Heritability of Quantitative Traits with an Important Role for Improving *Gladiolus hybridus* Assortment

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Abstract

The purpose of the experiments is to estimate the variability and the heritability for some hybrid combinations of *Gladiolus* by calculating the coefficient of variation and the heritability in broad sense (H^2) and in narrow sense (h^2) for 5 ornamental characters. Knowing that a low value of the coefficient represents the guaranty that the morphological trait will be transmitted to descendents, the results are useful for the selection of elites. The present investigation was developed during 2012 - 2013 at UASVM Cluj-Napoca. The results show medium variability for most of the analyzed characters, while high heritability in broad sense was recorded to all the cyclic combination used in the experiments. Furthermore, the value of the H^2 was completed by the values of h^2 ranging between 0.360-0.677.

Keywords: *coefficient of variation, characters, direct selection, hybrids.*

INTRODUCTION

In the modern era, floriculture is gaining importance as a good source of income apart from giving pleasure and happiness. In this regard, *Gladiolus* or sword lily (*Gladiolus* spp.) has gained much importance as a cut flower or for garden display (Bhajantri, 2006).

Gladiolus is widely cultivated, economically important flowering plants. The luxuriance unique colorful spikes of some height demanding *Gladiolus* cultivars have attained immense importance in the community of flower lovers (Nasir *et al.,* 2012).

The modern *Gladiolus* cultivars offer a diversity of colors, shapes, and sizes available in few other flowering plants. It is cultivated in almost all countries of the world where spring and summer conditions are favorable (Cantor and Tolety, 2011).

Gladioli know a revolution in the assortment plan by introducing in culture forms from South Africa and crossing them with European ones (Munteanu and Fălticeanu, 2008).

Most of the economically important ornamental plants are cut flowers, which are produced by vegetative propagation. For many years, new varieties of ornamental plants have been produced by cross-hybridization and mutation breeding techniques, separately or in combination (Shibata, 2008).

It is important to study the performance of existing cultivars for their superior desirable characters (Swaroop, 2010). The morphological character of *Gladiolus* varies due to its genotypes (Hossain *et al.,* 2011).

Researches regarding the heritability and the coefficient of variation were made by researchers like Mahesh Choudhary *et al*, 2012, who reported high heritability and high genetic advance for number of cormels per plant, weight of cormels per plant, leaf area, number of spikes per plot, number of corms per plot, number of florets remaining open at a time, number of spikes per plant, leaf width, spike diameter, weight of corm, rachis length, vase life of spike, number of corms per plant and plant height.

Balaram *et al.* (2000) observed that genotypic and phenotypic variance had higher values for plant height, spike length, spike weight, weight of

daughter corm and number of cormels per corm. Genotypic variance was low for number of shoots per plant (0.91), number of leaves per shoot (1.25), floret diameter (2.49), floret length (2.09), number of spike per corm (0.87), number of side shoots per plant (0.18). Almost all the characters had higher heritability estimates.

Bichoo *et al.* (2002) observed that high genotypic coefficient of variations for number of cormels per plant and less cormel weight in *Gladiolus* indicated the presence of sufficient genetic variability for selection and high heritability and high genetic advance for days taken for basal floret opening, plant height and number of florets per spike (Bhajantri, 2006).

In 2004, Patil A. *et al*. reported that high heritability with high genetic advance was observed in hybrids for traits like spike weight, number of cormels per plant, weight of daughter corm and dormancy period of corm, which indicates usage of these for varietal improvement.

MATERIALS AND METHODS

The present investigation was developed during 2012-2013 at the Department of Floriculture at UASVM Cluj-Napoca, on the didactical collection of *Gladiolus hybridus.* There were used three cyclic combinations to observe the heritability of the height of the plant, the length of the stem and the inflorescence, the diameter of flower, and the number of flowers per inflorescence. The crop was raised by following the recommended agronomic practices. The data collected from the field using measurement instruments were processed using Excel 2007 software.

To obtain the coefficient of variation for the main characters were calculated: s and s^2 cited by Ardelean, 2010, and the results were comprised in Tables 1, 2, 3.

The values of heritability coefficient in narrow sense (h^2) were determined by calculating the coefficient of regression of F_1 hybrids using the parental mean, knowing that h^2 represents the absolute value of the coefficient of regression (Ardelean, 2007). The results were interpreted using the student test. For the coefficient of heritability in broad sense and in narrow sense and for the interpretation of results, were used the formulas published by Ardelean *et al*. (2007).

RESULTS AND DISCUSSIONS

The results from Table 1 show that, concerning the combination of Nova Lux with Fidelio and Madonna, for all the characters, the data show medium and high variability, the values range 15.4 - 23.3. In only one case was registered very high variability with a coefficient of 39.7 and the difference is distinct significant. Regarding the diameter of flowers, results show medium coefficient of variability that is very close to the control variant reaching very significant values for both combinations.

Considering the average of the experience as control, can observe from the data included in Table 2 that only in the combination of 'White Prosperity' (maternal parent) with 'Praha' (paternal parent) the results have no significance. The lowest CV% value appears at the diameter of flower (4.2%) which means that the variability is very low and the character can be transmitted from the parents to the F_2 generation. The plant height and the spike length are characters that registered medium variability, having the CV% values between 13.7 and 19.4, in the case of this combinations. Great variability was registered on characters as stem length where the results are significant for the combination of 'White Prosperity' with 'Plumtart' (negative significance) and 'Praha' (almost positive significance), and for number of flowers/inflorescence, only for the combination of 'White Prosperity' with 'Plumtart', the results presented negative significance.

Regarding the combination where 'Madonna' is the paternal parent and 'Cipriana' and 'Nova Lux' are the maternal ones (Tab. 3), the results show that low variability is registered only in the case of 'Cipriana' for the spike length (CV% = 9.1) and the diameter of flowers (CV% = 5.4), and this results are significant and distinct significant comparing to the average of the experience. Therefore, the character is stable and the descendents can inherit this character. Medium values were also registered for the plant height, stem length, number of flowers, but not all the results were statistically ensured. The greatest variability was registered on the combination 'Nova Lux' x 'Madonna', but, comparing to the Control variant, there are no significant results excepting the diameter of flower in which case the differences are distinct significant.

Tab. 1 Values of coefficient of variation on 'Nova Lux' hybrid combination regarding the analyzed characters

Character	No. 1. Cyclic hybrid combination ♀ x ♂		Average height (cm)	% Value	Difference (cm)	t Value	Signif.	CV%
Plant height	Nova Lux	Fidelio	74	93.7	-4.92	-0.7	oo	15.4
		Madonna	83.8	106.2	4.92	0.6	xx	20.4
	Mean of exper. (Ctrl)		78.9	100	-	-	-	19.7
Stem lenght	Nova Lux	Fidelio	58.2	89.5	-6.82	-1.0	o	20.3
		Madonna	71.83	110	6.82	0.8	x	23.3
	Mean of exper. (Ctrl)		65	100	-	-	-	17.9
Spike lenght	Nova Lux	Fidelio	31.6	94.8	-1.7	-0.5	oo	13.9
		Madonna	35	105.1	1.7	0.3	xx	39.7
	Mean of exper. (Ctrl)		33.3	100	-	-	-	26.8
No. of flowers	Nova Lux	Fidelio	10.2	80.3	-2.57	-1.9	o	21.3
		Madonna	15.3	120.4	2.57	2.1	x	12.1
	Mean of exper. (Ctrl)		12.7	100	-	-	-	16.7
Diameter of flowers	Nova Lux	Fidelio	7.4	100	0.01	0.01	ooo	14.6
		Madonna	7.4	100	-0.01	-0.01	xxx	16.3
	Mean of exper. (Ctrl)		7.4	100	-	-	-	15.4

Tab. 2 Values of coefficient of variation on 'White Prosperity' hybrid combination regarding the analyzed characters

Character	No.2. Cyclic hybrid combination ♀ x ♂		Average height (cm)	% Value	Difference (cm)	t Value	Signif.	CV%
Plant height	White Prosperity	Plumtart	83.8	90.69	-14.0	-2.4	o	15.0
		Praha	101.0	109.30	14.0	2.0	x	13.7
	Mean of exper. (Ctrl)		92.4	100	-	-	-	14.3
Stem lenght	White Prosperity	Plumtart	64.8	81.10	-15.1	-2.1	o	22.2
		Praha	95.0	118.89	15.1	1.7	(x)	21.8
	Mean of exper. (Ctrl)		79.9	100	-	-	-	22.0
Spike lenght	White Prosperity	Plumtart	33.1	81.7	-7.4	-2.3	o	19.4
		Praha	47.9	118.27	7.4	2.0	x	16.4
	Mean of exper. (Ctrl)		40.5	100	-	-	-	17.9
No. of flowers	White Prosperity	Plumtart	10.5	84.67	-1.9	-1.8	o	21.6
		Praha	14.4	116.12	1.9	1.4	n.s.	22.3
	Mean of exper. (Ctrl)		12.4	100	-	-	-	22.0
Diameter of flowers	White Prosperity	Plumtart	11.5	117.34	1.7	3.6	xx	4.2
		Praha	8.1	82.65	-1.7	-2.9	oo	13.7
	Mean of exper. (Ctrl)		9.8	100	-	-	-	8.9

Tab. 3 Values of coefficient of variation on 'Madonna' hybrid combination regarding the analyzed characters

Character	No. 3. Cyclic hybrid combination ♀ x ♂		Average height (cm)	% Value	Difference (cm)	t Value	Signif.	CV%
Plant height	Nova Lux	Madonna	83.8	90.69	-8.6	-1.1	n.s.	20.4
	Cipriana		101.0	109.3	8.6	1.6	(x)	10.2
	Mean of exper. (Ctrl)		92.4	100	-	-	-	15.3
Stem lenght	Nova Lux	Madonna	71.8	90.42	-7.5	-1.0	n.s.	23.3
	Cipriana		86.9	109.4	7.5	1.6	(x)	10.8
	Mean of exper. (Ctrl)		79.4	100	-	-	-	17.0
Spike lenght	Nova Lux	Madonna	35.0	82.1	-7.6	-1.2	n.s.	39.7
	Cipriana		50.2	117.8	7.6	2.2	x	9.1
	Mean of exper. (Ctrl)		42.6	100	-	-	-	24.4
No. Of flowers	Nova Lux	Madonna	15.3	99.3	-0.1	-0.1	n.s.	12.1
	Cipriana		15.6	101.3	0.1	0.1	n.s.	14.8
	Mean of exper. (Ctrl)		15.4	100	-	-	-	13.5
Diameter of flowers	Nova Lux	Madonna	7.4	69.8	-3.2	-3.2	oo	16.3
	Cipriana		13.8	130.2	3.2	3.5	xx	5.4
	Mean of exper. (Ctrl)		10.6	100	-	-	-	10.8

Tab. 4 Heritability for cyclic combinations regarding total height

No. of cyclic combination	Sex	Heritability coefficient	
		Heritability in broad sense (H^2)	Heritability in narrow sense (h^2)
1.	♀	0.935	0.638
2.	♀	0.952	0.407
3.	♂	0.857	0.396

Tab. 5 Heritability for cyclic combinations regarding stem height

No. of cyclic combination	Sex	Heritability coefficient	
		Heritability in broad sense (H^2)	Heritability in narrow sense (h^2)
1.	♀	0.910	0.601
2.	♀	0.930	0.387
3.	♂	0.835	0.372

In tables 4, 5, 6, 7, 8 were presented the results for the coefficient of heritability in broad sense and in narrow sense for each one of the five studied characters for all three of the cyclic analyzed combinations. Regarding the total height of the plants, the heritability in broad sense presents height and very height values, exceeding 85%, therefore, can conclude that the characters were influenced by the genotype.

In table 5 are presented the coefficient of heritability for the stem length, that reaches values height between 0.83 to 0.93, but, only in the case that 'Nova Lux' (No. 1) is the maternal parent, the result is correlated with a height variability in narrow sense, therefore, the efficiency of phenotypic variance is increased. In the case of the other two combination, even the H^2 is height, the h^2 has low values, which suggests that only a small part of the genotypic variance is due to the additive variance.

Tab. 6 Heritability for cyclic combinations regarding inflorescence length

No. of cyclic combination	Sex	Heritability coefficient	
		Heritability in broad sense (H^2)	Heritability in narrow sense (h^2)
1.	♀	0.961	0.677
2.	♀	0.951	0.406
3.	♂	0.906	0.451

Tab. 7 Heritability for cyclic combinations regarding the number of flowers

No. of cyclic combination	Sex	Heritability coefficient	
		Heritability in broad sense (H^2)	Heritability in narrow sense (h^2)
1.	♀	0.903	0.591
2.	♀	0.900	0.360
3.	♂	0.037	"F" non significant

Tab. 8 Heritability for cyclic combinations regarding the diameter of flowers

No. of cyclic combination	Sex	Heritability coefficient	
		Heritability in broad sense (H^2)	Heritability in narrow sense (h^2)
1.	♀	0.940	0.645
2.	♀	0.988	0.439
3.	♂	0.994	0.549

Analysing Tab. 6 can affirm that the height values of H^2 suggests a great participation of the genotype in the manifestation of the characters, with the higher value of 0.96. Also, the medium to high values of h^2 suggests that some of the genetic variance is due to the additive variance. Having such a great values of H^2 is very good for the phenotypic selection of those characters, but the datas must be completed by the results of heritability in narrow sense. The values of the h^2 range between 0.45-0.67.

Regarding the number of flowers per inflorescence, for the combination where 'Nova Lux'(No. 1) and 'White Prosperity' (No. 2) are the maternal parent, the H^2 is height and the h^2 has a medium value, suggesting that total genotypic variance will be carry out to descendents. For the combination where 'Madonna' (No. 3) is paternal genitor, the heritability in broad sense has a very low value and the heritability in narrow sense could not be calculated because the "Fisher" test had non significant vales (were negative), therefore, the results are not clinching.

From all the studied characters the 'White Prosperity' (No. 2) and 'Madonna' (No. 3) combinations, the diameter of flower has the greatest values 0.94 and 0.99. furthermore, the results are completed with a medium to high variability in narrow sense which means that the additive genetic variance has an important role in the hereditary process.

CONCLUSION

Using direct selection, some qualitative characters can be transmitted to descendents and so can improve the assortment of *Gladiolus hybridus.* The correct selection of genitors has an important role for the success of hybridization and a detailed knowledge of the characteristics of initial material is required.

Finding the value of the CV% is an important aspect in the varietal improvement of *Gladiolus* assortment because the selection of elites is made based on this coefficient. It is known the fact that a medium value of CV% shows that the heritage of characters from the genitors is influenced

by the environmental conditions and applied agrotechnics.

Knowing that the value of H^2 for all the ornamental characteristics of the three analyzed combinations is high, a genotypic breeding can be used in the selection process, using crossings between the most valuable individuals, and acting in the same time by ensuring the ecological conditions necessary for the development of *Gadiolus* flowers.

In all the cases studied, the coefficient of heritability in broad sense has great values varying between 0.90- 0.96 for the combination where 'Nova Lux' is the maternal parent and 0.90-0.98 in the case that 'White Prosperity' is the maternal parent. Therefore, in more than 90% of the cases, the morphological characters were influenced by the genotype.

Even if the heritability in broad sense is height, the values must be accompanied by low values of heritability in narrow sense. If not, the results suggest that some of the genetic variance is due to the additive variance, meaning that the environment had high influence on the growing and development of plants.

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