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Study on Vegetative Propagating Materials, Flower Characteristics and Production of True Seed Through Crossing among the Different Gladiolus Genotypes

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Abstract: The present experiment was carried out during the period from November 2008 to October 2009 to investigate the morphology of vegetative propagating materials, flower and production of true seed through crossing among them the different gladiolus genotypes. The experiment included five gladiolus genotypes. The characteristics studied included corm, cormels, flowers, capsule and seed. The results indicate the existence of wide variability among the genotypes on their morphological characters in respect of vegetative propagating materials and flower along with yield and yield attributes. The number of corms produced per plant was the highest in Orange genotype (2.55) followed by Red (1.70), Violet (1.40) and Yellow (1.25) ones. The lowest number of corms (1.15) was produced by the White genotype. The highest corm weight (36.76g) was recorded from the Yellow genotype which was followed by White (30.92g), Violet (26.30g) and Red (25.30g) ones. The lowest corm weight per plant was obtained from the Orange genotype (18.16g). Number of cormel and cormel weight of the genotypes significantly differed and ranged from 25.70 to 43.20 and 5.20 to 6.40 g respectively. The highest number of cormels per plant was obtained from the White genotype (43.20) which was followed by Violet (28.85), yellow (27.20) and Orange (25.75) one. The Red genotype (25.70) produced the lowest number of cormels per plant. The highest cormel weight was recorded in genotype White (6.40g) which was closely followed by Yellow (6.39g), Violet (5.75g) and Red (5.30g).The Orange genotype (5.20g) produced the lowest weight of cormel per corm. Genotypes varied from 59.63 cm to 92.05 cm and 25.66 cm to 47.30 cm in spike length and rachis length respectively. Number of flower was highest in white (14.25) and lowest in orange (8.40) genotype. Considering crossing parameters, variation were observed for length of capsule (cm), breadth of capsule, number of seed per capsule and weight of thousand seed (g). Mean data indicated that all the crosses produced more or less gladiolus true seed (F_1 seed). The number of seed per capsule ranged from 15.08 to 38.40. The highest number of seed per capsule was produced by the cross Yellow × Red (38.40) while the lowest number of seed per capsule was produced by the cross Violet × Red (15.08).

Key words: Corm and Cormel % Flower % Crossing % True Seed

INTRODUCTION

The name gladiolus has been derived from the Latin word gladius, meaning a sword as it has sword shaped leaves Lewis *et al.* [1]. So, gladiolus (*Gladiolus grandiflorus* L.) popularly known as sword lily, is an ornamental bulbous plant native to South Africa Sharma and Sharma [2]. Gladiolus (*Gladiolus grandiflorus* L.) belongs to the family Iridaceae and is herbaceous perennial. It is now grown as a cut flower very widely in the continent of Europe, particularly in Holland, Italy and Southern France Butt [3]. It was introduce into cultivation towards the end of the 16th century Innes [4]. In India, its cultivation dates back to nineteenth century, as Firminger's Manual of Gardening in India published in 1863 mentioned that Charles gray of coonoor grew some gladioli from corms and seeds in his garden Apte, [5]. In Bangladesh gladiolus was introduces around 1992

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from India Mollah *et al*. [6]. It has recently become popular in Bangladesh and its demand in this country is increasing day by day. It has been rated as the second most important popular flower in the world, especially from the economical point of view Hamilton, [7]. It has great economic value as a cut flower and its cultivation is relatively easy. Various kinds of Gladiolus flowers are produced in different parts of the country like Bangladesh. This flower is grown round the year but large scale production is done during winter season. Farmers grow it in the field for commercial purpose.

The morphology of Gladiolus differs from genotype to genotype. Morphological variability is the essence of any planned crop improvement programmed. It is well established that the greater the genetic diversity the higher the chance of getting better hybrid or recombinant. A plant breeding program can be divided into three stages, viz. building up a gene pool of variable germplasm, selection of individual from the gene pool and utilization of selected individual to evolved superior variety [8]. 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 [9]. 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 Misra [10]. By 1816 France, Holland and Belgium started raising hybrids of gladiolus flower. All the modern, popular cultivars (cultivated varieties) of gladioli are of complex hybrid origin, raised from sexual wild, South African species. Wilfret [11] selected Florida Flame from a cross between WBL 047 and Folies Bergere. This cultivar is *Fusarium* tolerant. But in Bangladesh there is a lack of scientific research on the improvement of gladiolus flower. There is no disease and insect resistant Gladiolus variety in Bangladesh. Disease and pest attack is the serious problem in cultivation 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 work will be under taken to solve this problems.

MATERIALS AND METHODS

The present experiment was carried out at the Commercial Flower Garden of Society and Human Development organization, Tangail (SAHDOT) during the period from November 2008 to October 2009 to investigate the characteristics of vegetative propagating material, flowers and production of true seed in gladiolus genotypes. The experiment included five gladiolus genotypes. The characteristics studied included corm, cormels, flowers, capsule and seed. The experimental plot was opened in the first week of November 2008 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 to bring about good tilth. Manure (well decomposed cow dung), MP and TSP were applied as basal dose during the final land preparation and incorporated into the soil, but Urea was applied three/two installments as side/top dressing (as per treatment). Half of the Urea were applied after emerging 4 leaves and the rest half of the Urea will be 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 25cm and plant to plant spacing of 15cm. Inter cultural operations viz. weeding, irrigation, earthing up, stacking, pesticide and fungicide application was done as and when necessary. The soil was mulched frequently after irrigation by breaking the crust for better aeration and conservation of soil. Weeding was done in the soil whenever it was necessary to keep the soil free from weeds. The experimental plots were irrigated as when necessary during the crop period. 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 (DAS). The second earthing up was done after 45 DAS. Stacking was done during flowering stage of plants by 80cm long bamboo sticks to facilitate the plant to keep erect. To control insects Malathion-57 EC @2ml/litre of water was applied. Ridomil 2g per liter 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. No. of corm, cormel, days to 50% flowering, days to maturity, number of capsule per

plant, number of seed per capsule, 1000 seed weight and seed yield per plant were recorded. Mean of the data were calculated.

RESULTS AND DISCUSSION

Numbers of Corm: Data recorded in respect of corm production of five genotypes of gladiolus are presented in Table 3. The number of corms produced per plant was the highest in Orange genotype (2.55) followed by Red (1.70), Violet (1.40) and Yellow (1.25) ones. The lowest number of corms (1.15) was produced by the White genotype. The variation observed in corm production amongst the genotypes might be due to difference in genetically constituents as well as environmental factors. Variation (1.0 to 4.0m) in corm production amongst some genotypes of gladiolus was observed at Bangalore in India by Anuradha and Gowda [9].

Average Breath of Corms: There had slightly variation (2.74 cm to 3.81cm) in corm breadth among the genotypes (Table 1). The genotype yellow attained the maximum corm breadth (3.81cm), which was followed by genotypes Red (3.26cm), white (3.24 cm) and violet (3.17cm). Breadth of corm was found to be minimum in orange (2.74 cm). Corms of different genotypes of gladiolus flower are presented Plate 1.

Weight of Corms: Genotypes had displayed a wide range of variability amongst them in respect of corm weight (Table 1and Plate 1). It ranged from 18.16 to 36.76 g. The highest corm weight (36.76g) was recorded from the Yellow genotype which was followed by White (30.92gm), Violet (26.30g) and Red (25.30g) ones. The lowest corm weight per plant was obtained from the Orange genotype (18.16g). Sharma and Sharma [2] reported that corm weight was the highest in Yellow genotype (67g) and lowest in GL-25(18g) genotype which was more or less in consonance with the present investigation.

Average No. Of Cormel per Plant: Number of cormel per plant was significantly affected by genotypes (Table 1). The highest number of cormels per plant was obtained from genotype white (43.20) which was followed by violet (28.85), yellow (27.20) and orange(25.75). The genotype red (25.70) produced the lowest number of cormels per plant. Cormels of different genotypes of gladiolus flower are presented Plate 1. Misra and Saini [12] recorded 5to 20 cormel per plant in gladiolus genotypes in a trial conducted at Bangalore, India.

Weight of Cormel per Plant: Genotypes had displayed a range of variability among them in respect of cormel weight per corm (Table 1). It ranged from 5.20g to 6.40 g. The highest cormel weight was recorded in genotype white (6.40g) which was closely followed by yellow (6.39g), Violet (5.75g) and Red (5.30g). The genotype Orange (5.20g) produced the lowest weight of cormel per corm. Negi *et al*. [13] reported that cormel weight in gladiolus genotypes ranged from 5.2g to 17.0g which is more or less similar result with the findings of the present investigation. Cormels of different genotypes of gladiolus flower are presented Plate 1.

Number of Cormel Per Plant: Number of cormel per plant differed significantly affected by genotypes (Table 3). The highest number of cormels per plant was obtained from the White genotype (43.20) which was followed by Violet (28.85), yellow (27.20) and Orange (25.75) one. The Red genotype (25.70) produced the lowest number of cormels per plant. Misra and Saini [12] recorded 5 to 20 cormel per plant in gladiolus genotypes in a trial conducted at Bangalore, India.

Days to Reach 50% Spike Initiation: Marked differences were observed for days to 50% spike initiation amongst the genotypes under investigation (Table 2 and Plate 2). The Yellow genotypes took maximum days (70 days) to reach 50% spike initiation which was followed by Orange (67 days), Red (65 days) and Violet (62 days).

Table 1: Corm and cormel characteristics of gladiolus flower

Sl.	Color of genotype	Av. No. of corm/plant	Av. Breath of corm (cm)	Weight of corm (g)	Average No. of cormel / plant	Wt. of cormel (g) / plant
01	White	1.15	3.24	30.92	43.20	6.40
02	Yellow	1.25	3.81	36.76	27.20	6.39
03	Orange	2.55	2.74	18.16	25.75	5.20
04	Violet	1.40	3.17	26.30	28.85	5.75
05	Red	1.70	3.26	25.30	25.70	5.30

Table 2: Morphological characteristics of different genotypes of Gladiolus

Sl. No.	Color genotype	Days to reach 50% spike initiation	Length of flower (cm)	Breadth of flower (cm)	Wt. of flower (g)	Wt. of single stick (g)	Length of spike (cm)	Length of rachis (cm)	Average Flowers per plant
01	White	60	9.42	9.09	7.14	53.87	92.05	47.30	14.25
02	Yellow	70	9.75	9.41	7.25	45.85	73.90	34.40	9.80
03	Orange	67	8.39	6.90	4.54	26.47	59.63	25.66	8.40
04	Violet	62	9.28	9.28	6.20	37.30	72.50	28.32	9.90
05	Red	65	8.78	8.52	6.51	39.65	65.65	36.62	10.15

Fig: Corm of White Genotype

Fig: Corm of Yellow Genotype

Fig: Corm of Orange Genotype

Fig: Corm of Violet Genotype

Fig: Corm of Red Genotype

Fig: Sprouted Corm of Gladiolus

Fig: Cormels of Gladiolus Flower

Plate 1: Corms and Cormels of different gladiolus genotype

The minimum number of days (60 days) was taken by the White genotype. In a varietal trial, Ashwath and Parthasarathy [14] 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 [15] 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.

Spike Length: Significant variation in respect of spike length was found among the genotypes (Table 2). The longest spike (92.05cm) was produced by White genotype which was followed by Yellow, violet and Red (73.90, 72.50 and 65.65cm respectively) ones while the shortest spike (59.63cm) was produced by Orange genotype. Bhagur [16] found that spike length ranges from 61.60 cm to 137.97cm in varietal evaluation of gladiolus.

Rachis Length: A great deal of genotypic variation in rachis length was observed (Table 2) and varied from 25.66 to 47.30cm. The highest rachis length was observed in White (47.30cm), which was followed by Red (36.62cm), Yellow (34.40cm) and Violet (28.32cm). The lowest rachis length (25.66cm) was observed in Orange genotype. Anuradha and Gowda [9] reported that rachis length was highest (51.77cm) in Deep Red (GL-06) genotype.

Plate 2: Flowers of different genotypes.

Number of Flower: Variation in average number of flower per plant amongst the genotypes was ranged from 8.40 to 14.25 (Table 2). The highest number of flower per plant was produced by White one (14.25). The Orange genotype (8.40) produced the lowest number of flower per plant. The number of flowers per plant varied from 5.33 to 20.00 as reported by Negi *et al*. [17] from their experiment at the Hariana Agricultural University Farm, Hissar, India. Lal and Plant [18] recorded 8 flowers per plant in GL-06 to 18 flowers in GL-15 in a gladiolus trail conducted at Maharastra in India. The results of this experimentation are in agreement with their results.

Weight of Single Stick: Genotypes had displayed a wide range of variability amongst them in respect of stick weight. It ranged from in 26.47 to 53.85 gm (Table 2). Highest stick weight was recorded for white genotype White (53.87 g) which was followed by Yellow (45.85g), Red (39.65g) and Violet (37.30g). The lowest stick weight producer genotype was Orange (26.47g).

Production of Hybrid Seed

Days to Capsule Maturity: Differences regarding the days to capsule maturity were observed among the crosses (Table 3) and varied from 22 days to 36 days. The cross Yellow × White took maximum days (36 days) to capsule maturity which was closely followed by crosses yellow × Orange (35 days), Yellow × Violet (35 days) and Yellow × Red (34 days). The cross white × Orange took 31 days which was closely followed by crosses White × Violet (31 days), White × Yellow (30 days) and White × Red (30 days). The cross Red × Orange took 28 days to capsule maturity which was closely followed by crosses Violet × Orange (27 days), Red × Violet (27 days) and Red × Yellow (27 days), Violet × Yellow (26 days), Violet × Red (26 days) and Violet × White (25 days). The cross Orange × Violet took the minimum days (22 days) which was closely followed by the crosses Orange × Red (22 days), Orange × White (23 days) and Orange × Yellow (23 days). Mirsa [10] reported that the genotype required about four to six weeks of pollination to capsule maturity.

Table 3: Diallel crosses among the selected genotypes of Gladiolus

Crosses	Days to capsule maturity	Length of capsule (cm)	Breath of capsule (cm)	Wt. of capsule (g)	No. of seed/ capsule	1000 seed Wt. (g)
White × Yellow	30	2.67	3.44	0.27	21.76	4.60
White × Orange	31	2.57	3.30	0.26	24.32	4.50
White × Violet	31	2.74	3.42	0.27	35.00	4.61
White × Red	30	2.68	3.44	0.28	25.00	4.50
Yellow × Orange	35	2.35	3.29	0.19	15.23	4.32
Yellow × Violet	35	2.68	3.45	0.25	37.52	4.44
Yellow × Red	34	2.75	3.66	0.26	38.40	4.66
Orange × Violet	22	2.22	2.97	0.18	15.28	3.38
Orange × Red	22	2.18	3.08	0.22	18.80	3.84
Violet × Red	26	2.50	3.33	0.23	15.08	4.08
Yellow × White	36	2.73	3.39	0.24	24.32	4.32
Orange × White	23	2.36	3.07	0.23	16.68	3.92
Violet × White	25	2.38	3.10	0.25	24.76	4.28
Red × White	26	2.56	3.20	0.25	17.28	4.26
Orange × Yellow	23	2.16	3.03	0.22	18.20	3.63
Violet × Yellow	26	2.37	3.23	0.26	19.72	4.24
Red × Yellow	27	2.81	3.39	0.27	19.00	4.48
Violet × Orange	27	2.42	3.05	0.23	20.52	4.04
Red × Orange	28	2.76	3.39	0.27	17.40	4.50
Red × Violet	27	2.52	3.09	0.21	20.68	4.16

Plate 3: Crossing, capsules and true seeds of different gladiolus genotypes

Length of Capsule (cm): Crosses had displayed a slight range of differences among them in respect of capsule length (Table 3). The longest capsule (2.81 cm) was produced by cross Red × Yellow which was closely followed by the crosses White × Violet (2.78 cm), Red × Orange (2.76 cm), Yellow × Red (2.75 cm) and Yellow × White (2.73 cm) while the shortest capsule (2.16 cm) was produced by cross Orange × Yellow which was followed by cross Orange × Red (2.18 cm).

Breadth of Capsule (cm): There had slightly varied (2.97 cm to 3.66 cm) in capsule breadth among the crosses (Table 3). The cross yellow × Red attained the maximum capsule breadth (3.66 cm), which was followed by the crosses Yellow × Violet (3.45 cm), White × Yellow (3.44 cm), White × Red (3.44 cm) and White ×Violet (3.42 cm). Breath of capsule was found to be minimum in cross Orange × Violet (2.97 cm). Capsules of different genotypes of gladiolus flower are presented Plate 3.

Weight of Capsule: Crosses had displayed a slight range of differences among then in respect of capsule weight. It ranges from 0.18 g to 0.28 g (Table 3). High capsule weight was recorded from the cross White × Red (0.28 g) which was closely followed by the crosses Red × Orange (0.27 g), Red × Yellow (0.27 g), White × Violet (0.27 g) and White × Yellow (0.27 g). The lowest capsule weight was recorded from the cross Orange × Violet (0.18 g) which was followed by the crosses Yellow × Orange (0.19 g).

Number of Seed per Capsule: Differences recording the number of seed per capsule among the crosses were observed and varied from 15.08 to 38.40 (Table 3). The highest number of seed per capsule was produced by the cross Yellow × Red (38.40) which was followed by the cross Yellow × Violet (37.52) and White × Violet (35.00). The cross Violet × Red produce the lowest number of seed per capsule (15.08) which was followed by the cross Orange × Violet (15.28), Orange × White (16.68). Mirsa and Choudhry [19] 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 difference in weight of thousand seed among the crosses (Table 3). The highest weight of thousand seed was produced by the cross Yellow × Red (4.66 g) and which was followed by the crosses White × Violet (4.61 g) and White × Yellow (4.60 g). The lowest weight of thousand seed was produced by the cross Orange × Yellow (3.58 g) which was followed by crosses Orange × Red (3.63 g) and Orange × Red (3.84 g).

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