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subbaraman.Sriram@icar.gov.in
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Rao, T.M.; Janakiram, T.; Negi, S.S.; Aswath, C.; Dhananjaya, M.V.; Kumar, R.; Ramachandran, N.
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Original Research Papers

Development and evaluation of novel gladiolus hybrid selections IIHRG-7 (IC620379) and IIHRG-11 (IC620380) for flower quality and Fusarium wilt resistance

T.M. Rao
ICAR-Indian Institute of Horticultural Research, India
T. Janakiram
ICAR-Indian Institute of Horticultural, India
S.S. Negi
ICAR-Indian Institute of Horticultural Research, India
C. Aswath
ICAR-Indian Institute of Horticultural Research, India
M.V. Dhananjaya
ICAR-Indian Institute of Horticultural Research, India
R. Kumar Rajiv.Kumar11@icar.gov.in
ICAR-Indian Institute of Horticultural Research, India
N. Ramachandran
ICAR-Indian Institute of Horticultural Research, India

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Abstract: The present study was carried out to evaluate the performance of two novel gladiolus hybrid selections IIHRG-7 and IIHRG-11 along with commercial checks, for flower quality traits and *Fusarium* wilt resistance in completely randomized block design, during 2012-13 to 2014-15. Three years data were pooled and analyzed statistically. The hybrid selections IIHRG-7 and IIHRG-11 had been developed through hybridization by crossing Arka Meera x Picardy and Gold Medal 412 x Arka Poonam, respectively followed by selection. IIHRG-7 has novel flower colour (as per RHS Colour Chart) *i.e.,* Red-Purple (65.B) having Red-Purple (62.A) streaks with Red-Purple (67.B) splash and spike with variegated florets, while, IIHRG-11 has novel floret colour as Red (41.C) having Red (41.A) margin. Blotch Red (46.B) with yellow (13.C) border and resistance to *Fusarium* wilt disease. These hybrid selections are suitable for cut-flower and flower arrangement purposes. Further, these hybrid selections will be useful for developing new gladiolus hybrid selections with novel traits and resistance to *Fusarium* wilt disease.

Keywords: Evaluation, Flowering, Fusarium wilt and Gladiolus Vase life.

INTRODUCTION

Gladiolus is one of the most important bulbous flowering plants commercially grown for cut flowers, garden display and floral arrangement. It belongs to the family Iridaceae and sub-family Ixioideae. It ranks second in area (20.53 thousand ha) and production (132.58 thousand tons) among the cut flowers grown in India (Anon., 2016). The

main emphasis in gladiolus improvement has to be given on development of varieties having attractive novel colour and more number of well-spaced large sized florets mainly for cut flower, long spikes and good corm multiplication ability (Swaroop *et al.,* 2018). Fusarium wilt is the most devastating disease in gladiolus which is caused by the fungus *Fusarium oxysporum* f. sp. *gladioli* (Massey) W.C. Snyder & H.N. Hansen (Massey, 1926 and Nelson *et al.,* 1981). It is a major bottleneck in gladiolus cultivation causing 60-80% crop damage and huge economic loss to flower growers (Lakshman *et al.,* 2012 and Kakade *et al.,* 2016).

As conventional management practices for Fusarium wilt disease include corm treatment with fungicides and soil fumigation are time consuming, labour intensive and increase the cost of cultivation, developing Fusarium wilt disease resistance gladiolus genotypes is an economically viable option in managing this disease. Identification of genetic resources for resistance to Fusarium wilt is crucial for harnessing resistance from these plants which can be deployed in development of resistant varieties. Therefore, the present study was carried out to evaluate two novel gladiolus hybrid selections IIHRG-7 and IIHRG-11 for their flower quality and Fusarium wilt disease resistance.

MATERIAL AND METHODS

Hybridization followed by selection was employed to develop novel gladiolus hybrid selections IIHRG-7 and IIHRG-11 involving crosses Arka Meera x Picardy and Gold Medal 412 x Arka Poonam during 1986 and 1988, respectively. From hybrid seeds, cormels were produced. After the period of dormancy, cormels were planted and corms were harvested. Promising novel hybrid selections *viz.,*IIHRG-7 and IIHRG-11 were selected and multiplied vegetatively. Further, these hybrid selections with commercial checks Pink Friendship and *Psittacinus* hybrid, were evaluated for flower quality traits and resistance to Fusarium wilt disease, in replicated trial in completely randomized block design for three consecutive years i.e., from 2012-13 to 2014-15. The data on various biometrical parameters recorded were subjected to statistical analysis (Panse and Sukhatme, 1967).

Screening for resistance was undertaken in pot culture inside polyhouse in replicated trial in completely randomized block design. Uniform sized corms (5.5 cm to 6 cm) of IIHRG-11 and Pink Friendship (check) were planted in plastic pots containing 2 kg sterilized growing media @ 2:1:1 v/v (soil: sand: FYM). Sorghum based *Fusarium oxysporum* f. sp. *gladioli* inoculum was mixed in the soil at 4 g per 100 g of soil one day before planting and watering was done. The response of genotypes to *Fusarium* inoculation was evaluated at 90 days after planting (Elewa *et al.,* 2001). The disease incidence in per cent was recorded according to Riaz *et al.* (2010) and categorization of gladiolus genotypes based on disease incidence percentage was carried out as reported by Shanmugam *et al.* (2009) as follows: 0-10% = Highly resistant (HR); 10-25% = Resistant (R); 25-50% = Moderately susceptible (MS); 50-75%

= Susceptible (S); 75-100% = Highly susceptible (HS). The results have been presented and discussed at the probability level of one per cent. The data regarding disease incidence and mortality were recorded using following formulae:

$$Diase \quad incidence\left(\%\right) = \frac{No.\ of\ \ diased\ \ plants}{Total\ \ No.\ of\ \ plants} \times 00$$

$$Mortality\left(\%\right) = \frac{No.\ of\ \ died\ \ due\ \ to\ \ diase}{Total\ \ number\ \ of\ \ plants} \times 100$$

RESULTS AND DISCUSSION

Perusal of data presented in Table 1 indicated significant differences between hybrid selection IIHRG-7 and Pink Friendship (check) for most of the vegetative and floral characters, however, plant height,

Table 1
Vegetative and floral traits of Gladiolus hybrid selection IIHRG7 with check Pink Friendship pooled data of three years

Genotype	Days to spike emergence	Days to flower	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Floret diameter (cm)	No. of florets per spike	Florets remain open at a time	No. of spikes/ corm	No. of marketable spikes/corm	Flowering duration (days)	Vase life (days)
IIHRG-7	63.95	72.25	142.06	123.11	46.77	10.66	12.66	5.55	1.66	1.43	9.61	9.33
Pink Friendship	53.00	62.67	144.88	113.70	57.41	10.79	17.10	6.12	1.40	1.40	12.03	9.00
C.D. at 5%	3.01	9.67	NS	6.23	2.97	NS	0.97	0.41	0.28	NS	1.11	NS

floret diameter, number of marketable spikes per corm and vase life were found non-significant. The genotype Pink Friendship (check) recorded significantly early spike emergence (53.00 days) and flowering (62.67 days) in comparison to IIHRG-7 (63.95 days and 72.25 days, respectively). IIHRG-7 recorded significantly higher spike length (123.11 cm) than the check Pink Friendship (113.70 cm), however, longest rachis was recorded in Pink Friendship (57.41 cm). The spike length is one of the major criteria in selection of superior hybrid selection in gladiolus. The Pink Friendship (check) recorded more number of florets per spike (17.10) and florets remain open at a time (6.12) than IIHRG-7 (12.66 and 5.55, respectively). However, IIHRG-7 recorded significantly maximum number of total spikes per corm (1.66) than the Pink Friendship (1.40). The more number of spikes per corm are directly related to the higher productivity per unit area. The Pink Friendship recorded higher flowering duration (12.03 days) than the IIHRG-7 (9.61 days) owing to presence of more number of florets per spike in Pink Friendship which opened in acropetal successions for longer period. Sankari *et al.* (2012) reported variation in flowering traits in 42 gladiolus genotypes and recommended genotypes Pusa Swarnima, Pusa Shagun, Thumbolina, Priscilla and Candyman for cut flower production under Eastern Ghats of Tamil Nadu. Safeena and Thangam (2019) also

evaluated ten cultivars of gladiolus for flowering traits and recommended Arka Amar and Darshan for cut flower purpose under Goa conditions.

Data presented in Table 2 indicate significant differences between hybrid selection IIHRG-7 and Pink Friendship (check) for corm and cormel characters. IIHRG-7 recorded significantly higher number of corms (1.46) than Pink Friendship (1.03); however, Pink Friendship recorded more number of cormels per corm (52.11) than IIHRG-7 (26.63). Significantly higher diameter of corm (6.75 cm), cormel (1.17 cm), weight of corm (72.44 g) and cormel (0.57 g) was recorded in IIHRG-7. Corm diameter and corm weight are important traits for

Table 2
Corm and cormels traits of Gladiolus hybrid selection IIHRG7 with check Pink Friendship pooled data of three years

Genotype	Corm per corm (Nos.)	Cormel per corm (Nos.)	Diameter of corm (cm)	Diameter of cormel (cm)	Weight of corm (g)	Weight of cormel (g)
IIHRG-7	1.46	26.63	6.75	1.17	72.44	0.57
Pink Friendship	1.03	52.11	5.65	1.02	61.33	0.44
C.D. at 5%	0.23	4.07	0.29	0.04	9.58	0.08

producing quality spikes, with higher number of florets with bigger size. Sankari *et al.* (2012) and Safeena and Thangam (2019) reported that genotypes Thumbolina, Priscilla, Candyman, Arka Amar and Darshan were found superior for corm number, corm weight and corm diameter.

The qualitative traits of IIHRG-7 and Pink Friendship are given in Table 3. The IIHRG-7 has novel flower colour (RHS colour chart) as Red-Purple (65.B) having Red-Purple (62.A) streaks with Red-Purple (67.B) splash with variegated spikes.

Table 3
Qualitative traits of Gladiolus hybrid selection IIHRG7 with check Pink Friendship

Sl. No.	Trait	IIHRG -7	Pink Friendship
1.	Floret Type	Open-faced	Open-faced
2.	Floret texture	Medium	Medium
3.	Floret structure	Wavy	Wavy
4.	Floret placement	Good	Good
5.	Floret colour	Red-Purple (65.B) having Red-Purple (62.A) streaks with Red-Purple (67.B) splash	Red (50.D) having Red (51.C) margin and White (155.D) lines with Yellow (2.D) blotch

On the perusal of the data presented in Table 4, significant differences were observed between hybrid selection IIHRG-11 and *Psittacinus*

hybrid (check) for most of the vegetative and floral characters, however, flowering duration and vase life were found non-significant. The hybrid selection IIHRG-11 recorded significantly early spike emergence (66.66 days) and flowering (76.65 days) in comparison to *Psittacinus* hybrid (check) (78.24 days and 89.245 days, respectively). Shaukat *et al.,* (2013) also reported early spike emergence in Applause and Peter Pears and early flowering in Priscilla and Peter Pears.

Psittacinus hybrid recorded significantly maximumplant height (150.38 cm), spike length (120.43 cm) andrachis length (60.07 cm) than IIHRG-11 (120.72 cm,95.18 cm and 48.81 cm, respectively). However,IIHRG-11 recorded significantly maximum floretdiameter (9.46 cm), number of florets per spike(17.54) and florets remain open at a time (6.86) thanPsittacinus hybrid (8.25 cm, 16.68 and 4.75,respectively), while, maximum total number of spikesper corm (3.92) and marketable spikes per corm(2.43) were recorded in Psittacinus hybrid thanIIHRG-11 (1.92 and 1.70, respectively). The genotypes

Table 4
Vegetative and floral traits of Gladiolus hybrid selection IIHRG11 with check Psittacinus hybrid pooled data of three years

Genotype	Days to spike emergence	Days to flower	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Floret diameter (cm)	No. of florets per spike	Florets remain open at a time	No. of spikes/ corm	No. of marketable spikes/corm	Flowering duration (days)	Vase life (days)
IIHRG-11	66.66	76.65	120.72	95.18	48.81	9.46	17.54	6.86	1.92	1.70	11.70	7.12
Psittacinus hybrid	78.24	89.24	150.38	120.43	60.07	8.25	16.68	4.75	3.92	2.43	11.96	7.00
C.D. at 5%	1.96	2.14	3.96	2.75	2.47	0.21	0.64	0.25	0.46	0.40	NS	NS

with more number of florets remain open at a time on the spike are more suited for exhibition purpose. The more number of spikes per corm are directly related to the higher productivity per unit area. Swaroop *et al.* (2018) evaluated 27 gladiolus hybrids and reported that hybrids Suchitra x Melody and Green Pasture x Regency recorded maximum plant height, spike length and rachis length, while, hybrids Suchitra x Melody and Bindiya (mutant) recorded more number of florets per spike, whereas, hybrids Suchitra x Melody and Green Pasture x Regency recorded higher number of shoots per plant. Bhat *et al.* (2017) evaluated 60 genotypes of gladiolus for growth and flowering traits and recommended that genotypes Eurovision, Jester Gold, Priscilla, Vink's Glory, White Friendship *etc*. are best suited for cut flower under temperate conditions of Kashmir.

Data presented in Table 5 indicate significant differences between hybrid selection IIHRG-11 and Psittacinus hybrid (check) for most of the corm and cormel traits except number of cormels per corm. Psittacinus hybrid recorded significantly higher number

Table 5
Corm and cormel traits of Gladiolus hybrid selection IIHRG11 with check Psittacinus hybrid pooled data of three years

Genotype	Corm per corm (Nos.)	Cormel per corm (Nos.)	Diameter of corm (cm)	Diameter of cormel (cm)	Weight of corm (g)	Weight of cormel (g)
IIHRG-11	1.91	10.14	6.64	1.53	64.44	1.08
Psittacinus hybrid	3.64	10.90	5.22	1.78	44.33	3.10
C.D. at 5%	0.28	NS	0.18	0.06	4.47	0.12

of corms per plant (3.64), diameter of cormel (1.78 cm) and weight of cormel (3.10 g) than IIHRG-11 (1.91, 1.53 cm and 1.08 g, respectively), whereas, IIHRG-11 recorded significantly higher corm diameter (6.64 cm) and corm weight (64.44 g) than Psittacinus hybrid (5.22 cm and 44.33 g, respectively). Bhat *et al.* (2017) evaluated 60 genotypes of gladiolus for corm and cormels traits and recommended genotypes Buff Beauty, Mayur, Priscilla, Pusa Suhagin, Regency etc. are best suited for corm production under temperate conditions of Kashmir.

The qualitative traits of IIHRG-11 and *Psittacinus* are given in Table 6. The IIHRG-11 has novel flower colour (RHS colour chart) as Red (41.C)

Table 6
Qualitative traits of Gladiolus hybrid selection IIHRG11 with check Psittacinus hybrid

Sl. No.	Trait	IIHRG -11	Psittacinus hybrid
1.	Floret Type	Open-faced	Hooded
2.	Floret texture	Thick	Medium
3.	Floret structure	Slightly ruffled	Plain
4.	Floret placement	Double row	Fair
5.	Floret colour	Red (41.C) having Red (41.A) margin. Blotch Red (46.B) with Yellow (13.C) border	Red (39.A) with orange-Red (34.A) margin. Blotch Yellow (8.B)

Table 7
Disease incidence (%) and mortality (%) in IIHRG-11 with Pink Friendship (check) as influenced by Fusarium inoculum

Genotype	Disease incidence (%)	Mortality (%)
IIHRG-11	18.52 (18.47)	0.00 (2.87)
Pink Friendship	33.33 (30.95)	18.52 (18.47)
SEm±	3.46	3.14
CD (P=0.01)	20.63	18.70

Note Values within parenthesis are arc sign transformed values

having Red (41.A) margin. Blotch Red (46.B) with Yellow (13.C) border and have resistance to Fusarium wilt disease.

Data presented in Table 7 indicate that the hybrid selection IIHRG-11 recorded 18.52% disease incidence with zero per cent mortality which comes under resistant categor y, while, check Pink Friendship recorded 33.33% disease incidence with 18.52 per cent mortality which comes under moderately susceptible category as categorized by Shanmugam *et al.* (2009).

On the basis of three years of evaluation, gladiolus hybrid selections IIHRG-7 was found promising for novel flower colour and variegated spike, and IIHRG-11 for novel flower colour and resistant to *Fusarium* wilt disease. These hybrid selections will be useful in developing new gladiolus hybrid selections with novel flower traits and resistant to Fusarium wilt disease.

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