2004 ve 2004-2005 kışlık ürün yetiştirme döneminde, Harran Ovası koşullarında, tesadüf blokları deneme desenine göre, 3 tekerrürlü olarak yürütülmüştür. Materyal olarak Viranşehir ekotipi nergisin, 3 farklı irilikteki (8-10, 10-12 ve 12-14 cm çevre uzunluğu) soğanları kullanılmıştır. Araştırmada, bitki boyu (18.4-30.82 cm), bitki başına çiçekli sap sayısı (0.38-2.63 adet bitki^{-1}), sapta çiçek sayısı (1.48-4.67 adet sap^{-1}), anaç soğan çevre uzunluğu (12.80-13.90 cm), anaç soğan ağırlığı (44.47-51.83 g), anaç soğan çevre uzunluğu artış oranı (%2.05-43.70 (cm cm^{-1})), yavru soğan sayısı (0.48-4.80 adet bitki^{-1}), yavru soğan çevre uzunluğu (6.67-9.60 cm) ve soğan verimi (9.99-11.89 kg $(m^2)^{-1}$) incelenmiştir. İstatistiksel analizler, incelenen tüm özelliklerin soğan büyüklüğünden etkilendiğini göstermiştir. Araştırmada, 12-14 cm

çevre uzunluğuna sahip soğanların çiçek üretimi için ve 10-12 cm ve daha düşük çevre uzunluğuna sahip soğanların ise çiçek soğanı üretimi ve peyzaj alanları için uygun tohumluk iriliği olduğu saptanmıştır.

Anahtar Kelimeler: Bitkisel özellikler, Soğan verimi, Soğan ağırlığı, Soğancık iriliği, Çiçek sayısı

Introduction

Biodiversity has to be thought of in a number of ways such as evolutionary tension between insects and plants and contribution to human society. Therefore, biodiversity has to be recorded, used and reserved. Natural products occupy a significant place in world pharmaceutical market. The loss of biological diversity due to faulty practices is a major problem. The major task of the parties concerned is to stimulate the awareness among the general public on the importance of conserving the biological diversity and develop it in a sustainable manner. Turkey exports bulbs for horticultural purposes mainly gathered from the wild environment. The amount of material exported from Turkey has increased continuously each year. Since the majority of these bulbs are taken from the wild environment, the Turkish government has recently limited the export to some extent in order to conserve the native flora (Karagüzel et al., 2007; Anonymous, 2017). In the meantime, the cultivation of these bulbs has also been accelerated in Turkey. For this purpose, the Turkish government has developed legislative measures for the conservation and sustainable utilization of Geophytes (Sener *et al.*, 1997). *Narcissus* is one of these geophytes plant collected from the wild environment.

Narcissus which has as many as 80 species is the most representative of *Amaryllidaceae* family with 60 genera (Takos and Rook, 2013). *Narcissus* is a plant used as an emetic, wound healer, heart and memory intensifier for the cure of epilepsy and leprosy diseases and for poliomyelitis and Alzheimer treatments in folk and modern medicine (Orhan and Şener, 2003). *Narcissus* is one of the oldest known plants in perfume industry (Remy, 2002). *Narcissus* is critically important for the world cut flower and bulb trade; for example, in the Netherlands alone, produces narcissus bulbs on 1.600 ha area (Anonymous, 2018). Like other geophytes, *Narcissus* having bulbs with efflorescence maturities can have a place in the market.

Many factors including genotype, location, ecological factors and growth techniques affect the flowers and bulb quality and yield of Narcissus (Sharga, 1984; Rees, 1986; Nazki et al., 2005; Toama et al., 2008; Kebeli and Çelikel 2013; Khan et al., 2013; Salman et al., 2013). In addition, the bulb yield is changed dependent on the bulb weight and bulb densities (De Vroomen, 1975: Khan et al., 2013). Small bulbs do not give flower or result in products with a low market potential (Rees, 1986). In addition, Hanks (2002) reported that yields are mainly controlled by the grade of bulbs, bulbs are graded by circumference. For this reason, it is important to determine the bulb size for optimum yield and appropriateness for cut flower and landscape areas.

This work was performed to determine the effect of different bulb sizes on the yield and some plant characteristics of *Narcissus tazetta* subsp. *tazetta* L..

Material and Methods

Field experiments were conducted at the Agricultural Experiment Research Area of the

Agricultural Faculty, Harran University in Şanlıurfa, Turkey, during 2003-04 and 2004-05 winter crop production seasons for duration of 2 years. The experimental field was located in South-eastern Anatolia region (in the Harran Plain) where semi-arid climate conditions are prevailing, and some climatic data for the area were given in Table 1 (Anonymous 2005).

Table 1. Some climatic parameters for Sanliurfa region relating to 2003-04 and 2004-05 growing seasons.
Çizelge 1. Şanlıurfa'da 2003-04 ve 2004-05 yetişme sezonunda saptanan bazı iklim değerleri.

Months *Aylar*	Years *Yıllar*	Temperature °C*/Sıcaklık*			Precipitation*/Yağış* (mm)	Humidity*/Nem* (%)
		Average	Maximum	Minimum		
October	2003	21.5	35.5	3.8	23.1	51.5
Ekim	2004	21.7	35.0	11.3	3.4	48.7
November	2003	12.7	26.6	4.3	36.1	62.0
Kasım	2004	11.7	26.0	-0.1	187.7	72.2
December	2003	7.2	16.2	-0.3	64.4	75.0
Aralık	2004	6.2	19.6	-3.0	7.8	56.3
January	2004	6.0	13.5	-2.1	138.8	81.3
Ocak	2005	6.6	16.7	-0.8	64.4	64.4
February	2004	6.2	20.3	-4.7	92.0	74.9
Şubat	2005	6.4	17.5	-2.2	69.5	68.5
March	2004	13.4	26.7	2.2	3.2	50.5
Mart	2005	11.4	24.5	1.9	23.1	57.1
April	2004	16.1	33.4	-0.7	51.6	47.1
Nisan	2005	17.3	29.7	4.8	25.2	50.9
May	2004	21.9	35.2	10.6	27.3	48.9
Mayıs	2005	23.1	35.0	7.8	9.9	41.4
June	2004	29.0	39.4	17.3	0.0	33.5
Haziran	2005	27.4	38.5	15.1	31.3	35.9

As seen in Table 1, the climatic data of 2003-04 and 2004-05 growing seasons showed similarities. On the other hand, in the first year, in November and March, the precipitations were lower than the same period of the second year. Throughout vegetation period, totally 436.5 mm in the first year and second year 422.3 mm precipitation were recorded.

The soil of the research field belonged to Harran I series and had A, B and C horizons, flat and/or flat-like slope, alluvial main material, a deep profile, and had a low organic matter (1.37%) and clay texture (Almaca and Gök, 1997).

Three different bulb sizes of (8-10 cm, 10-12 cm and 12-14 cm circumferences) Viransehir ecotype of bunch-flowered daffodil (*Narcissus tazetta* subsp. *tazetta* L.) were used as material in the research. Daffodil bulbs were gathered manually at the area of their natural spread (village Nergisli, near to the Viransehir, Şanlıurfa, South-eastern of the Turkey), after all the plant parts had dried off. The bulbs obtained after being cultivated and reproduced under field conditions were kept in controlled storage conditions (at a temperature of 16°C and relative humidity of 65%) until the planting time for both years of the trial. The experiment of area was irrigated before planting and the soil was deeply tilled with a plow when the soil was in the suitable conditions for tilling and then treated with cultivators and rototiller and prepared for planting. The experiment was designed as a Randomized Complete Block Design with three replications. The bulbs were planted in

October 18, 2003 and October 13, 2004, by hand with 10 cm x 10 cm plant density and to 10 cm depth. At the stage of planting, nitrogen (50 kg ha^{-1}) and phosphorus (50 kg ha^{-1}) were applied to the soil, and at the beginning of May, nitrogen (50 kg ha^{-1}) was applied to all plots. The each plot was set up as four rows each was 5 m in length, and include 200 bulbs. Irrigation was performed at the time of planting, and in the later periods of vegetation, when necessary. The weed controls were done by hoeing. Phenological observations were performed during the vegetation period and the bulbs were harvested by spade after the parts of the plants above the soil level were completely dried and required measurements were performed in the laboratory environment.

The characteristics examined are given below.

Sprout date: Date on which 70% appearance of plants occurred at each plot was recorded as sprout date.

Beginning of the flowering: Date of the appearance of the first flower at the plots was recorded as beginning of the flowering.

Flowering period: The period from starting of flowering to the end was determined for randomly selected 20 plants at each plot and their average was recorded.

Vegetation period: The period from the date on which 70% appearance of plants occurred to the date on which the parts of the plants above the soil level were completely dried, was recorded.

Plant height (cm): Heights of randomly selected 20 plants were measured from soil surface to the highest part and the average was recorded.

Number of scapes (number $plant^{-1}$): Number of scapes with flower on randomly selected 20 plants on each plot was counted and the average was recorded.

Number of flowers (number $scape^{-1}$): Number of flowers on harvested flower with randomly selected 20 scapes with flowers and the average numbers were calculated.

Bulb size (cm): 20 plants were harvested at each plot and following the separation of bulbils and drying for 48 hours in the shade, the circumferences of bulbs were measured in cm unit and the average was recorded.

Bulb weight (g): 20 plants were harvested at each plot and following the separation of bulbils and drying for 48 hours in the shade, the weights of bulbs were measured in g units and the average was recorded.

Increasing ratio of the bulb size (%): The increasing ratio of the bulb size was calculated by dividing circumferences of 20 bulbs after harvesting by circumferences of the bulbs planted, expressed as percentage (%).

Number of bulbils (numbers $plant^{-1}$): The number of bulbils from harvested 20 plants was determined and the average values were recorded.

Bulbil size (cm): Bulbils separated from 20 bulbs were dried off in shade for 48 hours and then the circumferences of the bulbils were measured in cm units and the average was recorded.

Bulb yield (kg m^{-2}): In each plot, an area of 1 m^2 was harvested by hand, and then dried for 48 hours and weighed, and then their average was recorded.

The data were subjected to analysis of variance (ANOVA) using Combined Randomized Complete Block Design. The significance of differences among the different bulb sizes was determined using LSD with 5%. All statistical analyses were carried out by means of MSTAT-C© software.

Results and Discussion

Phenological phases

The phenological phases (the sprout time, the beginning of the flowering, the flowering periods and the vegetation period) of the bunch-flowered daffodils for both experimental years are given in Table 2.

Generally, the sprout time, the beginning of the flowering, the flowering periods and the vegetation period showed differences depending on the bulb size.

Table 2. Some phenological characters of *Narcissus tazetta* subsp. *tazetta* L. depending on different bulb size in 2003-04 and 2004-05 growing seasons.

Çizelge 2. Farklı soğan iriliklerine göre, 2003-04 ve 2004-05 sezonlarında Narcissus tazetta subsp. *tazetta* L.*'da saptanan bazı fenolojik özellikler.*

Phenological characters *Fenolojik özellikler*	Bulb size*/Soğan iriliği*					
	8-10 cm		10-12 cm		12-14 cm	
	2003-2004	2004-2005	2003-2004	2004-2005	2003-2004	2004-2005
Sprout date *Çıkış tarihi*	24.11.2003	18.11.2004	19.11.2003	14.11.2004	17.11.2003	11.11.2004
Beginning of the flowering *Çiçeklenme tarihi*	15.01.2004	12.01.2005	29.12.2003	26.12.2004	25.12.2003	22.12.2004
Flowering period (day) *Çiçeklenme süresi (gün)*	19	20	24	23	23	24
Vegetation period (day) *Vejetasyon süresi (gün)*	182	184	182	182	185	188
Harvested date *Hasat tarihi*	08.06.2004	06.06.2005	06.06.2004	09.06.2005	05.06.2004	08.06.2005

The sprout time as seen in Table 2, in both years, the size of the bunch-flowered daffodil bulb increased, was shortened. It was determined in the second year that the planting was performed 5-6 days earlier than the first year, resulted in the sprout time also occurred at earlier dates.

The earliest flowering time amongst different bulb sizes was recorded for the 12-14 cm bulb sizes (Table 2). The beginning of the flowering shortened in accordance with increasing bulb size. It can be said that the difference between bulb sizes regarding flowering days results from earlier formation of flower buds and their earlier appearance. The bunch-flowered daffodils with 10-12 and 12-14 cm bulb sizes had flowering period of 23-24 days and no significant difference were noted between the years. On contrary, bunch-flowered daffodils with 8-10 cm bulb size had shorter flowering period than the bigger bulb sizes (Table 2). These findings are in line De Vroomen (1975) who reported that flower productivity and quality increases with the increase in the bulb size and Rees (1986) who, small bulbs do not give flower or result in products with a low market potential.

The vegetation period was 182-185 days for the first year and 182-188 days for the second year. This difference may be due to the differences between the appearing dates of bunch-flowered daffodils with different bulb sizes and ecological conditions.

Table 3. Morphological characters, yield of bulb and flowers of *Narcissus tazetta* subsp. *tazetta* L. depending on different bulb size in 2003-04 and 2004-05 growing.

Çizelge 3. *Farklı soğan iriliklerine göre, 2003-04 ve 2004-05 sezonlarında Narcissus tazetta* subsp. *tazetta* L.*'da saptanan morfolojik karakterler, soğan ve çiçek verimi.*

Bulb sizes *Soğan iriliği*	Plant height (cm) *Bitki boyu*	Number of scape *Sap sayısı*	Number of Flower *Çiçek sayısı*	Bulb size(cm) *Soğan iriliği*		Bulb weight (g) *Soğan ağırlığı*	Bulb size increase ratio (%) *Soğan iriliği artış oranı*		Bulbil Numbers *Soğancık sayısı*	Bulbil size (cm) *Soğancık iriliği*	Bulb yield (kg m^{-2}) *Soğan verimi*	
				1.Year *1.Yıl*	2.Year *2.Yıl*		1.Year *1.Yıl*	2.Year *2.Yıl*			1.Year *1.Yıl*	2.Year *2.Yıl*
8-10 cm	18.40 c	0.38 c	1.48 c	12.80 c	12.93 b	44.58 c	42.22 a	43.70 a	0.48 c	6.88 b	9.99 c	10.02 c
10-12 cm	21.82 b	1.37 b	2.92 b	13.53 b	13.20 a	47.32 b	23.03 b	20.61 b	2.12 b	9.60 a	10.89 b	11.02 b
12-14 cm	30.82 a	2.63 a	4.67 a	13.90 a	13.27 a	51.78 a	6.92 c	2.05 c	4.88 a	6.67 c	11.52 a	11.89 a
LSD	0.76	0.07	0.08	0.24	0.18	0.45	2.11	1.42	0.10	0.18	0.10	0.07
F values												
Years/Yıllar	-	-	-	*		-	**		-	-	**	
Bulb Size Soğan iriliği	**	**	**	**		**	**		**	**	**	

The mean values with the same letter within variable are not significantly different (LSD P < 0.05); significant at *0.05 and **0.01 levels.

Aynı harfler arasındaki fark önemsiz (LSD P < 0.05); 0.05,** 0.01 düzeyinde önemli.*

Morphological characters

The morphological characters (plant height, number of scapes with flowers, number of flowers, bulb size, bulb weight, bulb size increase ratio, bulbil numbers, bulbil size and bulb yield) of the bunch-flowered daffodils for both experimental years are given in Table 3.

The plant height, the number of scapes with flowers, the number of flowers, the bulb weight, the bulbil numbers and the bulbil size results of variance analysis showed that the difference between the years was not significant, but the differences between the bulb sizes were found to be significant. However, it was found that there were significant differences between the years and the different bulb sizes in terms of the bulb size, the bulb size increase ratio and the bulb yield. The values of two years showed that, the plant height, the number of scapes with flowers, the number of flowers, the bulb size, the bulb weight, the bulbil numbers and the bulb yield were markedly increased with the increase in the bulb size (Table 3). This may be related to the maturation level of the bulb. The highest the plant height, the number of scapes with flowers, the number of flowers, the bulb size, the bulb weight, the bulbil numbers and the bulb yield value was obtained from the bulb size of 12-14 cm, and the lowest value was obtained from the bulb size of 8-10 cm. This finding was in consistent with De Vroomen (1975), Rees (1986) and Hanks (2002).

The number of flowers per scape, were slightly lower than those reported by Baker et al. (2000). This difference may be due to genotypic or ecological factors or due to the differences in the size of the bulbs used. Bulb yield of the bunch-flowered daffodil with a bulb size of the 8-10 cm reached the lowest values of 9.99 kg m^{-2} and 10.02 kg m^{-2}, in 2003-2004 and 2004-2005, respectively. An increase in bulb yield was seen concomitantly with increasing bulb sizes. This may be due to the big bulbs producing a higher number of bulbils.

As seen in Table 3, in both years, the highest values of the bulb size increase ratio were determined as 42.22 % and 43.70 %, respectively, from the 8-10 cm bulb sizes and the lowest values were found to be 6.92 % and 2.05 %, from the 12-14 cm bulb sizes, respectively. As the bulb size increased, the ratio of increase of the bulb size decreased. This may be due to the big bulbs closer to the maximum size they could achieve. These findings were in harmony with Khan et al. (2013) who recorded that the more weight bulbs give to reduce bulb yield than the lighter weight bulbs.

Otherwise, in terms of bulbil size, according to the combined values of the two years, the bunch-flowered daffodil with the 10-12 cm bulb size reached the highest value of 9.60 cm whereas the 12-14 cm bulb sizes reached the lowest value of 6.67 cm (Table 3). The medium size (10-12 cm) bulbs produced larger bulbils compared with larger size (12-14 cm) bulbs.

To conclude, it could be said that the 12-14 cm bulb sizes, which had higher plant heights, larger number of scapes with flowers, larger number of flowers, larger bulb size and bulb weight, larger number of bulbils and bulb yield were found to be suitable for the cut flower production. The 10-12 cm bulb sizes, which had higher bulbil size and higher bulb size increase ratio that could produce suitable amounts of flowers, were suitable for bulb production and landscaping applications.

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