

**RESULTS REGARDING PHENOTIPIC CORRELATIONS  
BETWEEN MORPHO-DECORATIVE  
CHARACTERISTICS FOR SOME *DAHLIA VARIABILIS*  
CACTUS TYPE CULTIVARS**

**REZULTATE PRIVIND CORELAȚIILE FENOTIPICE ÎNTRE  
CARACTERELE MORFO-DECORATIVE LA UNELE SOIURI DE  
*DAHLIA VARIABILIS* TIP CACTUS**

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**Abstract.** *The aim of the present study was to determine the influence of planting material (forced and unforced tuberous roots) on some morpho-decorative characteristics of seven Dahlia variabilis cactus type cultivars: 'Kennemerland', 'Tsuki Yori No Sisha', 'Hayley Jane', 'Purple Gem', 'Star Favourite', 'Park Princess', and 'Friquoulet'. The biometrical observations regarding the morpho-decorative characteristics consisted in assessing: the average number of shoots per plant, the average height of flower stems, the average diameter of inflorescence, the average number of inflorescence per plant and the average number of ligulate florets per inflorescence. Between these characteristics there were made some phenotypic correlations. Following the interpretation of the results regarding the biometrical determinations using Duncan test, it is evident that by forcing the tuberous roots the results obtained are superior for the analyzed characteristics compared to plants with unforced tuberous roots. The most positive results for the correlation coefficient, respectively significant and significantly distinct were registered for the variants of unforced tuberous roots.*

**Key words:** characteristics morpho-decorative, correlation coefficient, cultivar, Dahlia

**Rezumat.** *Scopul cercetărilor efectuate a fost de a determina influența materialului săditor (rădăcini tuberizate forțate și neforțate) asupra unor caractere morfo-decorative, de la șapte cultivare de Dahlia variabilis tip cactus: 'Kennemerland', 'Tsuki Yori No Sisha', 'Hayley Jane', 'Purple Gem', 'Star Favourite', 'Park Princess', 'Friquoulet'. Observațiile biometrice privind caracterele morfo-decorative au constat în: număr mediu de lăstari pe plantă, înălțimea medie a tijelor florale pe plantă, diametrul mediu al inflorescenței, număr mediu de inflorescențe pe plantă și număr mediu de flori ligulate în inflorescență. Între aceste caractere s-au efectuat unele corelații fenotipice. În urma interpretării rezultatelor privind măsurătorile biometrice prin testul Duncan reiese că prin forțarea rădăcinilor tuberizate obținem rezultate superioare la caracterele analizate comparativ cu plantele care nu au avut rădăcinile forțate. Cele mai multe valori pozitive ale coeficientului de corelație semnificativ și distinct semnificativ se înregistrează la variantele cu rădăcini neforțate.*

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## INTRODUCTION

Forcing is a widespread practice for many flower species, and until the present time it was extensively researched. This allowed the continuous improvement and eventually the implementation of forcing in large scale production technology of cut flowers, particularly for tulips (Miller, 2002), but it is practicable for many other well-known bulbous flower species (Graine, 2014; <https://www.netherlandbulb.com>). For the species utilized in landscaping, forcing was adopted as a cultural practice with good results especially in regards with earliness and abundance of flowering (<http://www.bakker-irl.com>).

The *Dahlia* crop can be established from the end of March in unheated greenhouse using forced tuberous roots. By cultivation of *Dahlia* in unheated greenhouse, there can be obtained an advancement of flowering with an earliness of about two months and with a yield of 30-40 flower stems per plant.

Protection with polyethylene film is ensured until the end of May and it is reinstalled at the end of September (Șelaru, 2007). Cantor and Pop (2008), recommend the planting in the field to be made at the beginning of May.

The plants with sprouted forced tuberous roots are planted in the field at the end of May or beginning June, but it is usually more common to plant a month earlier. The junction point of the root with the stem must be situated at planting at 7.7 cm under the soil level for border varieties and 5 cm for seedlings and dwarf plants (Hessayon, 2007).

Previous authors have studied in the case of different flower species the effects of various forcing parameters: like temperatures during forcing (Han *et al.*, 1991), the effects of photoperiod on plants by forcing at different times in the year, and there were made comparative studies on the forcing in growth chamber and greenhouse (Van der Meulen-Muisers *et al.*, 1998). The studies on forcing effects provided useful and practical information for horticultural producers and gardeners. For example, Han *et al.* (1991), regarding *Brodiaea* species citing previous studies mentions that high temperatures during forcing leads to an acceleration of flowering but at the same time a reduction in the percentage of flowers that bloomed, the number of flowers per inflorescence and the length of the scape. Also, the researches of Han *et al.* (1991) on *Brodiaea*, managed to identify that low night temperatures (5-10°C) during forcing promotes a remarkably scape elongation with 250%, an important characteristic for this flower species, and this increase was not linked to any decrease in flower quality or increase in forcing time. Also, in regards with flowering they proved that forcing under long days advanced flowering by 1-3 weeks.

All the previous studies cited were conducted to identify the specific effects of forcing on the plants, by quantifying and settling relationships between various characteristics and traits of the plants. Their aim was the optimization of cultivation for various flower species. In the same sense the present study,

analyzed the influence of *Dahlia* planting material represented by forced and non-forced tuberous roots on some plant morpho-decorative characteristics and settling a series of correlations between these.

## MATERIAL AND METHOD

The biologic material came from Holland, and was represented by seven cultivars of *Dahlia variabilis* with cactus type flower (factor A):  $a_1$  - 'Kennemerland',  $a_2$  - 'Tsuki Yori No Sisha',  $a_3$  - 'Hayley Jane',  $a_4$  - 'Purple Gem',  $a_5$  - 'Star Favourite',  $a_6$  - 'Park Princess' and  $a_7$  - 'Friquet'. The experimental field was situated in the Agrobotanical Garden of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. The crop was established using two types of plant material (factor B):  $b_1$  - tuberous roots started earlier in greenhouse and then planted in the field;  $b_2$  - tuberous roots that were unforced prior to planting in the field. By combining the two experimental factors with two and respectively with seven levels, resulted 14 experimental variants, using a number of 9 tuberous roots per variant. Forcing of the tubers was conducted in the didactic greenhouse of Horticulture Faculty UASVM Cluj-Napoca starting with 19<sup>th</sup> March 2015. The biologic material (forced and unforced) was planted in the field in 12 May 2015. All the observations conducted were undertaken again in 2016.

The biometrical observations regarding the morpho-decorative characteristics consisted in assessing: the average number of shoots per plant, the average height of flower stems, the average diameter of inflorescence, the average number of inflorescence per plant and the average number of ligulate florets per inflorescence. The measurements regarding the biometrical observations were made using: grade ruler (for determination of flower stems height and the diameter of inflorescence) and digital electronic caliper for measuring the inflorescence. Between the biometrical observations of plants characteristics were made a series of phenotypic correlations. The results of biometrical measurements were assessed using Duncan test at 5% level of probability (Ardelean *et al.*, 2007).

## RESULTS AND DISCUSSIONS

**The influence of planting material regarding biometrical measurements**

### *The average number of shoots per plant*

According to table 1, the number of shoots per plant for the 14 experimental variants ranges between the numeric values of 0.88 ( $V_{14}$  - 'Friquet'/unforced roots) and 5.22 ( $V_4$  - 'Purple Gem'/forced roots). The cultivar 'Purple Gem' belonging to the forced planting material, presents significant differences from the variants  $V_3$  - 'Hayley Jane'/forced roots,  $V_5$  - 'Star Favourite'/forced roots,  $V_6$  - 'Park Princess'/forced roots,  $V_7$  - 'Friquet'/forced roots,  $V_8$  - 'Kennemerland'/ unforced roots,  $V_{10}$  - 'Hayley Jane'/unforced roots,  $V_{12}$  - 'Star Favourite'/unforced roots,  $V_{13}$  - 'Park Princess'/unforced roots, respectively  $V_{14}$  - 'Friquet'/unforced roots, presents significant differences.

Variants  $V_1, V_2, V_4, V_9, V_{11}$  are different in value but the differences are not assured statistically.

Between variants V<sub>12</sub> - 'Star Favourite' and V<sub>13</sub> - 'Park Princess' belonging to non-forced planting material with a number of shoots per plant of 1.22, there were not registered values significantly inferior in comparison with the rest of experimental variants.

***The average height of flower stems (cm)***

The cultivar 'Friquolet', belonging to the experimental variant V<sub>7</sub>, registered the largest height (122.10 cm) being different in value from the variant V<sub>14</sub> - 'Friquolet'/unforced roots (105.90 cm) and also significantly superior from the variants V<sub>2</sub>, V<sub>3</sub>, V<sub>4</sub>, V<sub>6</sub>, V<sub>9</sub>, V<sub>10</sub>, V<sub>11</sub>, V<sub>12</sub>, V<sub>13</sub> (tab. 1).

The homogenous group designated by the notation "cde", specific to the variants V<sub>2</sub>, V<sub>3</sub>, V<sub>6</sub>, V<sub>12</sub> with flower stem height ranging between 43.97-53.27 cm from table 1, is different in value but not assured statistically.

Significant differences were registered between variants V<sub>3</sub>- 'Hayley Jane' (43.97 cm) and V<sub>10</sub> - 'Hayley Jane' (24.24 cm), V<sub>4</sub> - 'Purple Gem' (53.55 cm) and V<sub>11</sub> - 'Purple Gem' (21.17 cm).

Variants V<sub>10</sub> (24.24 cm) and V<sub>11</sub> (21.17 cm) present inferior differences assured-statistically from the other experimental variants.

***Average diameter of inflorescence (cm)***

Analyzing the Table 1 it can be observed that the size of flower heads for the seven cultivars studied is ranging between 4.10 (V<sub>10</sub>) -19.09 cm (V<sub>5</sub>).

Variant V<sub>5</sub>- 'Star Favourite' with inflorescence diameter of 19.09 cm is different in value from the variants V<sub>1</sub>- 'Kennemerland' (12.40 cm), V<sub>2</sub>- 'Tsuki Yori No Sisha' (18.18 cm), V<sub>4</sub>- 'Purple Gem' (14.14 cm), V<sub>9</sub>- 'Tsuki Yori No Sisha' (15.00 cm), V<sub>12</sub>- 'Star Favourite' (12.92 cm) and differs statistically from the rest of experimental variants.

Variant V<sub>10</sub> is inferior both in value and statistically, to the variants V<sub>1</sub>, V<sub>2</sub>, V<sub>4</sub>, V<sub>5</sub>, V<sub>6</sub>, V<sub>7</sub>, V<sub>9</sub>, V<sub>12</sub>, V<sub>13</sub> and V<sub>14</sub>.

Between variants V<sub>4</sub> (14.14 cm) and V<sub>11</sub> (7.55 cm) belonging to the cultivar 'Purple Gem', there are registered differences both statistically as well as in value.

Christiaens *et al.*, 2014, by forcing two cultivars of *Rhododendron simsii* in heated greenhouse (21°C) and by supplementation of light, obtained plants with high quality.

***The average number of flower heads (inflorescence) per plant***

It can be observed in Table 1, that the plants with the highest number of inflorescence per plant (157.11, 114.10, 89.60) belong to variants V<sub>7</sub> - 'Friquolet'/forced roots, V<sub>14</sub> - 'Friquolet'/unforced roots and V<sub>5</sub> - 'Star Favourite'/forced roots, the variants are non-significant statistically but different in value.

Variant V<sub>7</sub> - 'Friquolet'/forced roots presents differences both significantly and in value from the variants V<sub>1</sub>, V<sub>2</sub>, V<sub>3</sub>, V<sub>4</sub>, V<sub>5</sub>, V<sub>6</sub>, V<sub>8</sub>, V<sub>9</sub>, V<sub>10</sub>, V<sub>11</sub>, V<sub>12</sub>, V<sub>13</sub>, V<sub>14</sub>. Between variants V<sub>1</sub> and V<sub>8</sub>, V<sub>2</sub> and V<sub>9</sub>, V<sub>3</sub> and V<sub>10</sub>, V<sub>4</sub> and V<sub>11</sub>, V<sub>5</sub> and V<sub>12</sub>, there are significant differences. The smallest values were observed for the variants V<sub>8</sub> - 'Kennemerland'/unforced roots, V<sub>11</sub>- 'Purple Gem'/unforced roots and

V<sub>12</sub>-'Star Favourite'/unforced roots, these being inferior significantly different from the variants V<sub>1</sub>, V<sub>3</sub>, V<sub>4</sub>, V<sub>5</sub>, V<sub>6</sub>, V<sub>7</sub>, V<sub>9</sub>, V<sub>10</sub>, V<sub>13</sub> and V<sub>14</sub>.

Table 1

**Results regarding the influence of planting material on morpho-decorative characters of *Dahlia* plants**

No. var.	Planting material	Cultivar	Biometric observations				
			Average number of shoots/plant	Average height of flower stems (cm)	Diameter of infloresc. (cm)	Average number of infloresc./plant	Average number of ligulate florets/Infloresc.
V <sub>1</sub>	Forced tuberous roots	'Kennemerland'	3.22 abc	65.61 abc	12.40 abc	84.77 ab	114.88 efg
V <sub>2</sub>		'Tsuki Yori No Sisha'	4.55 ab	52.20 cde	18.18 ab	38.88 ef	161.89 bcd
V <sub>3</sub>		'Hayley Jane'	3.00 bcd	43.97 cde	7.22 de	45.37 de	136.95 cdef
V <sub>4</sub>		'Purple Gem'	5.22 a	53.55 bcde	14.14 ab	71.00 bcd	172.78 bc
V <sub>5</sub>		'Star Favourite'	2.99 cde	68.64 abc	19.09 a	89.60 ab	269.00 a
V <sub>6</sub>		'Park Princess'	2.22 cde	45.36 cde	10.03 bc	73.77 bc	125.56 defg
V <sub>7</sub>		'Friquolet'	2.55 cde	122.10 a	12.33 bc	157.11 a	188.37 ab
V <sub>8</sub>	Unforced tuberous roots	'Kennemerland'	1.88 de	55.83 abcd	7.77 cde	23.88 f	76.96 h
V <sub>9</sub>		'Tsuki Yori No Sisha'	3.33 ab	38.60 e	15.00 ab	20.89 g	94.12 gh
V <sub>10</sub>		'Hayley Jane'	0.99 fg	24.24 f	4.10 e	11.11 h	45.99 i
V <sub>11</sub>		'Purple Gem'	3.66 ab	21.17 f	7.55 cde	25.94 f	74.00 h
V <sub>12</sub>		'Star Favourite'	1.22 ef	53.27 cde	12.92 ab	33.44 f	140.44 bcde
V <sub>13</sub>		'Park Princess'	1.22 def	39.64 de	8.14 bcd	53.66 cd	97.85 fgh
V <sub>14</sub>		'Friquolet'	0.88 g	105.90 ab	9.55 bc	114.10 ab	182.67 ab
DS 5%			1.18- 1.39	20.71- 24.39	5.04-5.93	17.75- 20.91	37.26- 43.89

\*Note: The difference between any two values followed by at least one common letter is insignificant.

***The average number of ligulate florets per inflorescence***

The *Dahlia* cactus type cultivars present ligulate florets that are twisted lengthwise, have sharp tip either whole or bifurcated and are arranged in several whorls.

The number of ligulate florets per inflorescence is ranging between the limits 45.99 for the variant V<sub>10</sub> - 'Hayley Jane/unforced roots and 269.00 for the variant V<sub>5</sub> ('Star Favourite/forced roots). Also the variant V<sub>5</sub> was superior significantly different than most of the experimental variants. Significant inferior

difference was registered for the variant  $V_1$  compared to  $V_8$  and variants  $V_2, V_3, V_4, V_5$  present significant superior differences from the variants  $V_9, V_{10}, V_{11}, V_{12}$ .

### Results regarding phenotypic correlations between morpho-decorative characteristics at *Dahlia* cultivars studied

The results obtained after the determination of correlations between five traits: number of shoots per plant and the height of flower stems ( $a \times b$ ), number of shoots per plant and diameter of inflorescence ( $a \times c$ ), diameter of inflorescence and number of inflorescence per plant ( $c \times d$ ), number of inflorescence per plant and number of ligulate florets in inflorescence ( $d \times e$ ), number of ligulate florets and diameter of inflorescence ( $e \times c$ ), are presented in table 2.

It was calculated the correlation coefficient for an easier interpretation of the results obtained between two variables that form a bi-dimensional normal distribution. For the study of the link between the two variables there were made measurements on a number of nine plants from each cultivar. The results were compared to an occurrence probability of 5% and respectively 1% in an ideal statistical population in which between the variables there is no real connection (Ardelean *et al.*, 2007).

### Results regarding relationships between the number of shoots and height of flower stems

Characteristics regarding the number of shoots per plant and the height of flower stems enhance the esthetic appearance of *Dahlia variabilis* plants.

It can be observed in table 2, that for the variants  $V_3$  - 'Hayley Jane' (0.64),  $V_4$  - 'Purple Gem' (0.50),  $V_7$  - 'Friquet' (0.26),  $V_9$  - 'Tsuki Yori No Sisha' (0.56),  $V_{11}$  - 'Purple Gem' (0.21) and  $V_{13}$  - 'Park Princess' (0.55), the correlation coefficient has a non-significant value which means there is no reciprocal influence between the two characteristics. In the case of the cultivars 'Kennemerland' (-0.36), 'Tsuki Yori No Sisha' (-0.44), 'Star Favourite' (-0.16) belonging to forced roots category, and 'Friquet' (-0.68)/unforced root, the correlation coefficient registers negative values.

Table 2

The value of correlation coefficient (r) for five phenotypic traits in *Dahlia*

No. var.	Planting material	Cultivar	Values of (r) on phenotypic characters				
			$a \times b$	$a \times c$	$c \times d$	$d \times e$	$e \times c$
$V_1$	Forced tuberous roots	'Kennemerland'	-0.36	0.17	0.40	-0.22	-0.10
$V_2$		'Tsuki Yori No Sisha'	-0.44	-0.74°	-0.19	0.43	-0.71°
$V_3$		'Hayley Jane'	0.64	0.84**	0.64	0.98**	0.63
$V_4$		'Purple Gem'	0.50	0.05	0.17	0.36	-0.24
$V_5$		'Star Favourite'	-0.16	0.31	-0.63	0.21	-0.10
$V_6$		'Park Princess'	0.83**	0.82**	0.89**	0.64	0.71*
$V_7$		'Friquet'	0.26	0.18	-0.03	0.68*	0.27
$V_8$	Unforced tuberous roots	'Kennemerland'	0.75*	0.66	0.70*	0.64	0.79*
$V_9$		'Tsuki Yori No Sisha'	0.56	0.80**	0.31	0.53	0.91**
$V_{10}$		'Hayley Jane'	0.88**	0.76*	0.73*	0.77*	0.93**
$V_{11}$		'Purple Gem'	0.21	0.22	0.96**	0.94**	0.96**
$V_{12}$		'Star Favourite'	0.71*	0.61	0.74*	0.79*	0.78*
$V_{13}$		'Park Princess'	0.55	0.65	0.74*	0.74*	0.74*
$V_{14}$		'Friquet'	-0.68°	-0.23	-0.39	-0.71°	-0.03

n = 9 plants, P 5% = 0.67 P 1% = 0.80

\* notations: a – number of shoots, b – height of flower stems, c – diameter of inflorescence, d – number of inflorescences per plant, e – number of ligulate florets per inflorescence.

A link directly confirmed by the positive value of correlation coefficient it is registered for the variants  $V_6$  – 'Park Princess'/forced roots (0.83),  $V_{10}$  - 'Hayley Jane'/unforced roots (0.88) –significantly distinct positive and for the variant  $V_{12}$  - 'Star Favourite'/unforced roots (0.71) – significantly positive.

The cultivar 'Friquet' belonging to forced roots category stands out, because the value of correlation coefficient is negative but the result obtained is significant. This confirms the presence of a proportional inverse link (once with the increase in height it can be observed a decrease in number of shoots per plant).

***Results regarding the relationships between number of shoots per plant and the diameter of inflorescence***

The values of the correlation coefficient between the number of shoots per plant and the diameter of inflorescence in the case of the fourteenth variants studied, ranges between -0.23 and 0.84. The variants for which were registered negative values are  $V_2$ - 'Tsuki Yori No Sisha' and  $V_{14}$ - 'Friquet', these not being assured statistically. The non-significant correlation coefficient registered by the variants  $V_1$  (0.17),  $V_4$  (0.05),  $V_5$  (0.31),  $V_7$  (0.18),  $V_8$  (0.66),  $V_{11}$  (0.22),  $V_{12}$  (0.61) and  $V_{13}$  (0.65), suggest that there is no real link between the two studied characteristics. Cultivars 'Hayley Jane' (0.84), 'Park Princess' (0.82) and 'Tsuki Yori No Sisha' (0.80) have values that are distinct significantly positive from the cultivar 'Hayley Jane'/unforced roots (0.76) that has a significant positive value, suggesting the existence of an association between the number of shoots and the diameter of inflorescence. A significant value, but negative was registered also for the cultivar 'Tsuki Yori No Sisha'/forced roots (-0.74).

***Results regarding the relationships between the diameter of inflorescence and the number of inflorescence per plant***

The presence of a positive significantly distinct correlation coefficient for the variants  $V_6$  – 'Park Princess' (0.89),  $V_{11}$  – 'Purple Gem' (0.96) and significant positive for the variants  $V_8$  - 'Kennemerland' (0.70),  $V_{10}$  – 'Hayley Jane' (0.73),  $V_{12}$  – 'Star Favourite' (0.74),  $V_{13}$  – 'Park Princess' (0.74) confers to *Dahlia* a wide utilization. It is noticeable the variant  $V_{11}$  – 'Purple Gem'/unforced roots (0.96), due to its high value of the correlation coefficient. Analyzing the Table 2, it can be observed that among the variants  $V_2$  (-0.19),  $V_5$  (-0.63),  $V_7$  (-0.03),  $V_{14}$  (-0.39)  $V_1$  (0.40),  $V_3$  (0.64),  $V_4$  (0.17) and  $V_9$  (0.31) the results are not assured statistically, the correlation coefficient having both negative and positive values.

***Results regarding the relationships between the number of inflorescence per plant and the number of ligulate florets per inflorescence***

The way in which the inflorescence is distributed on plant and the way the florets are distributed within the inflorescence affect the general aspect of the plant. In this regards, it is appreciated a plant with more flower heads that are also well developed.

According to the table 2, only for the variants  $V_7$  - 'Friquet' (0.68),  $V_{10}$  - 'Hayley Jane' (0.77),  $V_{12}$  - 'Star Favourite' (0.79) and  $V_{13}$  - 'Park Princess' (0.74), the correlation coefficient has significant positive values, while for the variants  $V_3$

– 'Hayley Jane' (0.98) and V<sub>11</sub> - 'Purple Gem' (0.94), the values are significantly distinct positive, that indicates the close dependence between these two characteristics. For the variants V<sub>1</sub>, V<sub>2</sub>, V<sub>4</sub>, V<sub>5</sub>, V<sub>6</sub>, V<sub>8</sub>, V<sub>9</sub>, the correlation coefficient values are ranging between -0.22 and 0.64, the relationships between these two characteristics being no-significant correlated. There can be distinguished two variants: V<sub>3</sub> (0.98) and V<sub>11</sub> (0.94) that present correlation coefficients with high values.

In a study on four *Clematis* species Dan (2015) obtained results that were close correlated in regards with the number of flowers (or inflorescence) and the number of flowers in inflorescence, both having a decisive role in the overall landscape value of the plants. Lubovsky and Ozeri (1990) studied the effect of forcing treatment on *Ranunculus*, and identified a link between the number of buds present on the corm at planting and the better flower yield, in favor of forcing treatment for these species. Worley and Barrett (2001) studying *Eichhornia paniculata* found that all floral traits exhibited significant heritable variation (traits like flower size, daily flower number, and total flower number per inflorescence). They determined that daily flower number couldn't evolve independently from total flower number per inflorescence. In their study, genetic correlations between flower size and daily flower number ranged from negative to positive ( $r = -0.78$  to  $+0.84$ ). Also, positive correlations occurred when variation in investment per inflorescence was high and plants produced both larger and more flowers, but by comparison those that flowered later produced fewer and larger inflorescences ( $r = -0.33, -0.85$ ). Based on the results they obtained they settled that "patterns of resource allocation among inflorescences influence evolutionary changes in flower size and number per inflorescence".

Exploring the link between number of flowers per inflorescence and flower longevity for the Asian lily hybrids that were forced in growth chamber and greenhouse Van der Meulen-Muisers *et al.* (1998) identified a strong association between these two characteristics. Thus, the increase of one additional bud per inflorescence led to a decrease in the average longevity of flowers with about 0.2 days. Their results indicate that these two desirable characteristics in lily plants: the potential for the formation of a large number of floral buds per inflorescence and long individual flower longevity, are negatively correlated.

#### ***Results regarding the relationships between the number of ligulate florets in inflorescence and the diameter of inflorescence***

The correlations between the number of florets per inflorescence and the diameter of the inflorescence registered results with significantly distinct positive values for the following variants belonging to unforced planting material: V<sub>9</sub> - 'Tsuki Yori No Sisha' (0.91), V<sub>10</sub> - 'Hayley Jane' (0.93) and V<sub>11</sub> - 'Purple Gem' (0.96). For these variants, it can be affirmed that once with the increase in the number of florets in the inflorescence the diameter of the inflorescence also increases. Significant correlations can be noticed also in the case of the variants: V<sub>6</sub> (0.71), V<sub>8</sub> (0.79), V<sub>12</sub> (0.78) and V<sub>13</sub> (0.74) – significant positive and V<sub>2</sub> (-0.71) –



significant negative. Variants  $V_1$  (-0.10),  $V_3$  (0.63),  $V_4$  (-0.24),  $V_5$  (-0.10),  $V_7$  (0.27) and  $V_{14}$  (-0.03) having the non-significant correlation coefficient, suggests there is no real link between the two characteristics.

Studying the correlation between the number of flowers in inflorescence and diameter of the flower for 11 *Gladiolus* cultivars, Jucan Hort *et al.* (2015) found distinctly significant positive correlation for this traits in 'Espresso' cultivar ( $r=0.75$ ) and significantly positive correlation for the cultivar 'Oscar' ( $r=0.66$ ), indicating that an increase in number of florets per inflorescence is linked to an increase in the flower size in some *Gladiolus* cultivars. Vasconcelos and Proença (2015) in their study on the flower traits of *Myrtales* species, sustain that evidence suggests that floral display acts under energetic constraint, arguing that inflorescences with less flowers are more likely to have larger flowers than the inflorescences with many flowers. They calculated correlation coefficients between some flower size variables and the number of flowers per inflorescence. They found that the number of flowers per inflorescence showed the strongest significant negative correlation with the flower diameter.

## CONCLUSIONS

1. The planting material (forced and unforced tuberous roots) exercises different influence on the studied plant characteristics. Thus, all the cultivars with forced tuberous roots registered superior values compared to those with unforced tuberous roots.

2. By comparing the values for the number of shoots per plant, the highest value (5.22 shoots) was registered for the cultivar 'Purple Gem'/forced roots.

3. Regarding the height of the flower stems the variant  $V_7$  - 'Friquilet'/forced roots registered the highest value (122.10 cm) being superior significantly different from the other six cultivars studied.

4. The largest size of inflorescence belongs to the cultivars 'Tsuki Yori No Sisha'/forced roots (18.18 cm) and 'Star Favourite'/forced roots (19.09 cm).

5. The highest number of inflorescence per plant is cultivar 'Friquilet'/forced roots (157.11).

6. The highest number of ligulate florets per inflorescence was registered for the cultivar 'Star Favorite'/forced roots (269.00).

7. The most positive values of the correlation coefficient are registered for the variants belonging to the unforced planting material for the cultivars 'Hayley Jane', 'Purple Gem', 'Star Favourite', 'Tsuki Yori No Sisha', 'Park Princess', 'Kennemerland'.

8. In the case of the forced tuberous roots it can be observed a series of correlations with significantly distinct positive values for 'Park Princess', 'Hayley Jane', and significant positive correlation coefficient for the cultivar 'Friquilet'.

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