International Journal of Plant Science and Ecology
Vol. 2, No. 1, 2016, pp. 10-14
http://www.aiscience.org/journal/ijpse
ISSN: 2381-6996 (Print); ISSN: 2381-7003 (Online)

Domestication of Wild Gerbera (*Gerbera gossypina* (Royle) Beauved)

S. Singh*, D. Dhyani

CSIR-Institute of Himalayan Bioresource Technology, Palampur (HP), India

Abstract

Gerbera gossypina (Royle) Beauved is a wild plant of Western Himalayan origin. *G. gossypina* may be used as an ornamental pot plant due to its compact plant size, small flowers of light pink colour (RHS 76D) and green foliage with woolly fibers on the under surface. The wild gerbera species is free of diseases such as powdery mildew and grey mould which are prevalent in cultivated gerbera. These traits are not present in the cultivated species of gerbera. Besides, *G. gossypina* may be considered as a source of important traits which can be utilized for improvement of cultivated gerberas through a breeding programme. The chromosome number of the species is 2n = 46 and based on the asymmetry of the karyotype it is classified as type 3B. Morphologically the species exhibits adaptive features such as woolly fibers on the under surface of leaves, forms small light purple coloured flowers and is free of prominent diseases in cultivated gerbera viz., powdery mildew and grey mould. The species is not commonly distributed in Himalayas and is being domesticated for its conservation and sustainable utilization as an ornamental pot plant.

Keywords

Gerbera gossypina, Domestication, Chromosome Count, *Gerbera jamesonii*, Karyotype Asymmetry

Received: August 4, 2015 / Accepted: January 10, 2016 / Published online: January 28, 2016

1. Introduction

Gerbera gossypina (Royle) Beauved (Asteraceae) is a wild perennial plant species of infrequent occurrence in Western Himalayan mid hill region around an average elevation of 1300 m amsl. The plants form capitula of light coloured flowers with ray florets of light purple colour which are very attractive and open during a short span from April and June. The species is reported to be used for treatment of blood pressure, gastric disorder and staunching of wounds [1]. The distribution of this species is reported to extend from Jammu in the North to Uttarakhand in East in foothillsof Himalayas at an elevation of 1200-1400 m amsl. The collections of *G. gossypina* were made from the wild, existing in the western-Himalayan region (Foot hills of Dhauladhar range, at Chandpur village along the side of irrigation channel on rocks, near Palampur, District Kangra, Himachal Pradesh) and conserved for its utilization as a potential flowering pot plant [2]. The collected rhizomes were successfully domesticated in pots. The distinct feature of *G.gossypina* is that it bears woolly fibers under the surface of leaves. It may be considered as an adaptation to adverse climatic conditions prevaling in regions of Himalaya [3].

The plant is a perennial herb, rhizome creeping woody, stem 15-40 cm long, solitary, woolly, leaves 5-12, lanceolate, toothed to pinnately lobed near the base, entire, acute, cobwebby above, white wooly beneath petiole 4-6 cm long winged. Flower and fruit formation occurs during April and June. Heads are 2.5-4.0 cm diameter and solitary. Ray florets are 1.5 cm long, lobed, bilipped, unequal. Pappus is copious, white and rough with minute barbs. Achenes are 3.5-4.0 mm long, rough slightly ribbed, brown black. Open pollination is

* Corresponding author
E-mail address: sanatsujat@ihbt.res.in (S. Singh)

brought about by insects and a number of seeds are formed in a pollinated flower. The wild gerbera species of Himalayan origin has potential to be used as an ornamental pot plant due to its compact plant size, small flowers of distinct light pink colour and green foliage with woolly fibers on the under surface. *G. gossypina* is free of diseases such as powdery mildew and grey mould which are prevalent in cultivated gerbera. These traits are absent in the cultivated gerberas and therefore, *G. gossypina* may be considered as a source of important traits which can be utilized for improvement of cultivated gerberas through a breeding programme.

2. Research Significance

In order to successfully domesticate *G. gossypina* for sustainable utilization, we need to study the life cycle and characterize the species under cultivation. To determine the chromosome number of the wild gerbera species and distinguish it from the cultivated gerberas (*Gerbera jamesonii* Bolus ex. Hooker F), cytological and morphological characterization of the species was undertaken in the present study. Seed to seed cycle of the plant and vegetative propagation potential was also studied for its successful domestication and further utilization.

3. Experimental Investigation or Procedure

The plant collections of *G. gossypina* were made from natural population of the species in the western-Himalayan region (Foot hills of Dhauladhar range, at Chandpur village along the side of irrigation channel on rocks, near Palampur, District Kangra, Himachal Pradesh) and domesticated for its utilization as a potential flowering pot plant. The seeds used for the study were collected from plants domesticated at CSIR-Institute of Himalayan Bioresource Technology, Palampur. The voucher specimens are deposited in the Herbarium (PLP 11678) of IHBT, Palampur.

Root tips from seedlings were obtained by germinating seeds on humid filter paper in Petri dishes and used for cytogenetic studies. Root tips were also collected for cytological analysis from the cultivated gerbera plants of accession IHBT-Gr-02 grown in pots. The roots were pretreated with colchicine for 4 h and fixed in Carnoy's fluid (1:3 acetic acid / Absolute alcohol) at about 4°C for 24 hours. The fixed roots were hydrolysed in 1N HCl at 60°C for 8-10 minutes, followed by staining with 2% aceto-carmine and then squashed for cytological observations. The slides were examined using Nikon biological research photomicroscope (Model: Eclipse 80i) equipped with digital camera and good preparations photographed and prints made from which the metaphase chromosomes of three cells were measured. Standard procedures were followed for the symbols to describe metaphase chromosomes [4] and classification of asymmetry of the karyotype [5].

Meiotic analysis was done by fixing flower buds at an early stage of development in Carnoy's fluid (6:3:1 of ethyl alcohol: chloroform: acetic acid) for one hour and then transferring the buds to Carnoy's fluid (1:3 acetic acid / Absolute alcohol) for 24 hours. The fixed anthers were stained with 2% aceto-carmine and then squashed for cytological observations. The slides were examined under microscope and good preparations photographed.

Seedlings were raised in pots from ten different plants representing half-sib families in randomized block design with three replicates. Observations were made with respect to floral traits viz., flower colour using RHS colour chart [6], first bud appearance, longevity of the flowers, stalk length, flower diameter, stalk thickness, flower colour and pollination biology. Data were recorded over two consecutive years (2013 and 2014) in each replication and pooled. Analysis of variance was conducted for different traits to determine mean and variations among the traits. Observations were also made with respect to disease incidence in *G. gossypina* as compared to cultivated gerbera accession IHBT-Gr-02 being maintained at CSIR-IHBT, Palampur.

G. gossypina plants have perennial growth behavior and form suckers which multiply with the age of the plant. The number of suckers formed per plant in a year varies from three to seven and on an average four suckers are formed per plant in one year. It is easy to vegetatively propagate the plants through suckers by division of clumps formed during the autumn season under sub-tropical weather conditions and repotting the divided plants in separate pots.

4. Comparison of Predictions and Experimental Results and Discussion of Results

The results of cytological study were based on five observations of metaphase cells each in *G. gossypina* and gerbera accession IHBT-Gr-02. Chromosome count of 46 was observed in *G. gossypina* with a basic set of 23 chromosomes (Figure 1 a, b and c). Mean chromosome length of *G. gossypina* ranged from 4.51 to 9.63 µm and more than 50% chromosomes have an arm ratio of more than 2.00 (Table 1). Use of arm ratio was made for the identification of homologs because of gradual variation in chromosome length. The chromosomes were metacentric, submetacentric and subterminal (8 m + 14 sm + 1 st) as per

the terminology [4]. Based on the degree of asymmetry of the karyotype, *G. gossypina* is classified as type 3B. Twenty three bivalents were observed at diakinesis (prophase I) stage of meiosis confirming that the basic chromosome number of the species is 23. The chromosome count of cultivated gerbera was observed to be 50 confirming the earlier reports [7]. Considering the lower chromosome count in *G. gossypina*, the species may be primitive to *G. jamesonii*.

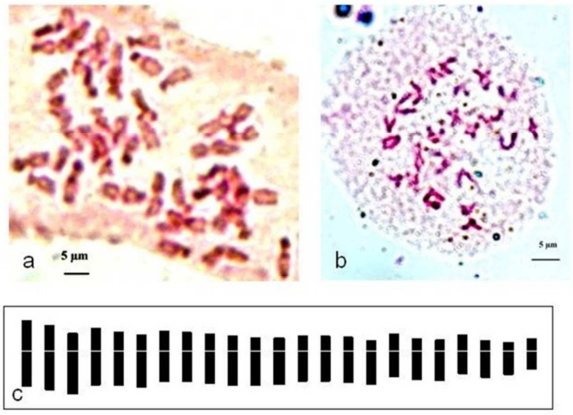

Figure 1. Chromosomes of *Gerbera gossypina*:(a)mitotic metaphase (2n = 46), (b) diakinesis (23 bivalents) and (c) ideogram.

Table 1. Parameters of mitotic metaphase chromosomes of *Gerbera gossypina*. Type of chromosomes classified as per Levan*et al*. (1964); m (metacentric) = arm ratio 1-1.7; sm (submetacentric) = arm ratio 1.7-3.0; st (subterminal) = arm ratio 3.0-7.0.

Chromosome Number	Chromosome length (um)	Length of short arm	Length of long arm	Arm ratio	Type
1	9.63	4.46	5.17	1.16	m
2	9.445	3.735	5.71	1.53	m
3	8.92	2.585	6.335	2.45	sm
4	8.35	3.325	5.025	1.51	m
5	7.79	2.755	5.035	1.83	sm
6	7.63	2.32	5.31	2.29	sm
7	7.43	2.89	4.54	1.57	m
8	7.185	2.685	4.495	1.67	m
9	7.18	2.395	4.785	2.0	sm
10	7.115	2.135	4.98	2.33	sm
11	6.995	1.91	5.085	2.66	sm
12	6.76	1.88	4.88	2.6	sm
13	6.68	2.25	4.43	1.97	sm
14	6.585	2.14	4.445	2.08	sm
15	6.565	2.0	4.565	2.28	sm
16	6.39	1.525	4.865	3.19	st
17	6.235	2.515	3.72	1.48	m
18	5.955	1.725	4.23	2.45	sm
19	5.95	1.565	4.385	2.8	sm
20	5.645	2.34	3.305	1.41	m
21	5.435	1.525	3.91	2.56	sm
22	4.775	1.285	3.49	2.72	sm
23	4.515	1.77	2.745	1.55	m

The colour of the ray florets is homogeneous and based on RHS colour chart was observed as RHS 76D. Earlier study by the group in case of cultivated gerberas [8] suggests that the colour trait of *G. gossypina* is distinct and may be incorporated in cultivated gerberas through a breeding programme. Mean values for all the traits, over two years is presented in Table 2. Based on analysis of variance no significant variation was observed among plants for most of the traits under observation (Table 3). Low variations were observed for floral traits among plants in the present study (Figure 2). Lack of variation for traits in the population may be considered as an impediment to fitness of the population. *G. gossypina* is sporadically distributed along the dry slopes at elevations of 1200-2400 m amsl in the Western Himalayan region and has been reported from Sainj and Jiva Nal valley in the Great Himalayan National Park [9], hills near Palampur in Dhauladhar Mountain region [1] and also Batote region of Jammu & Kashmir in the Northern parts of Western Himalayas [10]. The vernacular name of the species is mentioned as '*Kopara*' [9] and its leaves are used in traditional medicines for treatment of blood pressure, gastric disorders and staunching of wounds [1]. The species occurs in small niches and is exposed to natural threats such as over-grazing in meadows or other developmental activities by Humans. Considering its potential uses, the plant was selected for domestication as an ornamental and possible also as a medicine plant for future use [1].

Figure 2. Morphological features of Gerbera gossypina (a) Flowering plant, (b) close up of flowers and (c) seed formation.

Table 2. Performance of *Gerbera gossypina* in pots for different morphological traits (data pooled over 2008 and 2009).

Family No.	No. of days first flower remain fresh			Duration of flowering (days)			Flower diameter			Flowers/plant			Stalk height (cm)			Stalk diameter (mm)		
	R I	R II	R III	R I	R II	R III	R I	R II	R III	R I	R II	R III	R I	R II	R III	R I	R II	R III
1.	12.5	6.5	8.0	34.5	34.5	33.5	3.55	4.1	4.15	7.0	5.5	6.0	23.0	21.75	22.65	1.6	2.1	1.7
2.	13.5	10.5	7.0	30.0	34.5	32.5	4.55	3.35	3.85	5.5	6.0	3.5	21.65	25.3	26.9	2.3	2.2	2.35

Family No.	No. of days first flower remain fresh			Duration of flowering (days)			Flower diameter			Flowers/plant			Stalk height (cm)			Stalk diameter (mm)		
3.	8.0	11.5	13.0	31.5	35.0	28.5	4.2	4.1	3.95	6.5	3.5	6.0	21.25	22.75	23.8	2.4	2.2	2.1
4.	13.5	8.5	10.0	29.0	35.5	30.0	4.3	4.55	3.95	2.5	3.0	5.0	20.1	24.25	24.9	2.35	1.85	1.85
5.	12.5	11.0	10.5	30.5	31.0	32.0	4.15	4.1	3.85	5.5	4.0	5.5	20.45	23.0	26.55	2.0	2.2	1.75
6.	10.5	12.5	15.5	31.5	30.0	30.5	4.2	4.25	4.45	7.5	4.0	4.0	26.95	25.95	21.2	2.25	1.95	2.25
7.	6.5	8.0	10.0	30.0	31.0	28.0	3.85	3.95	3.95	3.0	6.5	4.0	20.35	25.8	22.9	1.85	2.25	1.95
8.	9.5	9.5	8.5	33.0	31.5	28.0	3.75	3.95	3.65	4.5	4.0	4.5	19.05	21.7	21.35	2.5	2.15	2.05
9.	9.5	9.0	11.5	33.0	32.5	31.0	3.25	3.45	3.55	5.5	4.5	2.0	21.35	24.8	23.45	2.2	2.35	2.3
10.	10.5	11.5	10.5	29.0	34.5	28.5	3.95	3.95	3.4	5.5	3.5	3.0	21.6	21.5	18.25	2.15	1.9	2.15
Mean	10.65	9.85	10.45	31.2	33.0	30.25	3.975	3.975	3.875	5.3	4.45	4.35	21.575	23.68	23.195	2.16	2.115	2.045
CD (±)	3.82			3.18			0.49			2.36			3.56			0.34		

Table 3. Analysis of variance of morphological traits of *Gerbera gossypina* plants over two years in pots.

Source of variations	df	Mean square values					
		No. of days first flower remain fresh	Duration of flowering (days)	Flower diameter	Flowers/plant	Stalk height (cm)	Stalk diameter (mm)
Families	9	5.26	4.52	0.19	1.84	5.85	0.07
Replications	2	1.73	19.50*	0.03	2.72	12.15	0.03
Error	18	4.96	3.44	0.08	1.90	4.32	0.03

*Significant at P=0.05

High error variance was observed for some of the traits suggesting influence of environmental conditions on these traits. Perennial plant species are reported to exhibit phenotypically plastic growth behavior in response to environment variations which account for adaptive feature of the species. Several plants that occur in high altitude meadows, rocky out crops and scrub areas survive adverse climatic conditions and exhibit special adaptation and interesting modes of perenation. The common adaptation seen in such plants are the cushion habit, development of wool and small size with thick hairy textures [3].

Cultivated gerbera accession IHBT-Gr-02 flowers throughout the year, has large flower size (10.4 cm) and vigorous growth. Flower colours in cultivated gerbera range from different shades of white, yellow, orange, red and purple. However, seedlings of *G. gossypina* have distinct and homogenous flower colour (RHS 76D) and is free of diseases such as powdery mildew and grey mould which are prevalent in cultivated gerbera species. Propagation of the plants through seeds as well as through division of suckers is easy, which is a desirable attribute for fast multiplication and successful establishment of plants under potted conditions. Also, *G. gossypina* is free of prevalent insect pests and diseases of *G. jamesonii*. Therefore, *G. gossypina* may be considered as a source of important traits which can be utilized for improvement of cultivated gerberas through a backcross hybridization programme. Overall, *G. gossypina* responded well under the domestication process and has potential use as an ornamental pot plant.

5. Summary and Conclusions

Gerbera gossypina (Royle) Beauv. (Asteraceae) is a perennial wild plant of Himalayan origin, which was collected from the Palampur area of Dhauladhar Mountain region of Western Himalayas. Ethno-botanic uses of the plant species include treatment of blood pressure, gastric disorders and staunching of wounds. Considering threat to the plant species in its natural habitat and its potential uses as an ornamental plant and a source of variations for improvement of the cultivated species, *G. gossypina* was studied for domestication and conservation. Domestication and characterization studies indicate that *G. gossypina* may be used as an ornamental pot plant due to its compact plant size, small flowers of distinct light pink colour and green foliage with woolly fibers on the under surface. Low variations were observed among the seedling plants for different floral parameters which suggest prospects of propagation through seeds for rapid multiplication of the planting material. The wild gerbera species is free of prevalent insect pests and diseases of *G. jamesonii* and may be considered as a source of important traits for improvement of cultivated gerberas through a breeding programme.

Acknowledgements

The authors are grateful to the Director, CSIR-Institute of Himalayan Bioresource Technology, Palampur (HP, India) for providing the plant material and facilities for the study.

References

[1] Anonymous. 2004. Annual Report of Institute of Himalayan Bioresource Technology (CSIR), HP. p. 37.

[2] Anonymous. 2005. Annual Report of Institute of Himalayan Bioresource Technology (CSIR), HP. p. 29.

[3] Aswal B.S., Mehrotra B.N. 1994. Flora of Lahaul-Spiti (a Cold Desert in North West Himalaya). Bishen Singh Mehendra pal Singh, Dehra Dun, India.

[4] Leván A., Fredga K.,Sandberg A. A.1964. Nomenclature for the centromeric position on chromosomes. Hereditas 52:201-220.

[5] Stebbins G.L. 1971. Chromosomal evolution in higher plants. London: Edward Arnold. pp. 87–90.

[6] RHS Colour Chart. 1995. Published by the Royal Horticultural Society, 80 Vincent Square, London, SW1P 2PE.

[7] Pryor R. L. 1972. A tetraploid gerbera. Hort Science 7: 197-198.

[8] Singh S., Dhyani D., Kumar Ashok. 2011. Flower colour variations in gerbera (Gerbera jamesonii) population using image analysis. Indian Journal of Agricultural Sciences 81 (12): 1130-1136.

[9] Singh, S. K., Rawat, G. S. 2000. Flora of Great Himalayan National Park, Himachal Pradesh. Bishen Singh Mehendra pal Singh, Dehra Dun, India. p. 153.

[10] Sharma B. M., Kachroo, P. 1981. Flora of Jammu & Plants of Neighbourhood. Bishen Singh Mehendra pal Singh, Dehra Dun, India. p. 187.