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VEGETATIVE AND REPRODUCTIVE CHARACTERISTICS OF DIFFERENT GENOTYPES OF GLADIOLUS FLOWER

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Abstract

The experiment was carried out during November 2013 to May 2014 in commercial flower garden of Society and Human Development Organization Tangail (SAHDOT), Village-Shota Gobra, Upazilla-Mirzapur, and District-Tangail to investigate the vegetative and reproductive characteristics of different genotypes of gladiolus flower. The experiment included five gladiolus genotypes. The characteristics in the study included plant height, length and breadth of leaf, number of leaves plant^{-1}, length of flowers, breadth of flower, weight of flower, weight of single stick, length of spike, length of rachis, flowers plant^{-1}, days to reach 50% spike initiation, capsule and seed. The results indicated the existence of wide variability among the genotypes on their vegetative and reproductive characteristics along with yield and yield attributes. The plant height of white genotype was the highest (60.25 cm) and the orange genotype was the lowest (45.00 cm), respectively due to genotypes. The length of leaf was recorded the highest (41.75 cm) in white genotype and while the shortest length (34.32 cm) was recorded for red one. The breadths of leaves were highest (3.04 cm) in yellow and the lowest (1.55 cm) in orange genotype. The average number of leaves was the highest (12.30) in white genotype which is followed by red, violet, orange and yellow, respectively. Genotypes varied from 59.61 to 92.00 cm and 25.60 to 47.20 cm in spike length and rachis length, respectively. Number of flower was the highest (14.30) in white and the lowest (8.42) in orange genotype. Considering crossing parameters, variations were observed for length of capsule, breadth of capsule, number of seeds capsule^{-1} and weight of thousand seeds. Data indicated that all the crosses produced more or less gladiolus true seed. The number of seeds capsule^{-1} ranged from 15.10 to 38.45. The highest number of seeds capsule^{-1} (38.45) was produced by the cross Yellow × Red while the lowest number of seeds capsule^{-1} (15.10) was produced by the cross Violet × Red. The results clearly indicated that the white genotype has the best planting materials which may be planted for luxuriant growth of plants and production of excellent flowers and for production of true seed the cross Yellow × Red is the best cross.

Keywords: Gladiolus, *Gladiolus grandiflorus*, genotype, crossing, true seed

Introduction

The name gladiolus (*Gladiolus grandiflorus* L.) has been derived from the Latin word gladius, meaning a sword as it has sword shaped leaves. So, gladiolus popularly known as sword lily is an ornamental bulbous plant native to South Africa (Sharma and Sharma, 1984). Butt (2005) reported that gladiolus is now using as cut flowers vary widely in the continent of Europe, particularly in Holland, Italy and Southern France. Gladiolus was introduced in Bangladesh around 1992 from India (Mollah *et al.* 2002). It has recently been become popular in Bangladesh. Its demand has been increasing day by day with the advancement of aristocracy and modernization in Bangladesh. Commercial cultivation of gladiolus is gaining popularity due to export potentials and prevalence of favorable growing conditions in different parts of the country having some suitable factors. Gladiolus is one of the most important bulbous cut flowers in the flower industry. It occupies eighth position in the world cut flower trade and has a global history (Ahmad *et al.* 2008). Gladiolus flowers have occupied the importance in Bangladesh for three main considerations namely aesthetic, economic, and social. Considering the present status, it deserves necessity for

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future improvement both for quantitative and qualitative characters to exploit native and exotic demand. The success of improvement depends mainly on the morphological variability. The morphological character of Gladiolus varies due to its genotypes. Rao and Negi (1994) studied the variability on 12 biometric characters in gladiolus and found the highly significant differences due to genotypes. Negi and Raghava (1986) observed a higher phenotypic co-efficient of variation than the corresponding co-efficient of variation for plant height, flower number, spike length, spike diameter and rachis length. Negi *et al.* (1978) conducted an experiment in gladiolus and concluded that the maximum variability was observed for plant height, corm number and flower yield. The morphology of gladiolus differs from genotype to genotype. Morphological variability is the essence of any planned crop improvement program. It is well established that the greater the genetic diversity the higher the chance of getting better hybrid or recombinant. Selection of better plant type from the collected germplasm can be of immense value to the breeder for improvement of this crop. Further, knowledge of relationship among yield and yield contributing characters is an effective basis for phenotypic selection in plant population (Anuradha and Gowdha, 1994). Gladiolus is propagated both sexually by seeds and asexually by corm and cormels. Gladiolus is largely propagated by corms and cormels. Seed propagation is followed to evolve new cultivars. The plants raised from seeds require four seasons to come to bloom under ordinary conditions and under best cultural treatments it may be reduced to two seasons. In Bangladesh there is lacking in scientific research on the improvement of gladiolus flower. On the other hand, limited availability of quality improved seed hampers the cultivation of gladiolus flower. At present, most flower seeds are imported particularly from India and Europe. Keeping the foregoing problems in view, present investigation and research was undertaken to compare the variability among the genotypes and to find out the suitable genotypes of gladiolus flower for increasing the production of flower and true seed in order to meet the demand of gladiolus flower.

Materials and Methods

The present experiment was carried out at the commercial flower garden of Society and Human Development Organization, Tangail (SAHDOT) during November 2013 to May 2014 to investigate vegetative and reproductive characteristics of different gladiolus genotypes. The experiment included five gladiolus genotypes. The studied characteristics were plants height, leaves, flowers, capsule and seed. The experiment was laid out in a Randomized Complete Block Design (RCBD) each having five replications. The unit plot size was 2 m × 1 m. The experimental plot was opened in the first week of November 2013 with a power tiller and was exposed to the sun for a weak. After a week, the land was prepared by several ploughing and cross ploughing followed by laddering and harrowing with power tiller and country plough for good tilth. The experimental plot was fertilized at the rate of 10 tons of Cowdung, 200 kg of Urea, 200 kg of Triple Super Phosphate (TSP) and 190 kg of Muriate of Potash (MoP). Cowdung, TSP and MP were applied as basal dose during the final land preparation and incorporated into the soil, but urea was applied two installments as top dressing. Half of the urea were applied after emerging 4 leaves and the rest half of the urea were applied after emerging 6-7 leaves (before flowering) of the plants. Medium sized corms were planted at 6 cm depth in furrows following the row to row spacing of 25 cm and plant to plant spacing of 15 cm. Weeding was done in the soil whenever it was necessary to keep the soil free from weeds. The irrigation was given 10-15 days interval after sowing the corms. Earthing up was done twice during growing period. The first earthing up was done at 25 days after sowing and the second earthing up was done after 45 days after sowing. Stacking was done during flowering stage of plants by 80 cm long bamboo sticks to facilitate the plant to keep erect. To control insects Malathion-57 EC @ 2 ml liter^{-1} of water was applied. Ridomil 2 g liter^{-1} of water was sprayed the plants as protective measures against fungal disease when necessary. Diallel crosses were conducted to produce true seed. Harvesting was done depending upon the maturity of crop varieties and their F_1s. The data were recorded on ten randomly selected plants for each genotype from each replication. Plant height, length and breadth of leaf, number of leaves plant^{-1}, length of flowers, breadth of flower, weight of flower, weight of single stick, length of spike, length of rachis, flowers plant^{-1}, days to 50% flowering, days to maturity, number of capsules plant^{-1}, number of seeds capsule^{-1}, 1000 seed weight and seed yield plant^{-1} were recorded. The recorded data on the selected parameters were set for statistical analysis. The mean, SD and CV of collected data for each treatment was calculated by using software Microsoft Excel.

Results and Discussion

The studied parameters were plant height, leaf, flowers, capsule and the results of study are presented and discussed under different headings as shown below:

Plant height

The plant height varied enormously due to genotype (Table 1). The tallest plant (60.25 cm) was in white and the shortest one was in orange (45.00 cm). The mean plant height and CV (%) were observed 52.16 cm and 12.98, respectively. The variation observed in plant height among the genotypes might be due to difference in genetically constituents as well as environmental effects.

Length of leaves

Leaf length was affected by genotypes and varied from 34.32 to 41.75 cm (Table 1). The longest leaf (41.75 cm) was recorded in white followed by violet (41.15 cm), yellow (40.25 cm) and orange (35.55 cm), while the shortest one was recorded for red (34.32 cm). The mean leaf length and CV (%) were observed 38.60 cm and 8.86 respectively. Wide variation in leaf length amongst some genotypes of gladiolus was observed by Singh and Dadlani (1990).

Table 1. Vegetative characteristics of different genotypes of gladiolus

Genotypes	Color of genotypes	Plant height (cm)	Length of leaves (cm)	Breadth of leaves (cm)	No. of leaves plant^{-1}
GL-21	White	60.25	41.75	2.70	12.30
GL-04	Yellow	58.50	40.25	3.04	8.55
GL-16	Orange	45.00	35.55	1.55	8.75
GL-12	Violet	48.55	41.15	2.64	8.77
GL-22	Red	48.50	34.32	2.52	10.92
Mean		52.16	38.60	2.49	9.85
St. Dev.		6.77	3.42	0.56	1.67
CV (%)		12.98	8.86	22.48	16.98

Breadth of leaves

There was variation (1.55 to 3.04 cm) in leaf breadth amongst the genotypes (Table 1). The yellow genotype attained the highest leaf breadth (3.04 cm), which was followed by white genotype (2.70 cm), violet (2.64 cm) and red (2.52 cm). Breadth of leaf was found to be the lowest in orange (1.55 cm). The mean breadth of leaves and CV (%) were observed 2.49 cm and 22.48, respectively. Bhagur (1989) recorded significant variation in respect of leaf breadth amongst thirty genotypes of gladiolus. He found that leaf breadth varied from 1.3 to 4.5 cm.

Number of leaves

Significant variation was observed as to the number of leaves amongst the genotypes (Table 1). The highest number of leaves (12.30) was obtained from the white genotype which was followed by red genotype (10.92), violet (8.77) and orange (8.75) whereas in yellow genotype gave the lowest number of leaves (8.55). The average number of leaves was 9.85. This variation might be due to genotype.

Days to reach 50% spike initiation

Marked differences were observed for days to 50% spike initiation amongst the genotypes under investigation (Table 2). The yellow genotypes took the highest days (69 days) to reach 50% spike initiation which was followed by orange (68 days) and red (66 days). The lowest number of days (60 days) was taken by the white genotype and which was closely followed by violet genotype (61 days). The average days to reach 50% spike initiation and CV (%) were observed 64.80 and 6.31, respectively. In a varietal trial, Ashwath and Parthasarathy (1994) reported that the white varieties required 40-70 days to 50% spike initiation which was in consonance with majority of the genotypes under investigation. Singh and Dadlani (1990) recorded 38.7 days to 50% spike initiation in case of Apsara as an earliest genotype. The differences in days to reach 50% spike initiation might be due to the genetical factors of the concerned genotype.

Length of flower

Significant variation in respect of length of flower was found among the genotypes (Table 2). The longest flower (9.70 cm) was produced by white genotype which was followed by yellow, violet and red (9.50, 9.25 and 9.00 cm, respectively) ones while the shortest spike (8.40 cm) was produced by orange genotype. The average length of flower and CV (%) were observed 9.17 cm and 5.50, respectively.

Breadth of flower

Significant variation in respect of length of flower was found among the genotypes (Table 2). The broadest flower (9.50 cm) was produced by yellow genotype which was followed by violet (9.30 cm) ones while the shortest spike (7.00 cm) were produced by orange genotype. The average breadth of flower and CV (%) were observed 8.67 cm and 11.60, respectively.

Weight of flower

Significant variation in respect of weight of flower was found among the genotypes (Table 2). The highest weight of flower (7.24 g) was produced by yellow genotype which was followed by white (7.20 g) ones while the lowest weight (4.44 g) was produced by orange genotype. The average weight of flower and CV (%) were observed 6.32 g and 18.04, respectively.

Weight of single stick

Genotypes had displayed a wide range of variability amongst them in respect of stick weight. It ranged from 26.45 to 53.85 g (Table 2). The highest stick weight (53.85 g) was recorded for white genotype which was followed by yellow (45.80 g), red (39.64 g) and violet (37.32 g). The lowest stick weight (26.45 g) producer genotype was orange genotype. The average weight of single stick and CV (%) were observed 40.61 g and 25.07, respectively.

Length of spike

Significant variation in respect of spike length was found among the genotypes (Table 2). The longest spike (92.00 cm) was produced by white genotype which was followed by yellow, violet and red (73.92, 72.52 and 65.63 cm, respectively) ones while the shortest spike (59.6 cm) was produced by orange genotype. The average length of spike and CV (%) were observed 72.74 cm and 16.77, respectively.

Length of rachis

A great deal of genotypic variation in rachis length was observed (Table 2) and varied from 25.60 to 47.20 cm. The highest rachis length was observed in white (47.20 cm), which was followed by red (36.60 cm), yellow (34.30 cm) and violet (28.31 cm). The lowest rachis length (25.60 cm) was observed in orange genotype. The average length of rachis and CV (%) were observed 34.40 cm and 24.46, respectively. Anuradha and Gowda (1994) reported that rachis length was highest (51.77 cm) in deep red (GL-06) genotype.

Average number of flower plant^{-1}

The highest number of flower plant^{-1} (14.30) was produced by white one (Table 2). The orange genotype produced the lowest number of flower (8.42) plant^{-1}. The average number of flowers plant^{-1} and CV (%) were observed 10.54 and 21.01, respectively. The number of flowers plant^{-1} varied from 5.33 to 20.00 as reported by Negi*et al*. (1982). Lal and Plant (1989) recorded 8 flowers plant^{-1} in GL-06 to 18 flowers in GL-15 in a gladiolus trail conducted at Maharastra in India. The mean number of flower plant^{-1} was 10.54. The results of this experimentation are in agreement with their results.

Table 2. Reproductive characteristics of different genotypes of Gladiolus

Color and genotype	Days to reach 50% spike initiation	Length of flower (cm)	Breadth of flower (cm)	Weight of flower (g)	Weight of single stick (g)	Length of spike (cm)	Length of rachis (cm)	Average Flowers plant^{-1} (No.)
White (GL-21)	60	9.70	9.05	7.20	53.85	92.00	47.20	14.30
Yellow (GL-04)	69	9.50	9.50	7.24	45.80	73.92	34.30	9.83
Orange (GL-16)	68	8.40	7.00	4.44	26.45	59.61	25.60	8.42
Violet (GL-12)	61	9.25	9.30	6.22	37.32	72.52	28.31	9.91
Red (GL-22)	66	9.00	8.50	6.50	39.64	65.63	36.60	10.25
Mean	64.80	9.17	8.67	6.32	40.61	72.74	34.40	10.54
St. Dev.	4.09	0.50	1.01	1.14	10.18	12.20	8.41	2.21
CV (%)	6.31	5.50	11.60	18.04	25.07	16.77	24.46	21.01

Table 3. Diallel crosses among the selected genotypes of gladiolus

Crosses	Days to capsule maturity	Length of capsule (cm)	Breath of capsule (cm)	Weight of capsule (g)	No. of seed capsule^{-1}	1000 seed weight (g)
White (GL-21) × Yellow (GL-04)	31	2.65	3.45	0.26	21.75	4.62
White (GL-21) × Orange (GL-16)	31	2.55	3.32	0.25	24.33	4.52
White (GL-21) × Violet (GL-12)	30	2.75	3.41	0.28	35.02	4.60
White (GL-21) × Red (GL-22)	30	2.66	3.43	0.27	25.01	4.52
Yellow (GL-04) × Orange (GL-16)	34	2.37	3.30	0.20	15.22	4.30
Yellow (GL-04) × Violet (GL-12)	35	2.69	3.44	0.21	37.50	4.43
Yellow (GL-04) × Red (GL-22)	33	2.77	3.64	0.25	38.45	4.65
Orange (GL-16) × Violet (GL-12)	22	2.25	2.95	0.19	15.30	3.37
Orange (GL-16) × Red (GL-22)	21	2.16	3.10	0.21	18.81	3.50
Violet (GL-12) × Red (GL-22)	24	2.51	3.32	0.22	15.10	4.09
Yellow (GL-04)× White (GL-21)	35	2.72	3.38	0.21	24.30	4.30
Orange (GL-16) × White (GL-21)	23	2.35	3.08	0.22	16.65	3.60
Violet (GL-12) × White (GL-21)	24	2.36	3.11	0.23	24.75	4.30
Red (GL-22) × White (GL-21)	25	2.55	3.22	0.24	17.30	4.25
Orange (GL-16) × Yellow (GL-04)	22	2.15	3.05	0.23	18.25	3.40
Violet (GL-12) × Yellow (GL-04)	24	2.36	3.25	0.25	19.75	4.25
Red (GL-22) × Yellow (GL-04)	25	2.80	3.40	0.25	19.02	4.47
Violet (GL-12) × Orange (GL-16)	26	2.43	3.07	0.24	20.53	4.05
Red (GL-22) × Orange (GL-16)	27	2.75	3.40	0.25	17.42	4.52
Red (GL-22) × Violet (GL-12)	25	2.50	3.10	0.22	20.69	4.18
Mean	27.35	2.52	3.27	0.23	22.26	4.20
St. Dev.	4.60	0.21	0.18	0.02	7.10	0.41
CV (%)	16.83	8.18	5.47	10.23	31.91	9.81

Days to capsule maturity

Differences regarding the days to capsule maturity were observed among the crosses (Table 3) and varied from 21 days to 35 days with an average 27.35 days. The crosses Yellow × White and Yellow × Violet took the highest days (35 days) to capsule maturity which was closely followed by crosses yellow × Orange (34 days) and Yellow × Red (33 days). The crosses White × Orange and White × Yellow took 31 days which was closely followed by crosses White × Violet (30 days) and White × Red (30 days). The cross Red × Orange took 27 days to capsule maturity which was closely followed by crosses Violet × Orange (26 days), Red × Violet (25 days), Red × White (25 days), Red × Yellow (25 days), Violet × Yellow (24 days), Violet × Red (24 days) and Violet × White (24 days). The cross Orange × Red took the minimum days (21 days) which was closely followed by the crosses Orange × Violet

(22 days), Orange × Yellow (22 days) and Orange × White (23 days). The average days to capsule maturity and CV (%) were observed 27.35 and 16.83, respectively. Mirsa and Choudhury (1976) reported that the genotype required about four to six weeks of pollination to capsule maturity.

Length of capsule

Crosses had displayed a slight range of differences among them in respect of capsule length (Table 3). The longest capsule (2.80 cm) was produced by cross Red × Yellow which was closely followed by the crosses Yellow × Red (2.77 cm), Red × Orange (2.75 cm), White × Violet (2.75 cm) and Yellow × White (2.72 cm) while the shortest capsule (2.15 cm) was produced by cross Orange × Yellow which was followed by cross Orange × Red (2.16 cm). The average length of capsule and CV (%) were 2.52 cm and 8.18, respectively.

Breadth of capsule

There had slightly varied (2.95 cm to 3.64 cm) in capsule breadth among the crosses (Table 3). The cross yellow × Red attained the maximum capsule breadth (3.64 cm), which was followed by the crosses Yellow × Violet (3.44 cm), White × Yellow (3.45 cm) , White × Red (3.43 cm) and White ×Violet (3.41 cm). Breath of capsule was found to be the lowest in cross Orange × Violet (2.95 cm). The average breadth of capsule and CV (%) were observed 3.27 and 5.47, respectively.

Weight of capsule

Crosses had displayed a slight range of differences among then in respect of capsule weight. It ranges from 0.19 to 0.28 g (Table 3). High capsule weight was recorded from the cross White × Violet (0.28 g) which was closely followed by the crosses White × Red (0.27 g), White × Yellow (0.26 g), White × Orange (0.25 g), Red × Orange (0.25 g) and Violet × Yellow (0.25 g). The lowest capsule weight was recorded from the cross Orange × Violet (0.19 g) which was followed by the crosses Yellow × Orange (0.20 g), Orange × Red (0.21 g), Yellow × Violet (0.21 g) and Yellow × White (0.21 g), respectively. The average weight of capsule and CV (%) were observed 0.23 and 10.23, respectively.

Number of seeds capsule^{-1}

Differences recording the number of seed capsule^{-1} among the crosses were observed and varied from 15.10 to 38.45 (Table 3). The highest number of seed capsule^{-1} was produced by the cross Yellow × Red (38.45) which was followed by the cross Yellow × Violet (37.50) and White × Violet (35.02). The cross Violet × Red produce the lowest number of seed capsule^{-1} (15.10) which was followed by the cross Yellow × Orange (15.22), Orange × Violet (15.30) and Orange × White (16.65). The average number of seeds capsule^{-1} and CV (%) were observed 22.26 and 31.91, respectively. Mirsa and Saini (1988) reported that Gladioli set seed abundantly and about 60 seeds are normally formed in three chambers of each capsule.

Weight of thousand seed

There had differences in weight of thousand seed among the crosses (Table 3). The highest weight of thousand seed was produced by the cross Yellow × Red (4.65 g) and which was followed by the crosses White × Violet (4.60 g) and White × Yellow (4.62 g). The lowest weight of thousand seed was produced by the cross Orange × Violet (3.37 g) which was followed by crosses Orange × Yellow (3.40 g) and Orange × Red (3.50 g) and Orange × White (3.60 g), respectively. The mean weight of thousand seed was 4.20 g and CV (%) was 9.81.

Results clearly indicated that the white genotype has the best planting materials which may be planted for luxuriant growth of plants and production of excellent flowers. All the crosses produced more or less true seed of gladiolus. The number of seeds capsule^{-1} ranged from 15.10 to 38.45. The highest number of seeds capsule^{-1} was produced by the cross Yellow × Red (38.45). So for producing true seed the cross Yellow × Red is the best cross.

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