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Prabhas Sidhya

Ph.D. Research Scholar,
Department of Floriculture,
Medicinal and Aromatic Plants,
Faculty of Horticulture, Uttar Banga
Krishi Viswavidyalaya, Pundibari,
Cooch Behar, West Bengal, India

Indrajit Sarkar

Professor, Department of
Floriculture, Medicinal and Aromatic
Plants, Faculty of Horticulture, Uttar
Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar,
West Bengal, India

Dipayan Sarkar

Ph.D. Research Scholar,
Department of Floriculture,
Medicinal and Aromatic Plants,
Faculty of Horticulture, Uttar Banga
Krishi Viswavidyalaya, Pundibari,
Cooch Behar, West Bengal, India

Soumen Maitra

Professor, Department of
Floriculture, Medicinal and Aromatic
Plants, Faculty of Horticulture, Uttar
Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar,
West Bengal, India

Arpita Mandal Khan

Assistant Professor,
Department of Floriculture,
Medicinal and Aromatic Plants,
Faculty of Horticulture, Uttar Banga
Krishi Viswavidyalaya, Pundibari,
Cooch Behar, West Bengal, India

Ayon Roy

Professor, Department of Plant
Pathology, Faculty of Agriculture,
Uttar Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar,
West Bengal, India

Suprakash Pal

Professor, Department of Agricultural
Entomology, Faculty of Agriculture,
Uttar Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar,
West Bengal, India

Corresponding Author:

Indrajit Sarkar

Professor, Department of
Floriculture, Medicinal and Aromatic
Plants, Faculty of Horticulture, Uttar
Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar,
West Bengal, India

Studies on the performance of spray chrysanthemum cultivars in Terai Region of West Bengal

Prabhas Sidhya, Indrajit Sarkar, Dipayan Sarkar, Soumen Maitra, Arpita Mandal Khan, Ayon Roy and Suprakash Pal

Abstract

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is a spectacular flowering plant known as the "Queen of the East" ranked second only to rose in terms of cut and loose flower crop. The selection of acceptable cultivars is a crucial aspect in export-oriented commercial floriculture; nevertheless, research on this region is quite limited. The present study aimed to evaluate and select suitable spray chrysanthemum cultivars for commercial cultivation in Terai region of West Bengal. The experiment was conducted in the instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya during the period of September to February of 2018-19 and 2019-20. Forty different cultivars of spray chrysanthemum were evaluated based on their growth and flowering parameters. Results revealed that plant height varied from 23.63 cm to 76.71 cm where maximum plant height was observed in Bidhan Antara, number of flowers per plant varied from 28.15 to 136.50 where maximum total number of flowers per plant was observed in Yellow Baby and minimum in Punjab Gold and the flower head diameter varied from 1.23cm to 7.96 cm where Local Yellow- 2 reported the maximum flower diameter and minimum flower diameter was observed in Yellow Baby.

Keywords: Cultivars, performance, spray chrysanthemum, West Bengal, India

1. Introduction

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is a spectacular flowering plant known as the "Queen of the East" (Anderson, 2006) [1]. "Autumn Queen" is another name for it. It is known as "Guldaudi" in Hindi. Chrysanthemum is derived from the Greek words Chryso (golden) and anthos (flower) (Gortzing and Gillow, 1964) [2]. It is native to the Northern Hemisphere, specifically Asia and Europe. "Autumn flower" is another name for it. In the international flower market, chrysanthemum is second only to rose in terms of cut and loose flower crop (Bhattacharjee and De, 2013; Dutta and Gupta, 2012) [3, 4]. It is a member of the 'Asteraceae' family. These pompon chrysanthemums, which look like daisies and are beautifully coloured, represent hope and joy. They are the November flower. They are not only the "National Flower of Japan" and an "Imperial Symbol of Japan," but they also have regal ancestors. Chrysanthemum is a significant flower crop on the global and domestic markets (Swaroop *et al.*, 2008) [5] due to of their great range of colour, form, and size, as well as their extended vase life. These flowers are being used as cut flowers, potted plants, bedding plants, display plants, and loose flowers (Bohra and Kumar, 2014) [6]. It is divided into two categories: large flowered (13 classes) and tiny flowered (10 classes). Large flowering chrysanthemums are produced for cut flowers, whereas tiny flowering chrysanthemums are grown for garland, wreath, bouquets, veni, gajra, loose flowers for religious offerings, and potted plants (Bhattacharjee and De, 2013) [3]. In addition, there are other classes of chrysanthemums: standard and spray. Spray chrysanthemums are dwarf, compact, and used as pot mums, cut sprays, and loose flowers. Erect and tall growing chrysanthemums are good for background planting in gardens and as cut flowers. For display reasons, extra-large blooming kinds are employed. Dwarf and compact growing varieties are used for front row borders and pot mums. Spray chrysanthemums provide an important contribution to floral decorations, garlands, and venis in India. While Indian women people employ the little flowered cultivars in hair ornaments, the long stemmed ones are used in bouquets and vases. It is grown for commercial reasons in numerous Indian states, including Tamil Nadu, Maharashtra, Bihar, Karnataka, West Bengal, Rajasthan, and Madhya Pradesh. There are an around of 2000 distinct cultivars of chrysanthemums worldwide, with India documenting 1000 different types. In 2012-2013, for example, 6.84 million bunches of spray chrysanthemums were sold at Taiwan China

auctions, compared to 3.26 million bunches of regular type chrysanthemums and 3.38 million bunches of roses. Liliun is its nearest rival, selling 8.82 million bunches (source: AHDB Horticulture) [7]. Spray chrysanthemum sales totaled 874 million pieces at Holland flower auctions in 2012, ranking third behind rose and tulip sales of 2336 and 1168 million pieces, respectively. The Terai Region has significant day and night duration fluctuation throughout the maturation periods, namely October and November. In this regard, Chrysanthemum may be a possible flower crop for West Bengal's Terai area, given the nearby flower markets of Siliguri, Assam and North East, Nepal, Bangladesh, and Bhutan. The selection of acceptable cultivars is a crucial aspect in export-oriented commercial floriculture; nevertheless, research on this region is quite limited. Because the agro-climatic circumstances are unique in nature, it is critical to select a group of equally well performing chrysanthemum cultivars exclusively for this location. The present study aimed to evaluate and select suitable spray chrysanthemum cultivars for commercial cultivation in Terai region of West Bengal.

2. Materials and Methods

The experiment was conducted in the Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya during the period of September to February of 2018-19 and 2019-20. Forty different cultivars of spray chrysanthemum were evaluated based on their growth and flowering parameters *viz.* Local yellow, Local Yellow- 2, Heritage, Shukla, Anmol, Doddabelegere, Doddabelegere-1, Arka Kirti, Arka Chandrakath, Bidhan Antara, Nanako Yellow, Nanako White, White Anemone, White Prolific, Yellow Baby, Aparajita, Basanti, Flirt, Geetanjali, Jaya, NBRI Little Kusum, Sweata Singar, Vijay kiran, White Dolley, Winter Queen, Marigold, BCC-4, Arka Yellow Gold, BCC-24, Punjab Gold, Arka Chandrika, BCC-38, BCC-79, Arka Usha Kiran, Arka Pink Star, Rekha, Coffee, Autumn Joy, Vasanthika and A₁ Collection. Soft tip cuttings that were rooted and one month old with two to three leaves were planted in UV-stabilized polybags before being moved to the experimental location. Ten plants of each genotype were planted for every replication in black polythene bags of 8-inch diameter to resemble pot culture. In the first week of September, planting took place. For all of the treatments, the plants received a top dressing of fermented mustard oil cake every 15 days. When it came time to shape the canopy, bamboo sticks were utilized to support the plants that were connected to them. At regular intervals of three to four days, irrigation was administered. After 30 days, the plant was pinched to encourage secondary branches and broaden the growth. The experiment was laid out in completely randomized design twice replicated. Collected data was analyzed with the help of SPSS software and Duncan's multiple range tests at probability level 0.5 was used for determining mean and standard error.

3. Results and Discussion

3.1 Plant Height (cm)

The perusal of data depicted in the table 1 revealed that the

spray chrysanthemum cultivars varied significantly with respect to plant height at the time of flowering. Among these forty selected spray chrysanthemum cultivars the maximum plant height of 74.19 cm and 79.24 cm at the time of flowering was observed in Bidhan Antara (V₁₀) in the year 2018-19 and 2019-20 respectively. In case of pooled data Bidhan Antara (V₁₀) reported the maximum plant height (76.71 cm) followed by BCC-4 (69.54 cm). The minimum plant height (21.26 cm) was observed in Shukla (V₄) in first year (2018-19) which was at par with Arka Pink Star (V₃₅) (21.31 cm) whereas Arka Pink Star (V₃₅) reported the minimum plant height (25.35 cm) in the second year (2019-20) which was at par with Shukla (V₄) (26.01 cm). In case of pooled data Shukla (V₄) reported the minimum plant height of 23.63 cm which was at par with Arka Pink Star (V₃₅) (25.35 cm). Plant height measurements are key factors for chrysanthemum varietal selection for a variety of reasons (Shanker and Tiwari 1993) [8]. The variance in plant height during the flower opening stage was varied, which might be attributed to genetic variables (Shirohi and Behra 2000; Baskaran *et al.*, 2010) [9, 10]. Increased plant height was associated with rapid meristematic activity, most likely due to rapid cell division and elongation during the tender growth period, and could be attributed to genetic factors as well as climatic factors such as light, temperature, nutrition, and soil condition, among others (Suvija *et al.*, 2016) [11]. Plant height variation was noticeable, which might be attributed to genetic control factors because all cultivars were subjected to identical climatic circumstances during the experiment (Sirohi and Behra 2000; Baskaran *et al.*, 2010) [9, 10]. According to Raghava *et al.*, (1992) [12], increased plant height and total vegetative growth would considerably add to chrysanthemum flower output.

3.2 Plant spread (East-West) (cm)

The plant spread can have a considerable impact on its overall aesthetic attractiveness, especially when planted as a bedding plant or in garden displays. Plant spreads that are balanced and well-proportioned are more appealing to gardeners and landscapers. The data presented in the table 1 revealed that the maximum plant spread (E-W) of 47.32 cm, 51.20 cm and 49.26 cm was observed in Bidhan Antara (V₁₀) in the year 2018-19, 2019-20 and pooled respectively whereas minimum plant spread (E-W) of 17.98 cm, 21.13 cm and 19.55 cm was observed in Arka Kirti (V₈) in the year 2018-19, 2019-20 and pooled respectively. Plant spread may increase owing to the creation of new branches and the genetic composition of the plant. Plant dispersal varies owing to additive gene effects (Vidalie *et al.*, 1985) [13].

3.3 Plant spread (North-South) (cm)

The data presented in the table 1 revealed that the maximum plant spread (N-S) of 44.72 cm, 43.50 cm and 44.11 cm was observed in Bidhan Antara (V₁₀) in the year 2018-19, 2019-20 and pooled respectively whereas minimum plant spread (N-S) of 15.40 cm, 19.76 cm and 17.58 cm was observed in Arka Kirti (V₈) in the year 2018-19, 2019-20 and pooled respectively.

Table 1: Plant height (cm), Plant Spread as E-W and N-S direction in cm of forty spray chrysanthemum cultivars in Terai region of West Bengal

Cultivars (Treatments)	Plant height (cm)			Plant Spread (E-W) (cm)			Plant spread (N-S) (cm)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
Local yellow	34.00 ^{lm}	38.12 ^{lm}	36.06 ^m	30.74 ^{ghijk}	32.72 ^{hij}	31.73 ^{hij}	31.41 ^{def}	33.69 ^{cde}	32.55 ^{def}
Local Yellow- 2	62.94 ^{cde}	67.57 ^{cd}	65.26 ^{cd}	43.17 ^b	46.54 ^b	44.85 ^b	39.84 ^b	42.07 ^{ab}	40.96 ^b
Heritage	31.76 ^m	35.99 ⁿ	33.87 ⁿ	20.78 ^{rstu}	23.35 ^{pqrs}	22.07 ^{opqr}	21.63 ^{mn}	24.38 ^{lmno}	23.00 ^{no}
Shukla	21.26 ^o	26.01 ^q	23.63 ^r	18.69 ^{tu}	23.02 ^{pqrs}	20.85 ^{qrs}	23.61 ^{lm}	25.19 ^{klmn}	24.40 ^{mn}
Anmol	34.73 ^l	37.32 ^{lm}	36.02 ^m	22.24 ^{qr}	25.31 ^{nopq}	23.77 ^{no}	19.19 ^{opq}	26.38 ^{ijklm}	22.78 ^{no}
Doddabelegere	33.20 ^{lm}	37.57 ^{lm}	35.39 ^{mn}	21.28 ^{qrst}	25.72 ^{nop}	23.50 ^{nop}	18.72 ^{pq}	21.69 ^{opq}	20.21 ^p
Doddabelegere-1	62.78 ^{cd}	57.34 ^{fg}	60.06 ^e	46.07 ^{ab}	41.70 ^c	43.89 ^b	43.69 ^a	39.27 ^b	41.48 ^b
Arka Kirti	34.69 ^l	36.74 ⁿ	35.71 ^m	17.98 ^u	21.13 ^{rs}	19.55 ^s	15.40 ^f	19.76 ^q	17.58 ^q
Arka Chandrakath	37.99 ^k	39.32 ^{lm}	38.65 ^l	27.35 ^{lmn}	29.03 ^{klm}	28.19 ^{lm}	26.45 ^{jkl}	28.00 ^{ijk}	26.83 ^{kl}
Bidhan Antara	74.19 ^a	79.24 ^a	76.71 ^a	47.32 ^a	51.20 ^a	49.26 ^a	44.72 ^a	43.50 ^a	44.11 ^a
Nanako Yellow	65.54 ^{bc}	72.06 ^b	68.80 ^b	31.87 ^{ghij}	34.76 ^{efgh}	33.32 ^{ghi}	29.23 ^{fg}	31.84 ^{efgh}	30.54 ^{gh}
Nanako White	64.87 ^{cd}	68.74 ^c	66.80 ^c	33.16 ^{defgh}	36.71 ^{def}	34.93 ^{cdefg}	31.07 ^{ef}	34.69 ^{cde}	32.88 ^{cde}
White Anemone	27.73 ⁿ	30.06 ^p	28.90 ^p	20.22 ^{stuv}	22.80 ^{qrs}	21.51 ^{pqrs}	18.73 ^{pq}	24.03 ^{mno}	21.38 ^{op}
White Prolific	43.24 ⁱ	39.30 ^{lm}	41.27 ^k	30.80 ^{ghijk}	27.99 ^{lmn}	29.39 ^{klm}	26.85 ^{hij}	27.41 ^{ijkl}	27.13 ^{jk}
Yellow Baby	32.73 ^{lm}	30.18 ^{op}	31.45 ^o	23.24 ^{pqr}	21.15 ^s	22.20 ^{opqr}	21.31 ^{no}	19.84 ^q	20.57 ^p
Aparajita	48.03 ^h	53.10 ^h	50.56 ^h	33.07 ^{defgh}	36.49 ^{def}	34.78 ^{defg}	32.27 ^{cde}	33.89 ^{cde}	33.08 ^{cd}
Basanti	42.9 ⁱ	47.47 ⁱ	45.19 ⁱ	27.30 ^m	28.77 ^{klm}	28.03 ^{lm}	25.01 ^{jkl}	28.37 ^{ijk}	26.69 ^{kl}
Flirt	55.18 ^{fg}	52.69 ^h	53.93 ^g	35.74 ^{cd}	30.91 ^{ijk}	33.32 ^{ghi}	33.36 ^{cd}	28.72 ^{hi}	31.04 ^{efg}
Geetanjali	56.55 ^f	59.67 ^f	58.11 ^f	28.85 ^{ijklm}	33.57 ^{ghi}	31.21 ^{ijk}	25.13 ^{jkl}	26.18 ^{ijklm}	25.65 ^{klm}
Jaya	53.40 ^g	56.76 ^g	55.08 ^g	27.50 ^{lmn}	28.04 ^{lmn}	27.77 ^m	24.72 ^{jkl}	25.35 ^{ijklm}	25.03 ^{lm}
NBRI Little Kusum	62.03 ^e	66.23 ^{de}	64.13 ^d	35.15 ^{cde}	36.69 ^{def}	35.92 ^{cde}	33.70 ^c	32.76 ^{cde}	33.23 ^{cd}
Sweata Singar	23.82 ^o	27.10 ^q	25.46 ^q	24.07 ^{opq}	26.23 ^{mno}	25.15 ⁿ	25.77 ^{jkl}	27.93 ^{ijk}	26.85 ^{jkl}
Vijay kiran	46.71 ^h	52.11 ^h	49.41 ^h	32.41 ^{efghi}	36.07 ^{defg}	34.24 ^{efg}	28.32 ^{gh}	32.05 ^{defg}	30.18 ^{gh}
White Dolley	46.56 ^h	43.64 ^k	45.10 ⁱ	30.35 ^{hijkl}	29.67 ^{kl}	30.01 ^{ijkl}	26.07 ^{hijk}	28.79 ^{ghi}	27.43 ^{ijk}
Winter Queen	63.43 ^{cde}	66.92 ^{cde}	65.17 ^d	36.67 ^c	37.21 ^{de}	36.94 ^c	32.90 ^{cde}	34.23 ^{cde}	33.57 ^{cd}
Marigold	34.53 ^l	37.51 ^{lm}	36.02 ^m	28.23 ^{klmn}	30.55 ^{ijkl}	29.39 ^{klm}	26.03 ^{ijk}	32.44 ^{de}	29.23 ^{ghi}
BCC-4	67.79 ^b	71.30 ^b	69.54 ^b	35.71 ^{cd}	37.69 ^d	36.70 ^{cd}	33.75 ^c	35.23 ^{cd}	34.49 ^c
Arka Yellow Gold	33.70 ^{lm}	36.14 ⁿ	34.92 ^{mn}	21.79 ^{qrs}	26.55 ^{mno}	24.17 ^{no}	20.71 ^{nop}	25.19 ^{klmn}	22.95 ^{no}
BCC-24	60.87 ^e	68.59 ^{cd}	64.73 ^d	33.67 ^{cdefg}	36.57 ^{def}	35.12 ^{cdefg}	31.18 ^{def}	34.69 ^{cde}	32.93 ^{cd}
Punjab Gold	39.3 ^k	44.78 ^{jk}	42.04 ^{ik}	18.96 ^{stu}	24.05 ^{opqr}	21.50 ^{pqrs}	17.81 ^q	23.16 ^{mnpq}	20.48 ^p
Arka Chandrika	46.9 ^h	52.14 ^h	49.54 ^h	29.07 ^{ijklm}	34.23 ^{fgh}	31.65 ^{hij}	24.51 ^{kl}	28.60 ^{hij}	26.56 ^{kl}
BCC-38	61.40 ^e	68.32 ^{cd}	64.86 ^d	34.52 ^{cdef}	36.49 ^{def}	35.50 ^{cdef}	32.30 ^{cde}	35.71 ^c	34.01 ^{cd}
BCC-79	56.76 ^f	64.52 ^e	60.64 ^e	32.35 ^{efghi}	34.71 ^{efgh}	33.53 ^{fgh}	29.23 ^{fg}	32.23 ^{def}	30.73 ^{fg}
Arka Usha Kiran	27.32 ⁿ	32.56 ^o	29.94 ^{op}	20.39 ^{rstu}	22.06 ^{rs}	21.22 ^{qrs}	19.96 ^{nopq}	20.10 ^{pq}	20.03 ^p
Arka Pink Star	22.31 ^o	25.35 ^q	23.83 ^r	18.67 ^{tu}	21.77 ^{rs}	20.22 ^{rs}	21.68 ^{mn}	20.71 ^{pq}	21.19 ^{op}
Rekha	37.50 ^k	40.92 ^l	39.21 ⁱ	26.79 ^{mno}	28.57 ^{klm}	27.68 ^m	26.01 ^{ijk}	28.78 ^{hi}	27.40 ^{ijk}
Coffee	38.00 ^k	44.33 ^{jk}	41.17 ^k	25.76 ^{nop}	29.02 ^{klm}	27.39 ^m	25.13 ^{jkl}	27.74 ^{ijk}	26.44 ^{kl}
Autumn Joy	40.00 ^{jk}	46.72 ^{ij}	43.36 ^j	26.99 ^{mno}	31.21 ^{ijk}	29.10 ^{klm}	25.07 ^{jkl}	28.80 ^{ghi}	26.93 ^{jk}
Vasanthika	42.28 ^{ij}	47.84 ⁱ	45.06 ⁱ	29.53 ^{ijklm}	30.66 ^{jkl}	30.09 ^{ijkl}	28.20 ^{ghi}	29.15 ^{fghi}	28.67 ^{hij}
A1 collection	34.45 ^l	36.27 ⁿ	35.36 ^{mn}	21.82 ^{qrs}	23.08 ^{pqrs}	22.45 ^{opq}	19.01 ^{pq}	22.40 ^{nopq}	20.71 ^p
S.E(m)±	0.92	0.87	0.74	1.06	0.98	0.74	0.79	1.14	0.65
CD at 5 %	2.63	2.48	2.11	3.04	2.80	2.11	2.26	3.26	1.86

3.4 Total number of flowers per plant

The perusal of data depicted in the table 2 reflected that the spray chrysanthemum cultivars varied significantly with respect to total number of flowers per plant. Among the forty cultivars the maximum total number of flowers per plant of 136.50 and 130.50 was observed in Yellow Baby (V₁₅) in first year and pooled respectively while in second year Sweata Singar (V₂₂) reported the maximum number of flowers per plant (128.13). The minimum number of flowers per plant (23.38, 32.92 and 28.15) was observed in Punjab Gold (V₃₀) in first year, second year and pooled respectively. Flower production per plant is a great indication for plant characterization for a variety of uses. Higher yield might be attributed to an increase in morphological characteristics such as plant height, plant spread, and number of branches, which could have led to the generation of more photosynthates, resulting in the production of more flowers per plant. (Singh *et al.*, 2019) [14]. The largest flower number per plant might be linked to the commencement of more branches per plant, which eventually results in the development of more flower

buds per plant, resulting in an increase in yield (Prabhu *et al.*, 2018) [15]. Growers consider yield to be one of the most desired characteristics. Flower output is primarily influenced by the genetic makeup of the cultivar and its interaction with its environment (Palai *et al.*, 1999) [16]. Significant results were also detected in relation to comparable discoveries, with Winter Queen being recorded with (29.33) number of blooms per plant, which was regarded poor in relation to the environment. Winter Queen was recorded (34.43) by Singh *et al.*, (2017) [17], which was lower with respect to the experiment.

3.5 Flower Diameter (cm)

It is evident from the table 2 that the flower diameter varied significantly among these cultivars. The result revealed that Local Yellow- 2 (V₂) reported the maximum flower diameter of 8.19, 7.73 and 7.96 in the first year (2018-19), second year (2019-20) and pooled respectively. The minimum flower diameter (1.31, 1.14 and 1.23) was observed in Yellow Baby (V₁₅) in first year, second year and pooled respectively. The

variance in flower diameter might be attributed to differences in the genetic composition of cultivars. Thus, variation in blossom diameter in cultivars may be linked to underlying genetic characteristics of specific cultivars as well as environmental influences (Singh and Ramachandran, 2002) [18]. The genetic makeup of the cultivars and their interaction with the environment determine all blooming properties (Suvija *et al.*, 2016) [11]. floral head diameter is an important

characteristic for determining floral quality, which promotes demand in excellent market value. (Thakur *et al.*, 2018) [19] discovered a disparity in the size of chrysanthemum flowers. In relation to the experiment, Kireeti *et al.*, (2017) [20] discovered comparable results, ranging from 3.38 to 7.84cm. Among them, White Prolific was measured at 5.75cm, which was lower than the experiment. Parmar *et al.*, (2019) [21] measured a lower value (5.16cm) in the same context.

Table 2: Flower Diameter (cm) and total number of flowers per plant of forty spray chrysanthemum cultivars in Terai region of West Bengal

Cultivars (Treatments)	Flower Diameter (cm)			Total number of flowers per plant		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
Local yellow	5.03 ^{efgh}	6.05 ^c	5.54 ^{ef}	26.23 ^{rs}	35.08 ^{tu}	30.65 ^{uv}
Local Yellow- 2	8.19 ^a	7.73 ^a	7.96 ^a	53.25 ^{ghijk}	63.73 ^{efghi}	58.49 ^{ghi}
Heritage	4.00 ^{klmn}	4.66 ^{gh}	4.33 ^{ijk}	33.79 ^{opq}	40.70 ^{rst}	37.24 st
Shukla	4.51 ^{ghij}	3.36 ^{lmn}	3.93 ^{lmnop}	43.79 ^{lm}	52.09 ^{mnp}	47.94 ^{mop}
Anmol	3.93 ^{klmno}	4.09 ^{ij}	4.01 ^{klmno}	40.66 ^{mn}	51.85 ^{nop}	46.26 ^{opq}
Doddabelegere	3.06 ^{qrs}	3.90 ^{jk}	3.48 ^{rstu}	50.32 ^{jk}	61.03 ^{ghijkl}	55.67 ^{ijk}
Doddabelegere-1	4.80 ^{fghi}	4.10 ^{ij}	4.45 ^{ij}	43.68 ^{lm}	37.06 ^{tu}	40.37 ^{rs}
Arka Kirti	3.65 ^{lmnopqr}	2.99 ^{no}	3.32 ^{tuv}	39.29 ^{mno}	44.83 ^{qrs}	42.06 ^{qr}
Arka Chandrakath	3.88 ^{klmno}	4.14 ^{ij}	4.01 ^{klmno}	37.74 ^{mno}	46.77 ^{pqr}	42.26 ^{qr}
Bidhan Antara	3.33 ^{opqrs}	4.08 ^j	3.70 ^{opqrs}	73.23 ^d	83.93 ^c	78.58 ^d
Nanako Yellow	3.93 ^{klmno}	3.15 ^{lmn}	3.54 ^{qrst}	58.73 ^{efg}	64.10 ^{efgh}	61.42 ^{fg}
Nanako White	3.67 ^{lmnopq}	4.13 ^{ij}	3.90 ^{lmnopq}	59.29 ^{efg}	64.78 ^{efgh}	62.04 ^{fg}
White Anemone	3.01 ^{rs}	2.71 ^o	2.86 ^w	84.19 ^c	94.88 ^b	89.53 ^c
White Prolific	6.24 ^c	5.61 ^{de}	5.93 ^d	62.88 ^e	70.20 ^{de}	66.54 ^e
Yellow Baby	1.31 ^t	1.14 ^p	1.23 ^s	136.50 ^a	124.50 ^a	130.50 ^a
Aparajita	3.84 ^{klmno}	3.29 ^{lmn}	3.56 ^{qrst}	62.07 ^{ef}	71.92 ^d	66.99 ^e
Basanti	3.47 ^{nopqrs}	4.03 ^j	3.75 ^{mnpqrs}	69.75 ^d	82.38 ^c	76.06 ^d
Flirt	5.13 ^{efg}	5.51 ^{de}	5.32 ^{fg}	58.13 ^{efgh}	47.75 ^{pq}	52.94 ^{ijklm}
Geetanjali	4.80 ^{fghi}	5.01 ^{fg}	4.91 ^h	48.37 ^{kl}	55.34 ^{lmno}	51.85 ^{klmn}
Jaya	6.05 ^{cd}	5.41 ^{def}	5.73 ^{de}	43.43 ^{lm}	57.21 ^{ijklmn}	50.32 ^{lmno}
NBRI Little Kusum	4.20 ^{ijklm}	3.91 ^{ijk}	4.06 ^{klmn}	57.62 ^{efgh}	64.70 ^{efgh}	61.16 ^{fg}
Sweata Singar	3.15 ^{pqrs}	3.28 ^{lmn}	3.21 ^{uvw}	110.50 ^b	128.13 ^a	119.31 ^b
Vijay kiran	3.91 ^{klmno}	4.25 ^{hij}	4.08 ^{klm}	39.50 ^{mno}	50.10 ^{opq}	44.80 ^{pq}
White Dolley	4.97 ^{fgh}	5.48 ^{de}	5.22 ^{fgh}	71.75 ^d	55.74 ^{klmno}	63.74 ^{ef}
Winter Queen	6.99 ^b	7.56 ^a	7.27 ^b	50.71 ^{ijk}	62.10 ^{fghijk}	56.40 ^{hij}
Marigold	6.25 ^c	6.84 ^b	6.54 ^c	10.05 ^t	11.47 ^v	10.76 ^w
BCC-4	4.28 ^{ijkl}	4.16 ^{ij}	4.22 ^{ijkl}	56.94 ^{efghi}	63.53 ^{efghij}	60.23 ^{fgh}
Arka Yellow Gold	3.40 ^{nopqrs}	4.13 ^{ij}	3.76 ^{mnpqrs}	40.78 ^{mn}	56.87 ^{ijklmn}	48.82 ^{mno}
BCC-24	5.40 ^{def}	4.63 ^{gh}	5.01 ^{gh}	53.99 ^{ghijk}	68.63 ^{def}	61.31 ^{fg}
Punjab Gold	3.68 ^{lmnopq}	3.08 ^{mno}	3.38 ^{stuv}	23.38 ^s	32.92 ^u	28.15 ^v
Arka Chandrika	3.14 ^{pqrs}	3.44 ^{lm}	3.29 ^{tuv}	34.92 ^{nopq}	44.89 ^{qrs}	39.90 ^{rs}
BCC-38	5.16 ^{ef}	5.75 ^{cd}	5.45 ^{ef}	58.58 ^{efgh}	67.00 ^{defg}	62.79 ^{ef}
BCC-79	5.68 ^{cde}	5.30 ^{ef}	5.49 ^{ef}	53.26 ^{ghijk}	63.69 ^{efghi}	58.47 ^{ghi}
Arka Usha Kiran	2.95 ^s	3.11 ^{mno}	3.03 ^{vw}	42.63 ^{lm}	46.61 ^{pqr}	44.62 ^{pq}
Arka Pink Star	3.61 ^{mnpqrs}	3.33 ^{lmn}	3.47 ^{rstu}	47.72 ^{kl}	58.74 ^{hijklm}	53.23 ^{kl}
Rekha	4.84 ^{fghi}	4.11 ^{ij}	4.47 ⁱ	55.74 ^{fghij}	66.69 ^{defg}	61.21 ^{fg}
Coffee	4.40 ^{hijk}	4.51 ^{hi}	4.46 ⁱ	50.98 ^{ijk}	60.73 ^{ghijkl}	55.86 ^{ijk}
Autumn Joy	3.73 ^{lmnop}	3.58 ^{kl}	3.65 ^{opqrst}	52.16 ^{hijk}	64.30 ^{efgh}	58.23 ^{ghi}
Vasanthika	5.30 ^{ef}	5.66 ^{cde}	5.48 ^{ef}	31.73 ^{pqr}	39.52 ^{stu}	35.63 ^t
A1 collection	5.39 ^{ef}	5.58 ^{de}	5.48 ^{ef}	31.05 ^{qr}	35.67 ^{tu}	33.36 ^{tu}
S.E(m)±	0.22	0.14	0.12	2.28	2.34	1.47
CD at 5 %	0.65	0.42	0.37	6.52	6.70	4.22

3.6 Duration of flowering (Days)

The perusal of data depicted in the table 3 showed that the spray chrysanthemum cultivars varied significantly with respect to duration of flowering. Among the forty cultivars the maximum duration of flowering of 45.19 days was observed in NBRI Little Kusum (V₂₁) in first year while in second year (2019-20) maximum duration of flowering of 49.39 days was observed in White Anemone (V₁₃) and in pooled Bidhan Antara (V₁₀) reported to be the maximum (46.24 days) followed by White Anemone (V₁₃) (46.19 days). The minimum duration of flowering (31.36 and 32.53 days) was

observed in Local yellow (V₁) in first year (2018-19) and pooled respectively while in second year (2019-20) minimum duration of flowering of 21.27 days was observed in the genotype Coffee (V₃₇). These variations have an economic advantage in terms of selecting cultivars with consistent floral blooming periods. The variance in blooming length among types can be ascribed to changes in the plant's genetic composition (Gaikwad and Patil 2001; Pal *et al.*, 2003) [22, 23]. The duration of blossoming is critical since it indicates the availability of the flower in marketplaces.

Table 3: Duration of flowering (Days) and field life (Days) of forty spray chrysanthemum cultivars in Terai region of West Bengal

Cultivars (Treatments)	Duration of flowering (Days)			Field life (Days)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
Local yellow	31.36 ^t	33.71 ^{stu}	32.53 ^v	16.88 ^{mnopqrstu}	18.95 ^{bcdefghij}	17.91 ^{ghijklmnop}
Local Yellow- 2	33.13 ^{opqr}	37.01 ^{mnopqr}	35.07 ^{stu}	17.73 ^{ijklmnopqrs}	19.38 ^{bcdef}	18.55 ^{efghijklm}
Heritage	41.06 ^{bcdef}	34.54 ^{rstu}	37.80 ^{ijklmnop}	18.63 ^{efghijklm}	19.25 ^{bcdefg}	18.94 ^{defghij}
Shukla	33.67 ^{lmnopqr}	38.56 ^{klmno}	36.11 ^{pqrst}	16.63 ^{opqrstu}	17.00 ^{ijklm}	16.81 ^{op}
Anmol	39.86 ^{cdefg}	32.89 ^{tu}	36.37 ^{opqrst}	17.38 ^{ijklmnopqrst}	18.13 ^{efghijk}	17.75 ^{ghijklmnop}
Doddabelegere	42.50 ^{abcd}	39.66 ^{ijklmn}	41.08 ^{defg}	17.88 ^{ijklmnopqr}	19.06 ^{bcdefghi}	18.47 ^{efghijklmn}
Doddabelegere-1	34.23 ^{klmnopqr}	40.66 ^{ghijkl}	37.45 ^{klmnopq}	18.63 ^{efghijklm}	17.74 ^{efghijklm}	18.18 ^{efghijklmno}
Arka Kirti	38.88 ^{efghi}	42.88 ^{efgh}	40.88 ^{defg}	18.13 ^{hijklmnop}	17.63 ^{efghijklm}	17.88 ^{efghijklmnop}
Arka Chandrakath	33.38 ^{nopqr}	37.24 ^{mnopqr}	35.31 ^{rstu}	16.50 ^{pqrstu}	18.38 ^{defghijk}	17.44 ^{ijklmnop}
Bidhan Antara	44.00 ^{ab}	48.49 ^{ab}	46.24 ^a	21.75 ^{bc}	20.75 ^{abc}	21.25 ^{ab}
Nanako Yellow	33.55 ^{mnopqr}	38.88 ^{ijklmno}	36.21 ^{pqrst}	18.38 ^{efghijklmno}	19.13 ^{bcdefgh}	18.75 ^{defghijk}
Nanako White	31.50 ^t	36.15 ^{opqrs}	33.82 ^{uv}	18.38 ^{efghijklmno}	17.25 ^{hijklm}	17.81 ^{ghijklmnop}
White Anemone	43.00 ^{abc}	49.39 ^a	46.19 ^{ab}	18.75 ^{efghijkl}	17.25 ^{hijklm}	18.00 ^{efghijklmnop}
White Prolific	32.38 ^{pqr}	36.71 ^{nopqrs}	34.54 ^{tuv}	17.00 ^{lmnopqrstu}	16.75 ^{klmn}	16.88 ^{nop}
Yellow Baby	40.75 ^{bcdef}	44.45 ^{cde}	42.60 ^{cd}	17.97 ^{ijklmnopq}	18.13 ^{efghijk}	18.05 ^{efghijklmnop}
Aparajita	32.25 ^{qr}	39.88 ^{hijklm}	36.07 ^{pqrst}	20.00 ^{cdefg}	18.88 ^{bcdefghij}	19.44 ^{cdef}
Basanti	36.88 ^{ghijklm}	46.25 ^{bcd}	41.56 ^{def}	19.88 ^{defgh}	18.38 ^{defghijk}	19.13 ^{cdefgh}
Flirt	31.63 ^f	40.79 ^{ghijkl}	36.21 ^{pqrst}	18.38 ^{efghijklmno}	17.13 ^{ijklm}	17.75 ^{ghijklmnop}
Geetanjali	41.88 ^{abcde}	35.07 ^{pqrstu}	38.47 ^{ijklmn}	16.89 ^{mnopqrstu}	17.50 ^{efghijklm}	17.20 ^{klmnop}
Jaya	38.13 ^{efghij}	40.45 ^{ghijkl}	39.29 ^{ghijkl}	19.63 ^{defghi}	17.73 ^{efghijklm}	18.68 ^{efghijkl}
NBRI Little Kusum	45.19 ^a	39.38 ^{ijklmn}	42.28 ^{cde}	19.16 ^{defghi}	18.88 ^{bcdefghij}	19.02 ^{defghi}
Sweata Singar	41.37 ^{bcdef}	46.57 ^{abc}	44.18 ^{bc}	17.50 ^{ijklmnopqrst}	20.25 ^{bcd}	18.88 ^{defghij}
Vijay kiran	34.20 ^{klmnopqr}	41.79 ^{efghij}	37.99 ^{ijklmnop}	23.91 ^a	19.50 ^{bcde}	21.70 ^a
White Dolley	35.75 ^{ijklmnop}	40.79 ^{ghijkl}	38.27 ^{ijklmno}	16.14 ^{rstu}	18.05 ^{efghijk}	17.09 ^{lmnop}
Winter Queen	36.24 ^{hijklmno}	43.43 ^{defg}	39.83 ^{efghij}	17.95 ^{ijklmnopqr}	18.31 ^{defghijk}	18.13 ^{efghijklmno}
Marigold	35.34 ^{ijklmnopq}	41.56 ^{efghijk}	38.45 ^{ijklmn}	18.95 ^{efghij}	22.41 ^a	20.68 ^{abc}
BCC-4	38.25 ^{efghij}	42.29 ^{efghi}	40.27 ^{efghi}	20.09 ^{cdef}	17.97 ^{efghijkl}	19.03 ^{defghi}
Arka Yellow Gold	38.68 ^{efghij}	34.78 ^{qrstu}	36.73 ^{mnopqrs}	16.80 ^{mnopqrstu}	18.96 ^{bcdefghij}	17.88 ^{efghijklmnop}
BCC-24	36.69 ^{ghijklmn}	44.54 ^{cde}	40.61 ^{defgh}	20.79 ^{cd}	17.95 ^{efghijkl}	19.37 ^{cdefg}
Punjab Gold	35.38 ^{ijklmnopq}	37.75 ^{lmnopq}	36.56 ^{nopqrst}	18.13 ^{hijklmnop}	16.06 ^{lmn}	17.09 ^{lmnop}
Arka Chandrika	36.94 ^{ghijk}	41.86 ^{efghij}	39.40 ^{ghijk}	18.58 ^{efghijklmn}	20.81 ^{ab}	19.69 ^{bcde}
BCC-38	38.88 ^{efghi}	42.81 ^{efgh}	40.84 ^{defg}	18.26 ^{ghijklmnop}	15.01 ⁿ	16.63 ^{op}
BCC-79	36.49 ^{ghijklmno}	41.04 ^{efghij}	38.76 ^{hijklm}	15.38 ^u	18.10 ^{efghijk}	16.74 ^{op}
Arka Usha Kiran	35.85 ^{ijklmno}	41.13 ^{efghijk}	38.49 ^{ijklmn}	20.47 ^{cde}	17.38 ^{efghijklm}	18.92 ^{defghij}
Arka Pink Star	37.25 ^{ghijk}	43.91 ^{def}	40.58 ^{defgh}	16.00 ^{stu}	19.17 ^{bcdefgh}	17.58 ^{hijklmnop}
Rekha	33.40 ^{nopqr}	37.95 ^{lmnop}	35.67 ^{pqrstu}	22.95 ^{ab}	17.75 ^{efghijklm}	20.35 ^{abcd}
Coffee	38.25 ^{efghij}	32.27 ^u	35.26 ^{rstu}	15.75 ^{tu}	18.97 ^{bcdefghij}	17.36 ^{ijklmnop}
Autumn Joy	39.41 ^{defgh}	35.17 ^{pqrstu}	37.29 ^{lmnopqr}	18.88 ^{efghijk}	15.00 ⁿ	16.94 ^{mnop}
Vasanthika	38.06 ^{efghij}	35.37 ^{pqrst}	36.72 ^{mnopqrs}	16.26 ^{qrstu}	18.81 ^{cdefghij}	17.53 ^{hijklmnop}
A1 collection	39.29 ^{defgh}	42.13 ^{efghi}	40.71 ^{defgh}	17.13 ^{klmnopqrstu}	15.79 ^{mn}	16.46 ^p
S.E(m)±	1.1	1.07	0.71	0.63	0.69	0.56
CD at 5 %	3.37	3.05	0.25	1.81	1.98	1.61

3.7 Field life (Days)

It is evident from the table 3 that the field life varied significantly among these cultivars. The result revealed that Vijay kiran (V₂₃) reported the maximum field life of 23.91 and 21.70 days in the first year (2018-19) and pooled respectively while Marigold (V₂₆) reported maximum field life of 22.41 days in second year (2019-20). The minimum field life of 15.38 days was observed in BCC-79 (V₃₃) in first year (2018-19), 15.00 days in Autumn Joy (V₃₈) in second year (2019-20) and 16.46 in A1 collection (V₄₀) in pooled. The variations resulted in the experiment may be due to the genetic and their interactions with environment.

4. Conclusion

Based on the observations and data analysis, it is possible to conclude that forty chrysanthemum cultivars differed significantly. These cultivars can be further classified based on their features. Furthermore, those cultivars classified as cut flower, pot flower, or bedding flower might be recommended. As a result, this morphological and floral attributes will be a

valuable resource for breeders and researchers in identifying new characteristics in future flower trait development and proposing better cultivars to the farming communities who associated with commercial cultivation of flowers in the Terai region of West Bengal. From the study, it may be recommended that the cultivars like Local Yellow- 2, White Prolific, Marigold, Jaya, Vasanthika and A1 collection are suitable for cut flowers while Yellow Baby, White Anemone, Arka Usha Kiran, Aparajita, Basanti, Bidhan Antara, Sweata Singar, White Dolley are for loose flowers production in the Terai region of West Bengal. The cultivars namely Bidhan Antara, Local Yellow-2, Doddabelegere-1, Yellow Baby, White Anemone, Sweata Singar and Winter Queen may be selected for pot plants and for garden display due to profuse uniform branching and blooming.

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