

## Determination of the Growth and Development Different Hyacinth Cultivars

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**Abstract:** This study was conducted to determine morphological characteristics of different hyacinths cultivars grown without fertilizing under greenhouse conditions. For this aim, Jan Bos, Carnegie, Blue Jacket, and City of Haarlem hyacinth cultivars were used. Several traits such as leaf numbers, leaf lengthiness, leaf diameter, plant height, flower diameter, floret number, floret height, floret diameter, harvest time, first bloom time, full bloom time, flower width, flower length and stem thickness etc were investigated. The obtained data were analyzed using One-Way ANOVA with three replications. In general, growing is sustainable with using minimal fertilization dozes. However, variation in flower growth and especially height may be due to greenhouse temperature and soil condition. While City of Haarlem cultivar was influenced from this limited condition, a significant reduction in size of other cultivars was observed. However, Carnegie and Blue Jacket cultivars that have the highest flower width were almost similar. Carnegie cultivar came before about of the first flowers, full of flowers, and the shortest harvest, duration was observed as the earliest cultivar. Results of the experiment reflected that varieties growing depending on short vegetation period were found sufficient without fertilization, but fertilization for improving flower quality could be required. As a result, it was concluded that statistically significant differences among cultivars were found.

**Key words:** *Hyacinthus orientalis* L., variety, plant development, morphological characteristics

### Introduction

Scientists believe that some plant bulbs grown in the natural environment have superior features. They are working for translating these features to cultural plants (Ergun *et al.*, 1997). It was reported that the first cultured plants are bulbous-tuberous ornamental plants (Arslan, 1998). *Hyacinthus orientalis* L. is used in landscaping as cut flowers with its beauty and smell and as potted flowers. *H. orientalis*, a bulbous plant and member of *Liliaceae* family, has 4-6 strap-shaped (Anonymous, 2009), 20-30 cm long, 1.25-3.75 cm wide leaves (Bailey, 1963); and 20-30 cm plant height, 15-20 cm flower size in width (Beckett *et al.*, 1982). Hyacinth plants have 15-30 florets in one spike (Perry, 2010). After vegetative term, hyacinths resume their lives under the ground for storage food to use in the next period. Hyacinth bulbs can store a sufficient amount of food without over-fertilization. However, when the need arises, very little chemical fertilizer can be added (Beazley, 1979).

Previous studies have showed that these plants are needed well-drained, light sandy-loam enriched with some organic matter (Krabbendam and Baardse, 1968), in the land ranging between pH 6-7 (Nowak & Rudnicki, 1993). Ebcioğlu, (2002), Korkut and İnan, (2002) stated that fertilization is not necessary for hyacinth bulbs, but bulbs will become strengthen with fertilization. In the literature, there were limited number of reports on the morphological traits of hyacinth cultivars, Jan Bos, Blue Jacket, Carnegie and City of Haarlem under greenhouse conditions.

The present study was designed to determine morphological characteristics of *H. orientalis* cultivars (Jan Bos, Blue Jacket, Carnegie and City of Haarlem) grown without fertilizing under greenhouse conditions.

### Materials and Methods

This experiment was conducted in Centary University's Agriculture Faculty, Department of Horticulture Research and Application Greenhouses in December. Hyacinth bulbs, which are

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surrounded 14 / 15 cm, were provided for the current study (*H. orientalis* "Jan Bos", "Blue Jacket", "Carnegie", "City of Haarlem") and supplied from a commercial company. Before planting, onions kept in copper preparate are called Cupravit (4% (w / v), 10 min) for precaution. Bulbs prepared for planting, placed number 6 plastic pots and then exchanged glass greenhouse. Glass greenhouse heating system was not available. Mixtures of pots were analyzed and the averages of minimum and maximum temperature were recorded in the greenhouse during the vegetation. Hyacinth bulbs in each plot were 5 units.

### Morphological traits

During the experiment, morphological traits such as the first leaf out of the number of days (days), leaf numbers (number), average leaf length (mm), average leaf width (mm), floret number (number), the first bloom time (days), full bloom time (days), harvest time (days), plant height (mm), flower width (mm), floret length (mm), floret width (mm), stem thickness (mm) were recorded.

### Statistical analysis

In the experiment, four hyacinth cultivars such as Jan Bos, Carnegie, Blue Jacket, and City of Haarlem were used. The studied traits such as, leaf lengthiness, leaf diameter, plant height, flower diameter, floret height, floret diameter, flower width, flower length and stem thickness were measured by using digital compass. Other threats such as leaf numbers, floret number, harvest time, full bloom time and first bloom time were determined and recorded. Our main concern is to examine the effects of cultivar factor on these measured traits. Descriptive statistics for the investigated morphological traits in the current study were expressed as Mean  $\pm$ SE. The experimental data were analyzed using ONE-WAY ANOVA with three replications. All the statistical evaluations were performed with GLM (General Linear Model) procedure of the SAS statistical analysis program (SAS, 1998). The assumed linear model for the experimental design can be written below:

Where;  $Y_{ij} = \mu + c_i + e_{ij}$

$Y_{ij}$ : the amount of j. replication in i. cultivar

$c_i$ : i. cultivar effect (i= 1, 2, 3, 4; Jan Bos, Carnegie, Blue Jacket, and City of Haarlem)

$e_{ij}$ : random error.

Significant differences were performed using Duncan's test at 5 (%) levels.

### Results and Discussion

The sandy-clay-loam textured, alkaline, salt-free, low calcium, poor in organic matter, total nitrogen poor, phosphorus, potassium, calcium, magnesium, zinc, iron, manganese and copper contents of the soil used in the experiment was determined to be sufficient (Aydeniz, 1985). Some physical and chemical properties of the soil in the experiment are given in Table I.

**Table 1.** Some physical and chemical properties of soil testing ground

Depth (cm)	Texture class	pH (1:2.5)	Salt (dS/m)	Lime (%)	Organic matter (%)	Total N (%)	Useful P (ppm)	Vary			Useful			
								K (ppm)	Ca (%)	Mg (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
0-20	sandy-clay-loam	9.15	0.275	6.6	0.94	0.04	16.0	760	0.39	357	5.8	9.2	1.4	2.6

Minimum and maximum temperature values were recorded in glasshouse where the present study was conducted. The lowest temperatures varied between -4.71 °C and 6.83°C during vegetation period and the average temperature was determined as (0.98)°C. However, the highest temperatures ranged between (17) °C to 44.91°C and the average temperature was observed as 29.65 °C.

### Morphological Analysis Results

Table II presents descriptive statistics (mean  $\pm$ SE) and Duncan's test results for some morphological traits. When results of morphological traits were taken into consideration, no significant differences between cultivars only in terms of number of leaves were found (Table 2). However, the significant effect of cultivar factor on other morphological traits (viz. leaf-out time, the

first bloom time, full bloom time, harvest time, leaf length and width), development criteria were determined (Table II).

#### **The number of days out of the first leaf**

Hyacinth types which were used in the research, vegetation phase to pass through the first indication of the duration of leaf appearance was statistically different from each other. ANOVA result reflected that cultivar factor significantly affected leaf-out time trait ( $P<0.05$ ). Leaf-out time averages for Jan Bos, Carnegie, Blue Jacket and City of Haarlem cultivars were found as: 90.60, 84.07, 90.67 and 101.13 respectively. Leaf-out time (days) showed a range of 84.07 – 101.13 days. As seen from Table II, the significant difference in leaf-out time between Carnegie and City of Haarlem cultivars were detected exclusively ( $P<0.05$ ). Hyacinth cultivar that has the earliest leaf-out with 84.07 per/days was Carnegie cultivar, but City of Harlem was the latest leaf-out cultivar with 101.13 days (Table II). A value of 84.34 days in Carnegie cultivar was similar of the value reported by Çiğ, (2005). A leaf out time average of 90.67 day in the present study was lower than the leaf out time average of (97.05 day) reported by (Çiğ, 2005) for Blue Jacket cultivar.

#### **The first flower time**

The beginning of generative phase, first floret appeared again at Carnegie cultivar as with the exit of the first leaf at the beginning of vegetative phase (114.13 days after planting). ANOVA result illustrated that cultivar factor significantly affected the first flower time ( $P<0.001$ ). This means great variation in the first flower among Hyacinth cultivars. There were significant differences in the first flower time between City of Haarlem and other Hyacinth cultivars ( $P<0.05$ ). Duncan's results showed that Jan Bos, Carnegie and Blue Jacket Hyacinth cultivars in the trait were not different from each other. City of Haarlem cultivar had the latest flower formation with a value of with 128.73 days (Table II). In previous study, the latest appearance of beginning first floret (119.72 day) for City of Haarlem variety gave similar results to the result of the current study (Çiğ, 2005).

#### **Full bloom time**

Blooming process completed when %50 of florets on the ear are bloomed observed earliest at the cultivar of Carnegie as in the first flower process which started the first floret emerges (116.73th days after planting). Full bloom time averages for Jan Bos, Carnegie, Blue Jacket and City of Haarlem cultivars were 117.0, 116.73, 118.67 and 130.67 days respectively. City of Haarlem and Carnegie cultivars were observed to have the longest and earliest full bloom time, respectively. ANOVA result reflected that cultivar factor significantly influenced the full boom time ( $P<0.001$ ). Accordingly, considerable variation in the full boom time among Hyacinth cultivars was seen obviously. While Carnegie, Jan Bos and Blue Jacket cultivars in full bloom trait had statistically similar values, City of Haarlem cultivar (130.67 days) with the longest average to complete bloom time was detected to statistically different from other Hyacinth cultivars ( $P<0.05$ ) and In a similar study the earliest blooming time for Carnegie cultivar (112.75 days), the latest blooming time for the City of Haarlem cultivar (123.00 days) were reported by (Türkoğlu & Ciğ, 2006). In the current study, these values obtained for the Carnegie (116.73 days) and City of Haarlem (130.67 days) cultivars was relatively lower than the values reported by Türkoğlu and Ciğ, (2006).

#### **Harvest time**

The difference between the averages of the harvest time, from the moment the flowers start to bloom till they are ready to cut, was found statistically significant ( $P<0.001$ ). Similar trend in the full bloom time trait was observed numerically and comparatively in harvest time trait. Averages of harvest time for Jan Bos, Carnegie, Blue Jacket, and City of Haarlem hyacinth cultivars in the trait were 119.33, 119.00, 121.00, and 132.33 days with an average value of 122.92 days respectively. According to results from ANOVA, it could be suggested that harvest time was affected significantly by cultivar factor.

When the growth times of the first leaf, first flower and the complete bloom were taken into consideration, the longest average time was obtained from City of Haarlem cultivar with 132.33 days. However, the shortest average time with 119.00 days was recorded from the Carnegie cultivar. No significant differences between Harvest time averages of Jan Bos, Carnegie, Blue Jacket, and City of

Haarlem cultivars were found (Table II). The City of Haarlem cultivar in the current study was ascertained to have higher harvest time compared to others ( $P < 0.05$ ).

In earlier study of Türkoğlu and Cığ (2006), the earliest harvest time (114.94 days) for Hyacinths under the greenhouse condition, was obtained from the cultivar of Carnegie cultivar. However, hyacinth cultivar having the longest harvest time (125.41) was determined to be City of Haarlem cultivar. The present results were in practically agreement with those reported by Türkoğlu and Cığ (2006).

#### Number of leaves (number):

Number of leaves ranged from 6.6 (Jan Bos cultivar) to 7.53 (City of Haarlem cultivar) (per/plant). ANOVA result revealed that, no significant differences between Hyacinth cultivars were observed for number of leaf trait. This means that cultivar was not a substantial source of variation in number of leaves ( $P > 0.05$ ). Regardless of cultivar of *H. orientalis*, its leaves are between 6-7 mm (Anonymous, 2009). The results obtained for the trait were consistent with the result reported by Anonymous (2009).

#### The average length of leaves (mm)

Averages for length of leaves in the current study were recorded as 52.86, 61.38, 82.01, and 118.45 mm from Jan Bos, Carnegie, Blue Jacket, and City of Haarlem hyacinth cultivars respectively. ANOVA result in relation to average length of leaves illustrated that cultivar factor could be a significant source of variation. Duncan's test result represented that City of Haarlem cultivar in the trait was statistically superiority to other cultivars (Table II).

The present results with regard to length of leaves for Jan Bos and City of Haarlem cultivars were found higher than those of Cığ (2005) for corresponding cultivars. These differences might due to soil properties in relation to nutrition.

#### The average width of leaves (mm)

ANOVA result initiated that cultivar factor had statistically a significant effect on leaf width trait ( $P < 0.01$ ). Carnegie cultivar statistically produced the highest average for the trait. Similarly, Cığ (2005) reported that Jan Bos cultivar has the minimum leaf width (14.890 mm) and the maximum leaf width was measured from Carnegie (23.947 mm) and City of Haarlem (23.67 mm) cultivars.

**Table 2.** Descriptive statistics and Duncan's test results for hyacinth cultivars

Varieties	Leaf-out time (days)	The first flower (Days)	Full flower (Days)	Harvest (Days)	Number of leaves (per/plant)	Leaf length (mm)	Leaf width (mm)
Jan Bos	90.60±3.78 <sup>ab</sup>	114.40±0.61 <sup>b</sup>	117.00±0.50 <sup>b</sup>	119.33±0.06 <sup>b</sup>	6.60±0.20 <sup>a</sup>	52.86±2.17 <sup>c</sup>	14.76±0.49 <sup>c</sup>
Carnegie	84.07±3.41 <sup>b</sup>	114.13±0.47 <sup>b</sup>	116.73±0.40 <sup>b</sup>	119.00±0.23 <sup>b</sup>	6.93±0.18 <sup>a</sup>	61.38±2.08 <sup>bc</sup>	20.00±0.12 <sup>a</sup>
Blue Jacket	90.67±1.68 <sup>ab</sup>	116.73±0.07 <sup>b</sup>	118.67±0.13 <sup>b</sup>	121.00±0.40 <sup>b</sup>	7.33±0.47 <sup>a</sup>	82.01±1.05 <sup>b</sup>	17.86±0.11 <sup>ab</sup>
Haarlem City	101.13±3.66 <sup>a</sup>	128.73±1.84 <sup>a</sup>	130.67±1.77 <sup>a</sup>	132.33±1.57 <sup>a</sup>	7.53±0.53 <sup>a</sup>	118.45±16.15 <sup>a</sup>	16.63±1.42 <sup>bc</sup>
General	91.62±2.30	118.50±1.86	120.77±1.78	122.92±1.69	7.10±0.20	78.67±8.39	17.31±0.66
Prob.	*	***	***	***	NS	**	**

Difference between means with different letter in a column is significant ( $P < 0.05$ )

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$  NS: non-significant

#### Plant height (mm)

Table III presents descriptive statistics and Duncan's test results for flower yield traits of hyacinth cultivars. Plant height averages for Jan Bos, Carnegie, Blue Jacket, and City of Haarlem cultivars were 134.32, 125.68, 148.06 and 161.54 mm, respectively. Significant effect of cultivar factor on the plant height was detected with ANOVA ( $P < 0.05$ ). Blue Jacket cultivar was a statistically negligible different from City of Haarlem cultivar, which gave the highest plant height (Table III) The average of the longest plant height (161.54 mm) was obtained from City of Haarlem cultivar, whereas the average of the shortest plant height (125.68 mm) was obtained from Carnegie cultivar. In a previous study conducted by Cığ (2005), Carnegie cultivar produced the shortest plant height (150.15 mm) and City of Haarlem has the longest plant height (211.73 mm). It's reported that Jan Bos is 20-26

cm (Steward, 2010), Carnegie is 20-30 cm (De Hertogh and friends, 1997), Blue Jacket is 20-30 cm (Engelen, 2010) and City of Haarlem is 15-30 cm (Anonymus, 2010).

#### Flower width (mm)

ANOVA result revealed that cultivar factor had a statistically significant effect on flower width trait ( $P < 0.001$ ). Numerically, the highest plant width was recorded from Blue Jacket cultivar, which was statistically similar to Carnegie cultivar. Carnegie cultivar in relation to flower width was found to be statistically insignificant difference from Blue Jacket cultivar, but significantly difference from others ( $P < 0.05$ ). Cultivar that has the lowest average flower width value 54.32 mm was City of Haarlem cultivar; the highest average flower width value was recorded in Blue Jacket cultivar (Table III). These results was in agreement with those found by Çiğ (2005)

#### Floret number (count)

Descriptive statistics for hyacinth cultivars in terms of floret number trait are depicted in Table III. ANOVA result reflected that cultivar could be a factor significantly influencing floret number trait ( $P < 0.01$ ). These cultivars illustrated a range of 16.60 to 24.53. Except for Carnegie cultivar, Averages of other cultivars was statistically similar to each other ( $P > 0.05$ ). Additionally, Carnegie cultivar had the lowest average value with the 16.60 floret count (Table 3). Previously, Perry (2010) reported that the floret count on a single spike should be between 15 and 30. The current results were found within a range of 15-30 reported by Perry (2010).

#### Floret length (mm)

Descriptive statistics, ANOVA and Duncan's test results for floret length of Hyacinth cultivars are summarized in Table III. According to ANOVA results, cultivar significantly affected the trait ( $P < 0.05$ ). Floret length varied between 16.67 (Jan Bos cultivar) and 20.43 mm (20.43). Perry (2010), has indicated that the floret length for Hyacinth is 2.54 cm. Accordingly the Jan Bos cultivar remained below the average. Similar study was reported that Jon Bos had the lowest floret length with 18.40 mm, and the highest floret length of 23.10 obtained from Carnegie (Çiğ, 2005). The differences between three separate averages can be associated with cultivar traits and differences at growing conditions.

**Table 3.** Descriptive statistics and Duncan's test results for flower yield traits of hyacinth cultivars

Varieties	Plant height (mm)	width of flowers (mm)	Floret number	Floret length (mm)	Floret diameter (mm)	Stem thickness (mm)
Jan Bos	134.32±4.47 <b>b</b>	61.10±0.26 <b>b</b>	23.87±1.60 <b>a</b>	16.67±0.24 <b>c</b>	24.37±0.45 <b>be</b>	7.78±0.21 <b>c</b>
Carnegie	125.68±2.69 <b>b</b>	72.12±1.83 <b>a</b>	16.60±1.21 <b>b</b>	20.43±0.37 <b>a</b>	36.32±0.59 <b>a</b>	9.73±0.10 <b>b</b>
Blue Jacket	148.06±3.96 <b>ab</b>	73.23±0.65 <b>a</b>	22.80±1.22 <b>a</b>	19.47±0.68 <b>ab</b>	34.83±0.61 <b>a</b>	11.20±0.35 <b>a</b>
City of Haarlem	161.54±13.89 <b>a</b>	54.32±3.03 <b>c</b>	24.53±0.75 <b>a</b>	18.34±0.52 <b>b</b>	27.57±1.36 <b>a</b>	9.65±0.20 <b>b</b>
General Mean	142.40±5.25	65.19±2.49	21.95±1.08	18.73±0.47	30.77±1.54	9.59±0.38
Probability	*	***	**	**	***	***

*Difference between means with different letter in a column is significant ( $P < 0.05$ )*

*\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$  NS: non-significant*

#### Floret diameter (mm)

Descriptive statistics, ANOVA and Duncan's test results for floret diameter of hyacinth cultivars are given in Table III. ANOVA result showed that cultivar played a significant role on variation in floret width ( $P < 0.001$ ). Results of Çiğ (2005) cultivars were in agreement with those of the current study for floret diameter trait.

#### Stem thickness (mm)

Descriptive statistics, ANOVA and Duncan's test results for floret width of hyacinth cultivars are presented in Table III. Cultivar significantly influenced stem thickness in the current study. Türkoğlu and Cığ (2006), obtained the lowest stem thickness from Jan Bos with 8.073 and the highest average stem thickness from City of Haarlem and they also found the stem thickness of Blue Jacket cultivar as 11.450mm.

As a result of the morphological traits, significant differences were found in plant developments due to environmental and regional variation. While an important shortage observed on sample's flower length which is shown as a characteristic of that variety; a similar shortage observed on leaf count, width and length of the *Hyacinthus orientalis* L. plant.

As a result of this study that conducted under greenhouse conditions, some important differences were determined in terms of development criteria. It is determined that Carnegie cultivar is appropriate in terms of first flower, full flower and short harvest (Table 2). Considering the width of flower, one of the features that determine the attractiveness of the flowers, Carnegie and Blue Jacket cultivars are named with the same letter. Therefore they are equally important. However, the City of Haarlem, which has the longest flower length, may be preferred in terms of plant height (Table 3).

It was concluded that that the most suitable cultivar was Carnegie cultivar for the areas at a short vegetation period. However, to obtain flowers with better quality and attractiveness, it's accepted by analysis that the soil can be enriched with fertilizers.

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