

Breeding and Evaluation of Gerbera (*Gerbera jamesonii* Bolus ex Hooker F.) Lines

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Received 19 July 2016; Accepted 15 August 2016; Published online 28 August 2016

Abstract Gerbera is one of the most popular flower crops in the world and is gaining importance in our country. Hardy upright flowers, leafless long stalks, numerous colors with long vase life have popularized gerbera. Half sib mating was used and the parents IIHR 3 showed higher seed weight, number of seeds per cross and seed set percentage. IIHR 2 and IIHR 4 recorded earliest days taken for seed set. These lines were evaluated in naturally ventilated polyhouse for evaluation of novel characters. The line IIHR 1-3 recorded highest number of leaves per plant at 30, 60, 90 and 120 days after planting. The

line IIHR 3-1 recorded maximum plant spread and length and breadth of ray florets, line IIHR 2-4, IIHR 4-2 and IIHR 5-4 recorded earliest bud burst, line IIHR 5-4 recorded earliest first flower opening. maximum stalk length was recorded in IIHR 1-3, stalk diameter in IIHR 1-1, flower diameter in IIHR 3-2. The lines IIHR 1-1, IIHR 2-2, IIHR 3-2, IIHR 3-5, IIHR 4-3 and IIHR 5-1 recorded double form of flower head with novel flower color. Line IIHR 2-5 recorded longest vase life. From the present study it can be inferred that these lines may be recommended for the commercial cultivation both for cut flower and landscape purpose.

Keywords Gerbers, Breeding, Evaluation, Naturally ventilated polyhouse, Novel characters.

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Introduction

Gerbera (*Gerbera jamesonii* Bolus ex Hooker F) belongs to the family Asteraceae, is suitable both for export and domestic market, because of its potential to withstand long transportation. In India gerbera is mainly grown in north eastern states, Karnataka and Maharashtra.

The urgent need of floriculture industry especially in gerbera is the breeding of the local quality flower with biotic and abiotic resistance. The present varieties available in India are all imported by paying huge royalties. There is an urgent need to standardize the protocol for large scale multiplication

Table 1. Details of female parents used for crossing and their characters.

Characters	IIHR 1	IIHR 2	IIHR 3	IIHR 4	IIHR 5
Diameter of flower head (cm)	12.00	11.00	14.00	11.00	12.00
Length of the flower stalk (cm)	50.00	60.00	55.00	60.00	45.00
Diameter of flower stalk (mm)	6.10	5.90	6.00	5.20	6.20
Type of flower	Single	Double	Double	Double	Double
Color of ray florets	N67C (Red purple group)	N42A (Red group)	N28A (Orange group)	NN155D (White group)	NN155C (White group)
Color of disc florets	Yellow	Yellow	Black	Black	Yellow

of elite planting material with novel characters like flower color, flower form and vase life. The present paper assesses the performance and suitability of different gerbera lines for novel characters.

Materials and Methods

The experiment was carried out in Division of Ornamental Crops, ICAR-Indian Institute of Horticultural Research (IIHR), Hesaraghatta Lake Post, Bengaluru during 2014-2015. Twenty different lines of gerbera viz. IIHR-1 to IIHR-20 were used for hybridisation. Half sib method was used, where five genotypes were used as female parents, while mixed pollen of remaining 15 genotypes were used as male parent. The details of female parents used for crossing and their characters are presented (Table 1) and the observations were recorded.

Days taken for seed set, seed weight (mg), total number of ray florets, number of seeds/cross, number of chaffy seeds and seed set (%).

$$\text{Seed set (\%)} = \frac{\text{Total number of seed set per flower head}}{\text{Number of chaffy seeds}} \times 100$$

Each seed was considered to be a different line. These lines were evaluated for flower quality and novel traits under naturally ventilated polyhouse un-

Table 2. Mean performance of the female parents. Values given in parentheses are *Arc sine* transformed values.

Lines	Number of chaffy seeds	Days taken for seed set	Seed weight (mg)	Number of seeds/cross	Seed set (%)
IIHR 1	32.36	20.00	70.54	19.50	37.60 (37.80)
IIHR 2	20.54	24.00	81.95	25.50	55.38 (48.08)
IIHR 3	9.49	23.40	163.73	69.60	88.00 (69.86)
IIHR 4	26.29	21.20	120.78	30.20	53.86 (47.20)
IIHR 5	26.30	20.40	129.70	38.60	59.46 (50.45)
Mean	22.99	21.80	113.34	36.68	50.67
SEm±	2.12	0.72	9.25	3.73	1.41
CD at 5%	6.36	2.16	27.75	11.19	4.17

der pot cultivation. The following observations were recorded.

Number of leaves per plant, plant spread (cm), days to bud burst, days to first flower opening, flower stalk length (cm), stalk diameter (cm), flower head diameter (cm), length of the ray florets (cm), breadth of the ray florets (cm), number of ray florets per flower head, flower color and vase life (days).

Statistical analysis

In vitro plants were raised under polyhouse and the data were statistically analysed by following completely randomised design. Data were analysed with the help of software WASP (Web agri stat program) 2.0.

Results and Discussion

Five genotypes IIHR-1, IIHR-2, IIHR-3, IIHR-4 and IIHR-5 were used as female parents and were crossed by half sib mating, the data are presented (Table 2). All the five flowers except one were double with two or three whorls of ray florets and several whorls of very short, inconspicuous trans and disc florets.

In the present study, the highest numbers of

Table 3. Mean performance of gerbera lines for number of leaves per plant at 30, 60, 90 and 120 DAP.

Lines	30 DAP	60 DAP	90 DAP	120 DAP
IIHR 1-1	9.50	14.50	19.00	22.00
IIHR 1-2	5.50	10.00	10.50	16.00
IIHR 1-3	16.00	27.00	30.00	37.00
IIHR 1-4	7.50	11.00	12.50	19.00
IIHR 1-5	9.50	11.50	16.50	21.00
IIHR 2-1	13.50	12.00	21.50	22.00
IIHR 2-2	12.50	14.00	19.00	21.00
IIHR 2-3	9.00	9.50	12.50	15.00
IIHR 2-4	6.50	7.50	10.50	15.50
IIHR 2-5	8.50	12.00	18.50	21.50
IIHR 3-1	8.00	12.00	13.50	18.00
IIHR 3-2	6.50	7.50	9.00	15.50
IIHR 3-3	4.50	6.50	8.50	12.50
IIHR 3-4	9.00	11.00	15.50	18.50
IIHR 3-5	7.50	10.50	12.50	15.50
IIHR 4-1	6.50	8.00	12.50	14.50
IIHR 4-2	7.50	9.00	10.50	14.50
IIHR 4-3	7.50	8.00	10.50	14.50
IIHR 4-4	6.00	8.50	10.50	15.50
IIHR 4-5	7.00	9.00	10.50	17.50
IIHR 5-1	5.50	8.50	9.50	16.50
IIHR 5-2	6.50	8.50	9.00	15.50
IIHR 5-4	7.50	8.00	10.00	14.50
IIHR 5-5	8.50	7.50	10.50	15.50
SEm±	0.82	0.77	0.92	1.03
CD at 5%	2.43	2.16	3.05	3.85

chaffy seeds (32.36) were recorded in IIHR 1 with color (N67C, red purple group) and the least number of chaffy seeds (9.49) were recorded in N28A (orange group) flower color in line IIHR 3. Chaffy seeds were recorded more in the flowers, where trans florets were more.

It is evident that the earliest for seed set (20.00 days) was recorded in the line IIHR 1, but the number of seeds per cross and the seed set percent was low. The line IIHR 3 recorded maximum number of seeds per cross, seed weight and seed set percentage. This is attributed to the fact that double flowers take long time for seed set compared to single flowers and also if the ray florets are more, the seed obtained was also large [1].

The line IIHR 1-3 was significantly superior over other lines at 30, 60, 90 and 120 DAP for number of leaves (16,27, 32 and 37 days) (Table 3). The varia-

Table 4. Mean performance gerbera lines for plant spread (cm) (east-west) under naturally ventilated polyhouse.

Lines	30 DAP	60 DAP	90 DAP	120 DAP
IIHR 1-1	19.00	32.50	33.50	50.50
IIHR 1-2	14.50	25.00	27.50	33.00
IIHR 1-3	26.50	32.50	35.00	47.50
IIHR 1-4	9.50	15.00	32.50	46.00
IIHR 1-5	8.50	25.00	32.50	45.00
IIHR 2-1	8.50	15.00	28.50	29.00
IIHR 2-2	14.50	17.50	35.00	45.00
IIHR 2-3	8.50	15.00	27.50	27.50
IIHR 2-4	10.50	19.00	27.50	37.50
IIHR 2-5	18.50	30.50	35.00	36.00
IIHR 3-1	19.00	32.50	45.00	48.50
IIHR 3-2	19.00	29.00	32.50	35.00
IIHR 3-3	17.50	29.00	47.00	35.00
IIHR 3-4	10.50	32.50	45.00	45.00
IIHR 3-5	8.50	26.50	23.00	34.50
IIHR 4-1	6.50	17.50	24.50	35.00
IIHR 4-2	8.50	19.00	23.00	36.50
IIHR 4-3	9.50	17.00	25.00	32.00
IIHR 4-4	10.00	15.50	27.50	35.50
IIHR 4-5	10.00	19.50	29.00	34.00
IIHR 5-1	9.00	19.00	30.50	33.50
IIHR 5-2	8.50	20.50	28.50	29.50
IIHR 5-4	7.50	17.50	19.00	28.50
IIHR 5-5	8.00	18.00	19.00	26.50
SEm±	0.77	1.46	1.53	2.26
CD at 5%	2.12	4.66	8.44	8.09

tion observed in vegetative growth in different genotypes might be attributed to their genetic make up [2].

The data recorded in Tables 4 and 5 showed that line IIHR 3-1 recorded maximum plant spread (east-west) at 60, 90 and 120 days after planting, whereas same line recorded maximum plant spread at (north-south) at 60, 90 and 120 days respectively. The similar variation in vegetative growth characters in gerbera genotypes under polyhouse has also been reported [3].

The lines IIHR 2-4, IIHR 4-2 and IIHR 5-4 recorded earliest bud burst (40.17 days) (Table 6). The line IIHR 1-2 took the maximum days for bud burst (52.04 days). The data also indicated that line IIHR 5-4 recorded earliest first flower opening (49.81 days). Similar variation in days to bud burst and first flower opening was reported in 17 cultivars of gerbera [4]. The flowering in gerbera is known to be

Table 5. Mean performance gerbera lines for plant spread (cm) (north-south) under naturally ventilated polyhouse.

Lines	30 DAP	60 DAP	90 DAP	120 DAP
IIHR 1-1	29.00	37.50	47.50	50.00
IIHR 1-2	29.00	29.00	27.50	53.00
IIHR 1-3	32.50	32.50	35.00	55.00
IIHR 1-4	19.00	29.00	40.00	38.00
IIHR 1-5	19.00	27.50	38.00	42.50
IIHR 2-1	16.50	24.00	45.00	34.50
IIHR 2-2	19.00	25.00	35.00	40.50
IIHR 2-3	17.50	45.00	47.50	55.00
IIHR 2-4	19.00	35.00	55.00	46.00
IIHR 2-5	27.50	35.00	49.00	47.50
IIHR 3-1	19.00	40.00	49.50	61.50
IIHR 3-2	19.50	37.50	33.00	54.50
IIHR 3-3	21.50	22.00	34.50	51.00
IIHR 3-4	24.00	26.00	35.50	39.00
IIHR 3-5	16.50	19.00	33.00	39.50
IIHR 4-1	16.00	23.50	31.00	38.50
IIHR 4-2	19.00	25.00	29.00	37.50
IIHR 4-3	16.50	23.00	30.50	37.50
IIHR 4-4	16.50	18.50	31.00	36.50
IIHR 4-5	12.50	19.50	32.00	35.50
IIHR 5-1	11.00	21.00	29.50	29.50
IIHR 5-2	10.50	21.00	28.50	35.50
IIHR 5-4	12.50	19.00	23.00	29.50
IIHR 5-5	10.50	21.50	23.00	28.50
SE m ±	1.10	1.79	1.76	1.26
CD at 5%	4.36	5.39	5.30	3.78

genetically controlled [5].

The results revealed that the line IIHR 1-3 had stalk length of 54.00 cm which was on par with the

line IIHR 2-2. The least stalk length was observed in the lines IIHR 1-5 and IIHR 2-3 (Table 6). The stalk length increased with the decrease in shade percentage in different cultivars and variation in stalk length among the genotypes due to the genetic make up of particular genotype [6].

The highest stalk diameter (5.59 mm) was observed in line IIHR 1-1 which was statistically on par with lines IIHR 1-5, IIHR 2-4, IIHR 1-4 and IIHR 2-5, however, lowest stalk diameter was recorded in line IIHR 5-2. Similarly, line IIHR 3-2 recorded maximum flower diameter (10.26 cm) (Table 6). Similar variation in stalk diameter and flower diameter has been reported [7, 8].

The highest length of ray florets was recorded in the line IIHR 3-1. The lines IIHR 3-3, IIHR 3-4 and IIHR 3-1 recorded the maximum breadth of ray florets (Table 6). Similar variation in length and breadth of ray florets has been reported in gerbera [9]. The line IIHR 2-3 recorded maximum number of ray florets per flower head. The least number of ray florets per flower head was observed in the line IIHR 5-5.

The lines IIHR 1-1, IIHR 2-2, IIHR 3-2, IIHR 3-5, IIHR 4-3 and IIHR 5-1 recorded double form of flower head with novel flower color (28D, orange group), (40A, red group), (45 B, red group), (70),

Table 6. Mean performance gerbera lines for flower characters under naturally ventilated polyhouse.

Lines	Days to bud burst	Days to first flower opening	Stalk length (cm)	Stalk diameter (mm)	Flower diameter (cm)	Length of ray florets (cm)	Breadth of ray florets (cm)	Number of ray florets
IIHR 1-1	40.50	51.01	41.16	5.59	8.16	4.07	0.69	55.33
IIHR 1-2	52.04	63.44	31.16	5.43	8.33	3.20	0.69	56.00
IIHR 1-3	51.08	65.42	54.00	5.23	9.16	3.20	0.68	56.33
IIHR 1-4	47.84	63.17	42.83	5.51	9.93	2.61	0.46	52.66
IIHR 1-5	46.86	60.04	27.66	5.55	10.20	3.24	0.73	56.00
IIHR 2-1	50.90	60.62	29.16	5.41	8.86	3.23	0.80	56.00
IIHR 2-2	48.08	58.28	49.66	5.03	8.33	3.32	0.63	56.00
IIHR 2-3	42.11	54.19	27.66	5.28	9.46	3.89	0.77	59.33
IIHR 2-4	40.17	53.93	42.83	5.53	9.53	3.85	0.81	52.66
IIHR 2-5	41.12	52.96	36.00	5.49	8.66	3.70	0.75	56.00
IIHR 3-1	44.19	56.44	39.33	5.00	8.56	4.16	0.98	49.33
IIHR 3-2	42.20	53.52	34.00	5.06	10.26	4.00	0.96	54.00

Table 6. Continued.

Lines	Days to bud burst	Days to first flower opening	Stalk length (cm)	Stalk diameter (mm)	Flower diameter (cm)	Length of ray florets (cm)	Breadth of ray florets (cm)	Number of ray florets
IIHR 3-3	48.19	57.52	42.96	5.40	9.16	4.13	1.16	56.66
IIHR 3-4	46.64	57.38	36.00	5.22	8.33	3.83	1.00	52.66
IIHR 3-5	48.08	57.79	30.66	4.92	7.50	2.83	0.66	53.33
IIHR 4-1	42.11	52.31	31.66	4.86	7.83	3.03	0.79	54.33
IIHR 4-2	40.17	52.25	36.00	5.12	7.83	3.03	0.76	54.33
IIHR 4-3	41.12	54.88	37.33	5.44	8.66	3.40	0.73	51.00
IIHR 4-4	44.19	56.03	39.33	5.03	8.16	3.50	0.71	49.00
IIHR 4-5	42.20	54.34	40.00	5.14	7.50	3.60	0.72	50.66
IIHR 5-1	48.19	59.51	37.00	5.01	8.20	2.80	0.79	52.33
IIHR 5-2	46.64	55.97	35.00	1.76	10.00	2.73	0.72	17.66
IIHR 5-4	40.17	49.81	31.00	5.27	8.13	2.90	0.85	53.00
IIHR 5-5	41.12	51.32	34.33	1.78	10.00	2.93	0.75	16.66
SE m ±	0.50	0.79	3.71	0.63	0.70	0.19	0.32	6.12
CD at 5%	1.44	2.24	10.56	1.79	2.00	0.52	0.96	17.41

red purple group), (9A, yellow group) and (62 D, red purple group), respectively. The line IIHR 2-5 (12

A, yellow group) recorded longest vase life while it was recorded least in line IIHR 5-5 (Table 7). Variation in flower color, flower form and vase life has also been reported [10].

Table 7. Flower color, flower form and vase life of gerbera lines.

Lines	Flower color	Flower form	Vase life (days)
IIHR 1-1	28 D (Orange group)	Double	10.00
IIHR 1-2	155 B (White group)	Double	9.66
IIHR 1-3	73 C (Red purple group)	Double	10.33
IIHR 1-4	28 D (Orange group)	Single	10.66
IIHR 1-5	68 B (Red purple group)	Single	9.33
IIHR 2-1	NN155 B (White)	Single	8.66
IIHR 2-2	40 A (Red group)	Double	9.66
IIHR 2-3	41 B (Red group)	Double	10.33
IIHR 2-4	29 C (Orange group)	Double	10.66
IIHR 2-5	12 A (Yellow group)	Double	11.00
IIHR 3-1	11 D (Yellow group)	Double	10.33
IIHR 3-2	45 B (Red group)	Double	9.33
IIHR 3-3	68 B (Red purple group)	Single	10.33
IIHR 3-4	10 C (Yellow group)	Double	9.00
IIHR 3-5	70 D (Red purple group)	double	8.00
IIHR 4-1	68 A (Red purple group)	Single	8.00
IIHR 4-2	41 A (Red group)	Single	8.33
IIHR 4-3	9 A (Yellow group)	Double	9.00
IIHR 4-4	68 B (Red purple group)	Single	9.00
IIHR 4-5	4 C (Yellow group)	Double	8.00
IIHR 5-1	62 D (Red purple group)	Double	9.66
IIHR 5-2	6 A (Yellow group)	Double	8.33
IIHR 5-4	4 C (Yellow group)	Double	7.00
IIHR 5-5	30 C (Orange group)	Double	6.00
SE m ±	-	-	0.44
CD at 5%	-	-	1.276

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