

Correlation analysis of different morphological characters among cultivars and hybrids of *Gladiolus hybridus* Hort.

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Abstract

The experiments focused on studying hybrids obtained from cross hybridizations and their genitors in order to observe the similarities and differences between them, regarding the correlation of some morphological characters. The research field was established in 2016 and the 3 genitors from which 2 hybrids were obtained, were studied. The plants were measured in full flowering phenophase, and after the corms were removed from the soil. The experiments were organized in randomized blocks having three repetitions. Multiple correlations between 7 morphological characters were made and positive (diameter of the corm x weight of the corm) and negative (CW x PH) values of the correlation coefficient were obtained. In Madonna cultivar, positive r values are ranging between 0.36-0.46, the weight of the corm has a direct and positive influence on the number of flowers, length of the inflorescence and the height of the plant.

Key words: morphological traits, corm, correlation coefficient, genotype,

1. Introduction

The genus *Gladiolus* is classified in the family Iridaceae and includes approximately 255 species (P. GOLDBLATT, AND J. MANNING [7]). *Gladiolus* is known as queen of the bulbous plants being appreciated in garden displays as well as cut flower (J. C. M. BUSHMAN [3]). *Gladiolus* bulbs, in botanical terminology, are referred to as corms, the main propagating material in gladiolus. A corm is a shortened and thickened section of the stem that appears at the base of the plant. Corms and cormels as the common propagule of *Gladiolus* have high commercial value (T. B. POON et al. [12]). Yield of corm and cormel is affected depending upon genotype and agro-climate (S. C. SHARMA & A.N. SHARGA [15]).

Evaluation of different genotypes of *Gladiolus* for corm and cormel production is indispensable to select desirable parents to utilize for hybridization program (T. B. POON et al. [12]). The corm and cormel production was studied by analyzing the correlations to establish the influence of 16 morphological characters on the corm yield (P. SANGHAMITRA et al. [15]). Correlation analysis shows the intensity of dependence (correlation) between studied traits. From the genetic aspect, correlation indicates links between genes (N. DJURIC et al. [6]). Correlation study provides beneficial information regarding the interrelationship of quantitative traits among each other and influence of these traits on yield, thereby aid in selection (T. VETRIVEL et al., [18]). Positive correlations were

found between some morphological characters like: Floret size was positively correlated with number of leaves per plant, rachis length, leaf area, number of florets open at a time (CHOUDHARY et al. [5]). Number of cormels per plant were positively associated with floret size (1.025 and 0.545), number of florets per spike (0.614 and 0.501), duration of flowering (0.431 and 0.247) and weight of corms per plant showed positive significant association only with vase life at genotypic (0.789) and phenotypic (0.597) level (T. THAKUR AND K. K. DHATT [17]).

Considering the present status, it is necessary for future improvement both for quantitative and qualitative characters to exploit native and exotic demand. The success of breeding depends on the morphological variability, which varies thru it's genotypes (M. D. HOSSAIN et al. [8]). Genotypic factors, are directly or indirectly influenced by some environmental factors (temperature, humidity, rainfall, wind speed, soil texture, soil topography) as reported by several investigators (M. D. HOSSAIN et al. [8]). For exemple, a positive correlation $r = (+)$ 0.99 between temperature and number of florets and spike length was reported (A.G. MCCALLA at al. [10]). And also, a strong relationship was proven by R.S. SAINI et al. [14], when associating the time of planting to flowering and cormel production (K. NAGAR [11]).

The aim of this research was to assess information that suggests the relationship between the underground system of the *Gladiolus hybridus* plants and the phonological manifestation of the morphological characters. These data can be helpful for the breeding program and also to increase the quality and quantity of crops.

2. Materials and Methods

The experiments were conducted in the fields of the Ornamental Plant Department of UASVM Cluj-Napoca. The *Gladiolus hybridus* culture has been established in 2016 using the following varieties (used as genitors in the cross hybridization process) and some hybrids obtained: H6 hybrid, obtained thru cross hybridization between Nova Lux (♀) and Fidelio (♂) and H7 hybrid obtained from Nova Lux (♀) and Madonna (♂) (figure 1). The experiments were organized in randomized blocks having three repetitions. The physiological measurements were taken when the plants achieved the full flowering phenophase including the followings: plant height (PH), inflorescence length (IL), flower number (FN), flower diameter (FD), corm diameter (CD), corm perimeter (CP) and corm's weight (CW); these measurements were considered to be the most relevant to provide useful information about the successful cultivation of *Iris* plants in Cluj area.



Figure 1: Corm and cormels of studied hybrids

The corms were measured in autumn, at the end of the vegetative period, when they were removed from the soil. The different phenological characters were correlated separately for each cultivar by using Pearson's correlation coefficients (BOLBOACA [1]) in order to determine the relationships between the investigated variables.

3. Results and discussion

Among all the cultivars used in this experiment, H6 hybrid proved to be the most suitable hybrid that can grow in temperate climate conditions and is able to produce a high number of flowers with a great ornamental value. The results show that, there is a strong, positive correlation ranging between the weight of the corm and the ornamental value of the plant, being represented by plant height, flower stalk and flower dimensions as presented in Table 1. By correlating the weight of the corm with the other 6 analyzed characters, other strong and positive correlations has been revealed, which means that this character has a direct positive influence on the no. of flowers/stalk (0.72) and the weight of the corm (0.68). Similarly, positive but weaker relationships were found between the corm's weight and inflorescence length (0.53) or the diameter of the flowers (0.51).

Based on the Pearson's correlation coefficient in Fidelio cultivar, it can be observed that that the relationships between corms's weight on the studied physiological traits are different from those observed in H6 hybrid. A moderate downhill correlation can be observed between the corm's weight and plant height. Inflorescence length, flower number and flower diameter as well, as presented in Table 2. This result indicates that bigger the corm is, the smaller the regeneration capacity and ornamental values provided of this species are, which can be explained by the lowered capacity of regeneration due to advanced age of the corm. Similar correlations were found by M. CHOUDHARY et al. [5].

Table 1: Pearson's correlation coefficients (r) for the 7 physiological traits investigated in H6 hybrid

Physiological traits	PH	IL	FN	FD	CD	CP	CW
PH	1						
IL	0.94	1					
FN	0.89	0.84	1				
FD	0.94	0.95	0.80	1			
CD	0.17	0.30	0.32	0.24	1		
CP	0.34	0.38	0.41	0.35	0.94	1	
CW	0.68	0.53	0.72	0.51	0.64	0.42	1

Table 2: Pearson's correlation coefficients (r) for the 7 physiological traits investigated in Fidelio cultivar

Physiological traits	PH	IL	FN	FD	CD	CP	CW
PH	1						
IL	0.59	1					
FN	0.35	0.50	1				
FD	0.35	0.65	0.48	1			
CD	0.28	0.56	0.13	0.10	1		
CP	0.16	0.51	0.08	0.05	0.95	1	
CW	-0.37	-0.12	-0.02	-0.34	0.75	0.30	1

Nova Lux hybrid through its growth parameters showed weak positive correlations between corm's weight and inflorescence's height and plant height respectively, and moderate positive correlation coefficients were obtained between the corm's weight and flower number developed on the flower stalk, ranging from 0.35 to 0.64 as summarized in Table 3.

The weight of corm and cormels may show positive results in a correlation with the diameter of corm and could be due to the fact that larger corms might have deposited more food resulting into their correspondingly heavier weight and vice versa (R. KUMAR & D.S. YADAV [9], R.B. RAM et al. [13] and L.G.B. BHUJBA et al. [2]).

Table 3: Pearson's correlation coefficients (r) for the 7 physiological traits investigated in Nova Lux cultivar

<i>Physiological traits</i>	<i>PH</i>	<i>IL</i>	<i>FN</i>	<i>FD</i>	<i>CD</i>	<i>CP</i>	<i>CW</i>
<i>PH</i>	1						
<i>IL</i>	0.37	1					
<i>FN</i>	0.64	0.71	1				
<i>FD</i>	-0.13	-0.56	-0.61	1			
<i>CD</i>	-0.50	-0.36	-0.37	0.38	1		
<i>CP</i>	-0.48	-0.39	-0.41	0.37	0.98	1	
<i>CW</i>	0.35	0.39	0.33	-0.22	0.56	-0.63	1

Table 4: Pearson's correlation coefficients (r) for the 7 physiological traits investigated in Madonna cultivar

<i>Physiological traits</i>	<i>PH</i>	<i>IL</i>	<i>FN</i>	<i>FD</i>	<i>CD</i>	<i>CP</i>	<i>CW</i>
<i>PH</i>	1						
<i>IL</i>	0.54	1					
<i>FN</i>	0.50	0.66	1				
<i>FD</i>	0.21	0.10	-0.20	1			
<i>CD</i>	0.08	-0.17	-0.20	-0.29	1		
<i>CP</i>	0.07	-0.16	-0.24	-0.32	0.98	1	
<i>CW</i>	0.46	0.38	0.36	0.24	0.58	-0.19	1

In Madonna cultivar, positive Pearson's correlation coefficients were found ranging from 0.36-0.46 as the corm's weight positively influenced the number of flowers, length of the inflorescence and the height of the plant, respectively as shown in Table 4.

Table 5: Pearson's correlation coefficients (r) for the 7 physiological traits investigated in H7 hybrid

<i>Physiological traits</i>	<i>PH</i>	<i>IL</i>	<i>FN</i>	<i>FD</i>	<i>CD</i>	<i>CP</i>	<i>CW</i>
<i>PH</i>	1						
<i>IL</i>	0.74	1					
<i>FN</i>	0.44	0.47	1				
<i>FD</i>	0.49	0.47	0.10	1			
<i>CD</i>	0.49	0.55	0.49	0.34	1		
<i>CP</i>	0.40	0.53	0.36	0.49	0.94	1	
<i>CW</i>	0.13	0.14	-0.58	0.64	0.64	0.65	1

The variation in size index of corms of different varieties might be due to the differences in diameter and thickness of corms that could be due to variations in their genetic setup leading to differential growth of corms in horizontal (diameter) or vertical (thickness) axis (A. CHOURASIA et al. [4]).

In Table 5, the Pearson's correlation coefficients are presented for H7, indicating a strong, negative and positive relationships between the corm's weight and flower number and flower diameter respectively. These results also confirm the lowered capacity of blooming of this species being negatively affected by the corm's weight and age. It can also be observed that, the lower the number of flowers are, the bigger their size are – traits that can define the use of these species in green areas.

4. Conclusion

Strong positive influences can be observed among the morphological traits of the aerial part of the *Gladiolus hybridus* plans, both for cultivars and hybrids. Positive correlation between the dimensions of the corm were found ranging from 0.56 (H6 and Nova Lux cultivar) - 0.75 (Fidelio cultivar) for the relationship between the diameter of the corm x weight of the corm. But, in what concerns the direct relation between the dimensions of the corm to the manifestation of the aerial part of the plant, low to medium values of r were obtained ($r = 0.08$ to 0.56). Therefore, other factors that the dimensions of the corm (like ecological conditions, genotype) may have a stronger influence on the morphological traits of the glads, and, regarding the morphological characteristics of the corm, it's might be governed by the genotypic makeup of the varieties, as the number of corms produced per plant appeared to be negatively correlated to corm diameter (R. KUMAR & D. S. YADAV [9]). It might be due to partitioning of the food material and its less availability for accumulation into individual corm (A. CHOURASIA et al. [4]).

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