International Journal of Bio-resource and Stress Management https://ojs.pphouse.org/index.php/IJBSM

Crossref

IJBSM July 2025, 16(7): 01-14 **Article** AR6208

Research Article *Natural Resource Management*

DOI: HTTPS://DOI.ORG/10.23910/1.2025.6208

Performance of Chrysanthemum (*Chrysanthemum morifolium* Ramat.) in Terai Region of West Bengal

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0009-0009-4461-4964

ABSTRACT

The present investigation was carried out at Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants in Uttar Banga Krishi Viswavidyalaya, West Bengal, India during July, 2018 to February, 2020 at Terai region of West Bengal, India to evaluate the suitable spray chrysanthemum genotypes for commercial cultivation. The experiment was laid out in completely randomized design twice replicated. Fourty different genotypes of spray chrysanthemum were evaluated based on their growth and flowering parameters. Considering the vegetative growth, Local Yellow-2 showed the maximum number of branches (12.04) in pooled whereas Marigold recorded the minimum (6.82). The genotypes Arka Usha Kiran showed the maximum vase life of 11.69 days while Arka Pink Star recorded the minimum (6.64). Genotypes including Jaya, Vasanthika, Marigold, Local Yellow-2, White Prolific, and A1 collection were considered good for cut flowers, whereas Yellow Baby, White Anemone, Usha Kiran, Aparajita, Basanti, Bidhan Antara, Sweata Singar, and White Dolley were used for the production of loose flowers. Arka Yellow Gold reported the maximum days for first flower full blooming of 143.82 and 144.60 days in the second year and pooled respectively while in the first year Sweta Singar reported the maximum days for first flower full blooming. The minimum days for first flower full blooming was observed in Geetanjali in second year and pooled respectively while in the first year Jaya reported the minimum days for first flower full blooming.

KEYWORDS: Genotypes, performance, spray chrysanthemum

***Citation* (VANCOUVER):** Sarkar et al., Performance of Chrysanthemum (*Chrysanthemum morifolium* Ramat.) in Terai Region of West Bengal. *International Journal of Bio-resource and Stress Management,* 2025; 16(7), 01-14. HTTPS://DOI.ORG/10.23910/1.2025.6208.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 08th March 2025 RECEIVED in revised form on 26th June 2025 ACCEPTED in final form on 12th July 2025 PUBLISHED on 22nd July 2025

1. INTRODUCTION

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is one of the most beautiful flowering plant glorified to as Queen of East (Anderson, 2006). It is also known as "Autumn Queen", Autumn flower or in Hindi as "Guldaudi" which is indigenous to the Northern Hemisphere (Su et al., 2019), primarily in Asia and Europe (Kamal et al., 2024; Ryu et al., 2019). Chrysanthemum, belongs to family Asteraceae (Mekapogu et al., 2020; Li et al., 2016), is an important cut and loose flower crop which is next only to rose in the international flower market (Bhattacharjee and De, 2013; Uddin et al., 2015). These pompon chrysanthemums, which resemble daisies and are exquisitely coloured, stand for hope and joy. Chrysanthemum is an important flower crop both in international and domestic market. Due to the wide variation in their colour, form and size, long vase life; these flowers are used as cut flowers, potted plants, bedding plants, exhibition plants, loose flowers and also herbal applications (Klie et al., 2014; Cuyacot et al., 2016; Hoang et al., 2020). It is categorized as large flowered (13 classes) and small flowered (10 classes) (Mandal, 2024; Gupta et al., 2021). Large flowering chrysanthemums are grown as cut flower and small flowering chrysanthemums are grown for making garland, wreath, bouquets, veni, gajra, loose flowers for religious offering and potted plants (Bhattacharjee and De, 2013; Chong et al., 2016). In India, spray chrysanthemums have a significant contribution in floral decorations, preparation of garlands and venis (Vetrival and Jawaharlal, 2014). While the small flowered genotypes are used in hair decorations by Indian women folk, the long stemmed ones are used in bouquets and vases (Guddaraddi et al., 2024). There are several states in India where it is cultivated for commercial purposes. The states are Tamil Nadu, Maharashtra, Bihar, Karnataka, West Bengal, Rajasthan, and Madhya Pradesh (Ganesh et al., 2021). There are roughly 2000 different types of chrysanthemums in the globe, and India has documented 1000 different types (Datta and Bhattacharjee, 2001). The climatic condition of the region, which falls under sub-tropical sub Himalayan region, is congenial for cultivation of this crop. The temperature of the region ranges from 35°C to 10°C (Average monthly Max and Min) which is at par with the recommended optimum temperature range for chrysanthemum by Karlsson et al. (1989). Chrysanthemum is responsive to photoperiod and requires short days for flower bud initiation (Kumar and Singh, 2017). The Terai Region enjoys prominent day and night length variation during the developmental stages i.e. in the month of October and November. In this point of views, Chrysanthemum may be a prospective flower crop for the Terai region of West Bengal deal with the nearest flower markets of Siliguri, Assam North East, as well as abroad like Nepal, Bangladesh and Bhutan. The choice of suitable genotypes is an important factor in export oriented commercial floriculture; however, literature in this regards for the region is very scanty. It is essential to recommend a set of equally well performing chrysanthemum genotypes only for this region because the agro-climatic conditions are unique in nature. The necessity for varietal assessments for any crop emerges throughout the sequences of activities that occur from breeding through varietal release, propagation, harvesting, and exporting of produced materials. Morphological assessments can be done in a variety of methods. These characteristics represent not only the genotype's genetic composition, but also the genotype's interactions with the environment in which it is manifested (Lin and Bins, 1984). Hence, the present investigation aimed in evaluation and selection of suitable spray chrysanthemum genotypes for commercial cultivation in Terai region of West Bengal.

2. MATERIALS AND METHODS

2.1. Experimental site

The experimentwas carried out in the Instructional farm of the Department of Floriculture, Medicinal and Aromatic Plants at the Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar from July 2018 to February, 2020 for two-year replication. The location was at 26° 19 N latitude and 89° 23 E longitude in Terai Region of West Bengal. The location was 43 metres above mean sea level in the sub-Himalayan plains.

2.2. Experimental materials

Forty different genotypes of spray chrysanthemum were evaluated based on their growth and flowering parameters which are listed below.

2.3. Methods of planting

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.

2.4. Statistical analysis

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. Number of branches plant^{-1}

In the first year (2018–19), the maximum numbers of branch plant^{-1} (13.12) was observed in White Prolific (V_{14}) followed by Doddabelegere-1 (V_7) (11.41) whereas in the second year Local Yellow-2 (V_2) recorded the maximum numbers of branch plant^{-1}(13.30) followed by BCC-24 (13.07). In case of pooled data the maximum branches plant^{-1} (12.04) was observed in Local Yellow-2 (V_2) followed by White Prolific (V_{14}) (11.98) which was at par with V_2. On the other hand Marigold (V_{26}) reported to have the minimum number of branches plant^{-1} of 6.24 and 6.82 in the first year (2018–19) and pooled respectively whereas in second year (2019–20) minimum number of branches plant^{-1} (6.67) was observed in Yellow Baby (V_{15}) followed by Marigold (V_{26}) (7.40).

3.2. Number of leaves branch^{-1}

The result revealed that Bidhan Antara (V_{10}) reported the maximum number of leaves branch^{-1} of 18.73 and 17.36 in the first year and pooled respectively (Table 1) while in the second year maximum number of leaves branch^{-1} (18.63) was observed in Basanti (V_{17}). The minimum number of leaves branch^{-1} (6.38, 7.63 and 7.00) was observed in BCC-29 (V_{40}) in first year, second year and pooled respectively. The explanation for variation in the number of leaves branch-1might be related to variations in genotype genetic makeup, since both vegetative and floral qualities are primarily influenced by genotype genetic constitution and their interactions with environment (Mandal, 2024).

3.3. Leaf area (Sq.Cm)

Among the forty genotypes the maximum leaf area of 16.53, 15.76 and 16.14 sq. cm was observed in Marigold (V_{26}) in first year, second year and pooled respectively followed by Local Yellow-2 (V_2) (8.05, 7.73 and 7.89 sq. cm) whereas the minimum leaf area (3.53, 3.40 and 3.46 sq. cm) was observed in White Dolley (V_{24}) in first year, second year and pooled respectively.

3.4. Chlorophyll contain in leaves (SPAD502)

The result revealed that Bidhan Antara (V_{10}) reported the maximum chlorophyll contain in leaves of 142.13 in the first year (2018–19) followed by BCC-24 (139.25), Heritage (139.00), Local Yellow-2 (138.25) and Basanti (138.13) while in the second year maximum chlorophyll contain in leaves (142.00) was observed in Doddabelegere (V_6) followed by Marigold (V_{26}) (140.25). In case of pooled data Local Yellow-2 (V_2) reported the maximum chlorophyll contain in leaves (163.94) at par with Doddabelegere (V_6) (136.44) and minimum chlorophyll content of leaves (109.44) was observed in Arka Usha Kiran (V_{34}).

Table 1: Treatment details of the experiment

Sl. no.	*N	Treatments	Sl. no.	*N	Treatments
1.	V_1	Local yellow	21.	V_{21}	NBRI Little Kusum
2.	V_2	Local Yellow-2	22.	V_{22}	Sweta Singar
3.	V_3	Heritage	23.	V_{23}	Vijay Kiran
4.	V_4	Shukla	24.	V_{24}	White Dolley
5.	V_5	Anmol	25.	V_{25}	Winter Queen
6.	V_6	Doddabelegere	26.	V_{26}	Marigold
7.	V_7	Doddabelegere-1	27.	V_{27}	BCC-4
8.	V_8	Arka Kirti	28.	V_{28}	Arka Yellow Gold
9.	V_9	Arka Chandrakath	29.	V_{29}	BCC-24
10.	V_{10}	Bidhan Antara	30.	V_{30}	Punjab Gold
11.	V_{11}	Nanako Yellow	31.	V_{31}	Arka Chandrika
12.	V_{12}	Nanako White	32.	V_{32}	BCC-38
13.	V_{13}	White Anemone	33.	V_{33}	BCC-79
14.	V_{14}	White Prolific	34.	V_{34}	Arka Usha Kiran
15.	V_{15}	Yellow Baby	35.	V_{35}	Arka Pink Star
16.	V_{16}	Aparajita	36.	V_{36}	Rekha
17.	V_{17}	Basanti	37.	V_{37}	Coffee
18.	V_{18}	Flirt	38.	V_{38}	Autumn Joy
19.	V_{19}	Geetanjali	39.	V_{39}	Vasanthika
20.	V_{20}	Jaya	40.	V_{40}	BCC-29

*N: Notation

3.5. Fresh weight of 5 flowers (g)

Fresh weight of flowers was one of the important parameters which had great impact on transportation of the flowers. Among the forty genotypes the maximum fresh weight of 5 flowers of 21.15 g, 18.34 g and 19.74 g was observed in Local Yellow-2 (V_2) in first year, second year and pooled respectively while minimum fresh weight of 5 flowers (1.27, 1.34 and 1.30) was observed in Yellow Baby (V_{15}) in first year, second year and pooled respectively. The variance in floral weight character across types was mostly attributable to increased flower size with conspicuous centre disc florets and the presence of a relatively greater number of mature ray florets (Kireethi et al., 2017). The difference in yield (g) might be explained by the additive gene effect (Behera et al., 2002).

3.6. Dry weight of 5 flower (g)

The result revealed that Local Yellow-2 (V_2) reported the maximum dry weight of 5 flowers of 6.97 g, 6.53 g and 6.75

Table 2: Number of branch plant^{-1} and number of laves branch^{-1} of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Number of branch plant^{-1}			Number of leaves branch^{-1}		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	9.88^{bcdefg}	11.68^{abcdefg}	10.78^{abcdef}	10.81^{jklmnop}	13.25^{cdefghi}	12.03^{fghijklm}
Local Yellow-2	10.77^{bc}	13.30^{a}	12.04^{a}	13.72^{bcdef}	15.27^{bc}	14.49^{bc}
Heritage	7.50^{ijklm}	9.21^{hijklm}	8.35^{jklmno}	10.77^{jklmnop}	12.82^{defghi}	11.79^{ghijklmn}
Shukla	7.71^{hijklm}	9.05^{hijklm}	8.38^{jklmno}	11.62^{efghijklm}	14.08^{bcdefg}	12.85^{defghij}
Anmol	8.76^{cdefghij}	10.35^{defghijk}	9.55^{fghijk}	12.88^{bcdefghi}	13.50^{cdefgh}	13.19^{cdefgh}
Doddabelegere	7.78^{hijklm}	9.03^{ijklm}	8.40^{jklmno}	11.27^{fghijklmn}	15.19^{bc}	13.23^{cdefg}
Doddabelegere-1	11.41^{ab}	9.18^{hijklm}	10.29^{cdefghi}	15.38^{b}	11.02^{ijklm}	13.20^{cdefgh}
Arka Kirti	6.88^{jklm}	8.05^{lmn}	7.46^{op}	11.43^{efghijklm}	13.50^{cdefgh}	12.47^{efghijklm}
Arka Chandrakath	7.70^{ijklm}	8.81^{ijklmn}	8.25^{klmno}	11.26^{fghijklmn}	15.17^{bcd}	13.21^{cdefgh}
Bidhan Antara	10.88^{b}	12.50^{abcd}	11.69^{abc}	18.73^{a}	16.00^{b}	17.36^{a}
Nanako Yellow	10.88 b	12.64^{abc}	11.76^{ab}	9.24^{mnopq}	13.15^{cdefghi}	11.19^{klmnop}
Nanako White	8.75^{cdefghij}	10.50^{cdefghijk}	9.63^{fghijk}	12.93^{bcdefgh}	14.50^{bcdef}	13.72^{bcde}
White Anemone	9.91^{bcdef}	11.63^{abcdefg}	10.77^{abcdef}	12.38^{cdefghijk}	15.28^{bc}	13.83^{bcde}
White Prolific	13.12^{a}	10.85^{bcdefghij}	11.98^{a}	13.17^{bcdefg}	10.25^{klml}	11.71^{hijklmn}
Yellow Baby	8.84^{cdefghij}	6.67^{n}	7.75^{mnop}	14.32^{bcd}	11.63^{hijkl}	12.97^{defghi}
Aparajita	10.18^{bcd}	12.13^{abcde}	11.15^{abcde}	12.52^{cdefghij}	15.13^{bcde}	13.82^{bcde}
Basanti	8.25^{defghijklm}	10.88^{bcdefghij}	9.56^{fghijk}	14.25^{bcd}	18.63^{a}	16.44^{a}
Flirt	8.63^{defghijkl}	7.26^{mn}	7.94^{lmnop}	13.15^{bcdefg}	10.13^{lmn}	11.64^{ijklmno}
Geetanjali	7.67^{ijklm}	9.75^{fghijkl}	8.71^{jklmno}	10.11^{jklmnop}	12.11^{ghijkl}	11.11^{lmnop}
Jaya	8.69^{defghijk}	10.77^{cdefghij}	9.73^{efghij}	11.06^{ghijklmno}	13.72^{bcdefgh}	12.39^{efghijklm}
NBRI Little Kusum	8.68^{defghijk}	10.31^{defghijkl}	9.49^{fghijk}	13.88^{bcde}	14.38^{bcdefg}	14.13^{bcd}
Sweta Singar	6.72^{klm}	8.69^{jklmn}	7.70^{nop}	14.63^{bc}	15.00^{bcde}	14.81^{b}
Vijay Kiran	10.13^{bcde}	12.04^{abcde}	11.09^{abcde}	9.63^{lmnopq}	10.50^{jklml}	10.06^{pq}
White Dolley	11.11^{ab}	9.31^{hijklm}	10.21^{defghi}	12.02^{defghijkl}	13.27^{cdefghi}	12.64^{defghijk}
Winter Queen	9.73^{bcdefgh}	11.30^{abcdefgh}	10.51^{bcdefgh}	12.26^{cdefghijk}	13.67^{bcdefgh}	12.97^{defghi}
Marigold	6.24^{m}	7.40^{mn}	6.82^{p}	8.68^{opqr}	9.00^{mno}	8.84^{qr}
BCC-4	9.93^{bcdef}	11.05^{abcdefghi}	10.49^{bcdefgh}	12.50^{defghij}	14.25^{bcdefg}	13.38^{bcdef}
Arka Yellow Gold	8.81^{cdefghij}	10.17^{efghijkl}	9.49^{fghijk}	9.63^{lmnopq}	10.63^{jklm}	10.13^{opq}
BCC-24	9.81^{bcdefg}	13.07^{ab}	11.44^{abcd}	12.38^{cdefghijk}	13.38^{cdefghi}	12.88^{defghij}
Punjab Gold	6.67^{klm}	9.42^{ghijklm}	8.04l^{mnop}	7.36^{qr}	8.13^{no}	7.74^{rs}
Arka Chandrika	8.11^{efghijklm}	10.02^{efghijkl}	9.06^{ijklmn}	8.35^{pqr}	9.25^{mno}	8.80^{qr}
BCC-38	9.50^{bcdefghi}	11.78^{abcdef}	10.64^{abcdefg}	11.40^{efghijklm}	13.75^{bcdefgh}	12.58^{efghijkl}
BCC-79	8.80^{cdefghij}	11.75^{abcdef}	10.27^{cdefghi}	9.88^{klmnopq}	11.13^{ijklm}	10.50^{nop}
Arka Usha Kiran	6.61^{lm}	9.17^{hijklm}	7.89^{mnop}	8.86^{nopqr}	11.13^{ijklm}	9.99^{pq}
Arka Pink Star	7.16^{jklm}	8.50^{klmn}	7.83^{mnop}	10.52^{jklmnop}	12.80^{efghij}	11.66^{ijklmn}
Rekha	7.97^{fghijklm}	10.32^{defghijk}	9.14^{hijklm}	12.00^{defghijkl}	13.65^{bcdefgh}	12.83^{defghij}
Coffee	6.72^{klm}	8.78^{jklmn}	7.75^{mnop}	10.35^{ijklmnop}	12.55^{fghijk}	11.45^{jklmnop}
Autumn Joy	9.50^{bcdefghi}	11.94^{abcdef}	10.72^{abcdefg}	12.75^{cdefghi}	14.68^{bcdef}	13.72^{bcde}
Vasanthika	7.87^{ghijklm}	10.80^{cdefghij}	9.33^{ghijkl}	9.52^{lmnopq}	12.56^{fghijk}	11.04^{mnop}

Table 2: Continue...

Genotype	Number of branch plant^{-1}			Number of leaves branch^{-1}		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
BCC-29	7.23^{ijklm}	9.36^{hijklm}	8.29^{klmno}	6.38^{r}	7.63^{o}	7.00^{s}
SEm±	0.71	0.79	0.49	0.88	0.82	0.52
CD (p=0.05)	2.02	2.26	1.42	2.53	2.63	1.51

g in the first year (2018–19), second year (2019–20) and pooled respectively. The minimum dry weight of 5 flowers (0.26 g, 0.27 g and 0.26 g) was observed in Yellow Baby (V_{15}) in first year, second year and pooled respectively.

3.7. Flower colour (as per rhs colour chart)

The colour of ray and disc florets was determined by using Royal Horticultural Society colour chart. Different genotypes exerted different shades of colour in ray as well as disc florets. The colour shades was shown in the Table 4. Chrysanthemum cultivars differ in flower colour because of the genetic composition and colouring pigments of a certain genotype. Chalcones and aurones are responsible for the yellow colour of flowers, whereas anthocyanin pigment is responsible for the red shade. Flavonols and carotenoids gave flowers their white colour, while cyanidin pigment gives

Table 3: Leaf area and chlorophyll contain in leaves of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Leaf area (cm2)			Chlorophyll contain in leaves (SPAD502)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	5.51^{ijk}	5.88^{ijk}	5.69^{klmn}	111.88^{ijklm}	108.50^{k}	110.19^{a}
Local Yellow-2	8.05^{b}	7.73^{b}	7.89^{b}	138.25^{ab}	135.63^{abc}	136.94^{hi}
Heritage	5.13^{klm}	6.28^{fghi}	5.70^{klmn}	139.00^{ab}	122.63^{cdefghijk}	130.81^{abcd}
Shukla	3.99^{pqr}	4.70^{no}	4.34^{pq}	118.38^{defghijklm}	120.63^{cdefghijk}	119.50^{defghi}
Anmol	4.29^{nop}	3.88^{pq}	4.08^{qr}	122.50^{bcdefghijkl}	121.50^{cdefghijk}	122.00^{cdefghi}
Doddabelegere	4.10^{opq}	3.26^{q}	3.68^{rs}	130.88^{abcdef}	142.00^{a}	136.44^{a}
Doddabelegere-1	4.58^{mno}	4.25^{op}	4.42^{pq}	122.13^{bcdefghijkl}	126.50^{abcdefghi}	124.31^{abcdefg}
Arka Kirti	4.28^{nop}	3.85^{pq}	4.06^{qr}	119.00^{cdefghijklm}	135.88^{abc}	127.44^{abcde}
Arka Chandrakath	5.48^{ijk}	6.31^{fghi}	5.89^{jkl}	113.88^{fghijklm}	124.88^{bcdefghij}	119.38^{defghi}
Bidhan Antara	7.19^{def}	6.34^{efghi}	6.76^{hi}	142.13^{a}	127.63^{abcdefgh}	134.88^{abc}
Nanako Yellow	5.99^{hi}	6.24^{ghi}	6.11^{jk}	124.50^{bcdefghijkl}	111.88^{ijk}	118.19^{defghi}
Nanako White	6.83^{fg}	6.99^{cd}	6.91^{fgh}	120.25^{cdefghijklm}	121.63^{cdefghijk}	120.94^{defghi}
White Anemone	4.68^{lmn}	4.29^{op}	4.48^{pq}	118.63^{defghijklm}	121.00^{cdefghijk}	119.81^{defghi}
White Prolific	6.95^{f}	8.00^{b}	7.48^{bcd}	114.50^{efghijklm}	118.13^{efghijk}	116.31^{efghi}
Yellow Baby	6.27^{gh}	5.49^{jkl}	5.88^{jkl}	125.88^{abcdefghijkl}	118.50^{defghijk}	122.19^{cdefghi}
Aparajita	6.93^{f}	6.89^{cdef}	6.91^{fgh}	129.25^{abcdefgh}	126.63^{abcdefghi}	127.94^{abcde}
Basanti	7.00^{ef}	7.86^{b}	7.43^{bcde}	138.13^{ab}	131.00^{abcdef}	134.56^{abc}
Flirt	7.53^{bcde}	7.93^{b}	7.73^{bc}	131.00^{abcdef}	118.13^{efghijk}	124.56^{abcdef}
Geetanjali	5.52^{ijk}	6.01^{hij}	5.77^{klm}	132.50^{abcd}	129.63^{abcdefg}	131.06^{abcd}
Jaya	5.38^{jk}	5.28^{klmn}	5.33^{mno}	111.50^{jklm}	116.13^{fghijk}	113.81^{fghi}
NBRI Little Kusum	5.14^{klm}	5.61^{jkl}	5.38^{mno}	133.00^{abcd}	123.25^{cdefghijk}	128.13^{abcde}
Sweta Singar	4.10^{opqr}	4.42^{op}	4.26^{pq}	113.50^{ghijklm}	112.00^{ijk}	112.75^{fghi}
Vijay Kiran	7.89^{bc}	7.79^{b}	7.84^{bc}	118.88^{cdefghijklm}	114.75^{ghijk}	116.81^{efghi}
White Dolley	3.53^{r}	3.40^{q}	3.46^{s}	122.88^{bcdefghijkl}	133.88^{abcd}	128.38^{abcde}
Winter Queen	7.04^{ef}	6.88^{cdef}	6.96^{efgh}	131.13^{abcde}	129.00^{abcdefg}	130.06^{abcd}
Marigold	16.53^{a}	15.76^{a}	16.14^{a}	122.38^{bcdefghijkl}	140.25^{ab}	131.31^{abcd}
BCC-4	7.11^{ef}	6.60^{defgh}	6.85^{gh}	112.75^{hijklm}	135.25^{abc}	124.00^{abcdefg}

Table 3: Continue...

Genotype	Leaf area (cm^2)			Chlorophyll contain in leaves (SPAD502)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Arka Yellow Gold	7.34^{cdef}	7.40^{bc}	7.37^{cdef}	131.88^{abcd}	124.50^{cdefghij}	128.19^{abcde}
BCC-24	7.74^{bcd}	6.74^{defg}	7.24^{defg}	139.25^{ab}	132.38^{abcde}	135.81^{ab}
Punjab Gold	6.18^{h}	6.49^{defghi}	6.33^{ij}	125.13^{abcdefghijkl}	112.38^{hijk}	118.75^{defghi}
Arka Chandrika	3.65^{qr}	4.41^{op}	4.03^{qr}	104.25^{m}	117.25^{efghijk}	110.75^{hi}
BCC-38	6.91^{f}	6.73^{defg}	6.82^{gh}	128.63^{abcdefghij}	129.50^{abcdefg}	129.06^{abcde}
BCC-79	7.93^{b}	7.66^{b}	7.79^{bc}	124.25^{bcdefghijkl}	127.00^{abcdefghi}	125.63^{abcdef}
Arka Usha Kiran	3.78^{pqr}	4.85^{mno}	4.31^{pq}	108.75^{lm}	110.13^{jk}	109.44^{i}
Arka Pink Star	5.16^{jkl}	4.24^{op}	4.70^{p}	135.88^{abc}	132.38^{abcde}	134.13^{abc}
Rekha	5.17^{jkl}	5.31^{klmn}	5.24^{no}	127.13^{abcdefghijk}	122.50^{cdefghijk}	124.81^{abcdef}
Coffee	5.16^{jkl}	5.36^{klm}	5.26^{no}	128.88^{abcdefghi}	122.38^{cdefghijk}	125.63^{abcdef}
Autumn Joy	5.73^{hij}	5.50^{jkl}	5.61lmno	130.25^{abcdefg}	131.00^{abcdef}	130.63^{abcd}
Vasanthika	7.01^{ef}	6.95^{cde}	6.98efgh	123.63^{bcdefghijkl}	122.88^{cdefghijk}	123.25^{bcdefgh}
BCC-29	5.18^{jkl}	5.20^{lmn}	5.19^{o}	110.63^{klm}	112.00^{ijk}	111.31^{ghi}
SEm±	0.20	0.21	0.16	6.01	5.44	4.60
CD (p=0.05)	0.57	0.61	0.47	17.19	15.56	13.16

them their reddish shade (Sarkar et al., 2024).

3.8. Vase life (days)

The perusal of data depicted in the table 5 revealed that the spray chrysanthemum genotypes varied significantly with respect to vase life. Among the forty genotypes the maximum vase life of 11.75 and 11.69 days was observed in Arka Usha Kiran (V_{34}) in first year, and pooled respectively while maximum vase life (11.83 days) in second year was observed in NBRI Little Kusum (V_{21}). The minimum vase life of 6.63 days was observed in BCC-29 (V_{40}) in first year whereas minimum vase life of 6.78 and 6.64 days was observed in Arka Pink Star (V_{35}) in second year and pooled respectively. According to Singh et al. (2017), the freshness of bloom on the plant "in open "field circumstances" relies on several aspects such as environmental factors, and this variance in chrysanthemum genotypes may also be attributed to varied genetic composition of genotype. This variance in vase life may be related to varying carbohydrate accumulations caused by differences in leaf output and ethylene sensitivity of genotypes (Parhar, 2016). Variations in this feature may also be attributable to genotype genetic composition.

3.9. Days for first bud initiation (days)

The result revealed that Sweta Singar (V_{22}) reported the

Table 4: Fresh weight and dry weight of five flowers of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Fresh weight of 5 flower (g)			Dry weight of 5 flower (g)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	10.00^{d}	11.65^{c}	10.83^{d}	4.11^{cd}	4.27^{c}	4.19^{cd}
Local Yellow-2	21.15^{a}	18.34^{a}	19.74^{a}	6.97^{a}	6.53^{a}	6.75^{a}
Heritage	5.88^{mno}	6.18l^{mno}	6.03^{mno}	1.94^{hijklmn}	1.97^{jklm}	1.95^{ghijk}
Shukla	4.46^{pqr}	4.11^{rs}	4.28^{qr}	1.27^{klmnop}	1.22^{qr}	1.25^{mno}
Anmol	6.68^{jklm}	7.06^{jkl}	6.87^{jkl}	1.22^{lmnopq}	1.31^{pq}	1.27^{mno}
Doddabelegere	4.01^{rst}	4.42^{qrs}	4.22^{qrs}	1.28^{klmnop}	1.30^{pqr}	1.29^{mno}
Doddabelegere-1	8.11^{fgh}	7.78^{hij}	7.94^{hi}	2.18^{ghijkl}	2.15^{hijk}	2.16^{fghi}
Arka Kirti	3.52st	3.38^{s}	3.45st	1.54^{ijklmno}	1.41^{opq}	1.47^{klmn}
Arka Chandrakath	3.28^{t}	3.62^{rs}	3.45st	1.33^{klmno}	1.36^{opq}	1.34^{lmn}
Bidhan Antara	6.16^{mn}	6.48^{klmn}	6.32^{lmn}	1.84^{hijklmn}	1.97^{jklm}	1.90^{hijkl}
Nanako Yellow	7.14^{ijkl}	6.81^{jklm}	6.97^{jkl}	2.24^{fghijk}	2.14^{hijk}	2.19^{fgh}

Table 4: Continue...

Genotype	Fresh weight of 5 flower (g)			Dry weight of 5 flower (g)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Nanako White	8.02^{ghi}	8.15^{fghi}	8.08^{ghi}	3.16^{defg}	3.40^{d}	3.28^{e}
White Anemone	2.13^{u}	2.03^{t}	2.08^{u}	0.30^{pq}	0.29^{t}	0.29^{p}
White Prolific	9.10^{de}	9.01^{def}	9.05^{ef}	3.74^{cde}	3.63^{d}	3.69^{de}
Yellow Baby	1.27^{u}	1.34^{t}	1.30^{u}	0.26^{q}	0.27^{t}	0.26^{p}
Aparajita	4.33^{qrs}	4.60^{pqr}	4.46^{pq}	1.27^{klmnop}	1.22^{qr}	1.25^{mno}
Basanti	4.17^{rst}	4.16^{rs}	4.16^{qrst}	1.94^{hijklmn}	1.85^{klmn}	1.90^{hijkl}
Flirt	8.57^{efg}	8.33^{efgh}	8.45^{fgh}	2.75^{efgh}	2.49^{fgh}	2.62^{f}
Geetanjali	9.20^{de}	9.35^{de}	9.28^{e}	2.18^{ghijkl}	2.29^{ghij}	2.23^{fgh}
Jaya	8.11^{fgh}	7.82^{ghij}	7.97^{hi}	2.70^{fgh}	2.44^{fghi}	2.57^{f}
NBRI Little Kusum	7.52^{hij}	7.19^{ijkl}	7.36^{ijk}	2.50^{fghi}	2.12^{ijk}	2.31^{fgh}
Sweta Singar	3.37^{t}	3.57^{rs}	3.47^{rst}	0.67^{opq}	0.79^{s}	0.73^{op}
Vijay Kiran	6.21^{lmn}	6.60^{klm}	6.41^{lmn}	2.43^{fghij}	2.87^{e}	2.65^{f}
White Dolley	9.01^{ef}	9.92^{d}	9.46^{e}	2.01^{hijklm}	2.16^{hijk}	2.08^{fghij}
Winter Queen	6.75^{jklm}	7.20^{ijkl}	6.98^{jkl}	1.12^{mnopq}	1.22^{qr}	1.17^{mno}
Marigold	15.28^{b}	14.60^{b}	14.94^{b}	5.61^{b}	5.53^{b}	5.57^{b}
BCC-4	6.43^{klm}	6.63^{klm}	6.53^{lmn}	3.22^{def}	3.38^{d}	3.30^{e}
Arka Yellow Gold	5.13^{opq}	5.33^{opq}	5.23^{op}	1.47^{jklmno}	1.68^{mno}	1.58^{jklm}
BCC-24	12.25^{c}	11.95^{c}	12.10^{c}	4.60^{c}	4.40^{c}	4.50^{c}
Punjab Gold	3.36^{t}	3.39^{s}	3.37^{t}	1.28^{klmnop}	1.63^{mnop}	1.45^{klmn}
Arka Chandrika	3.42st	3.76^{rs}	3.59^{rst}	1.19^{lmnopq}	1.55^{nopq}	1.37^{lmn}
BCC-38	7.55^{hij}	7.84^{ghij}	7.69^{hij}	1.36^{klmno}	1.78^{lmn}	1.57^{jklm}
BCC-79	10.02^{d}	9.28^{de}	9.65^{e}	4.00^{cd}	3.63^{d}	3.81^{de}
Arka Usha Kiran	3.66^{rst}	3.85^{rs}	3.76^{qrst}	1.28^{klmnop}	1.70^{mno}	1.49^{klmn}
Arka Pink Star	3.42st	3.43^{s}	3.42st	0.97^{nopq}	0.96^{rs}	0.96^{no}
Rekha	5.86^{mno}	5.78^{mno}	5.82^{no}	1.78^{hijklmn}	1.39^{opq}	1.58^{ijklm}
Coffee	6.64^{jklm}	7.00^{jkl}	6.82^{klm}	2.38^{fghij}	2.66^{ef}	2.52^{fg}
Autumn Joy	5.31^{nop}	5.52^{nop}	5.42o	1.30^{klmno}	1.60^{nop}	1.45^{klmn}
Vasanthika	8.80^{efg}	8.85^{efg}	8.82efg	2.18^{ghijkl}	2.78^{ef}	2.48^{fgh}
BCC-29	7.28^{hijk}	7.49^{hijk}	7.39^{ijk}	2.10^{hijklm}	2.53^{efg}	2.31^{fgh}
SEm±	0.32	0.36	0.28	0.35	0.12	0.20
CD (p=0.05)	0.93	1.04	0.82	1.00	0.35	0.58

maximum days for first bud initiation of 121.41, 114.38 and 117.89 days in the first year (2018–19), second year (2019–20) and pooled respectively. The minimum days for first bud initiation(58.73, 64.86 and 61.79 days) was observed in Geetanjali (V_{19}) in first year, second year and pooled respectively. The number of days it takes for the first flower bud to develop is an essential characteristic that directly indicates early or late blooming and, ultimately, impacts floral availability across genotypes (Behera et al., 2002). Apart from its interaction with the relevant environmental factors such as light, temperature, and humidity, the varietal genetic character has a direct impact on the production of flower buds (Vasanthachari, 2003; Vijaylakshmi et al., 2010). Early blooming genotypes also mature early, and the number of days between initial flowering and harvesting is a key factor for varietal selection in pot culture for earliness (Laxmi et al., 2008; Swaroop et al., 2008).

3.10. Days for first bud colour shown (days)

The spray chrysanthemum genotypes varied significantly with respect to days for first bud colour shown. Among the forty genotypes the maximum days for first bud colour

Table 5: Flower colour of different spray chrysanthemum genotypes in Terai region of West Bengal (as per RHS colour chart)

Genotype	Flower color (As per RHS color chart)	
	Ray florets	Disc florets
Local yellow	5B Yellow group FAN 1	
Local Yellow-2	8B Yellow group FAN 1	
Heritage	6A Yellow group FAN 1	
Shukla	6A Yellow group FAN 1	8B Yellow group FAN 1
Anmol	NN 66 A Purple group FAN 2	25A Orange group FAN1
Doddabelegere	59 A Red-Purple group FAN 2	
Doddabelegere-1	NN 155B White group FAN 4	
Arka Kirti	NN 155A White group FAN 4	
Arka Chandrakath	NN 155A White group FAN 4	
Bidhan Antara	34A Orange-Red group FAN1	
Nanako Yellow	3A Yellow group FAN 1	
Nanako White	NN 155D White group FAN 4	
White Anemone	NN 155D White group FAN 4	6A Yellow group FAN 1
White Prolific	NN 155C White group FAN 4	
Yellow Baby	9A Yellow group FAN 1	
Aparajita	3A Yellow group FAN 1	
Basanti	5A Yellow group FAN 1	
Flirt	58C Red-Purple group FAN 2	
Geetanjali	163B Greyed yellow FAN 4	
Jaya	185B Greyed purple FAN 4	
NBRI Little Kusum	4B Yellow group FAN 1	
Sweta Singar	NN 155C White group FAN 4	6B Yellow group FAN 1
Vijay Kiran	4B Yellow group FAN 1	
White Dolley	NN 155C White group FAN 4	
Winter Queen	186C Greyed purple FAN 4	6B Yellow group FAN 1
Marigold	7A Yellow group FAN 1	
BCC-4	44A Red group FAN 1	
Arka Yellow Gold	6A Yellow group FAN 1	
BCC-24	73A Red-Purple group FAN 2	
Punjab Gold	60A Red-Purple group FAN 2	
Arka Chandrika	NN 155A White group FAN 4	
BCC-38	58B Red-Purple group FAN 2	8B Yellow group FAN 1
BCC-79	70A Purple group FAN 2	
Arka Usha Kiran	5A Yellow group FAN 1	
Arka Pink Star	159 C Orange white group FAN	14 B Yellow group FAN 1
Rekha	NN 155B White group FAN 4	163B Greyed orange
Coffee	60 B Red purple group FAN 2	
Autumn Joy	NN 66B White group FAN 2	
Vasanthika	NN 63A Greyed purple FAN 4	
BCC-29	60 A Red purple group FAN 2	

Table 6: Vase life of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Vase Life (Days)						
	2018–19	2019–20	Pooled		2018–19	2019–20	Pooled
Local yellow	8.88^{fghijkl}	10.75^{cde}	9.81^{efg}	Sweta Singar	7.07^{mno}	8.55^{jklmn}	7.81^{klm}
Local Yellow-2	10.74^{abcd}	12.13^{b}	11.44^{bc}	Vijay Kiran	8.89^{fghijkl}	10.75^{cde}	9.82^{ef}
Heritage	10.88^{abc}	9.32^{ghijk}	10.10^{de}	White Dolley	7.92^{klmno}	8.75^{hijklm}	8.33^{ijk}
Shukla	8.63^{ghijkl}	9.93^{defghi}	9.28^{fgh}	Winter Queen	7.88^{klmno}	8.25^{klmn}	8.06^{jkl}
Anmol	7.73^{lmno}	8.68^{ijklm}	8.20^{ijkl}	Marigold	9.83^{cdefgh}	11.69^{bc}	10.76^{cd}
Doddabelegere	8.38^{ijklm}	9.38^{fghijk}	8.88^{hi}	BCC-4	7.77^{lmno}	9.68^{efghij}	8.72^{hij}
Doddabelegere-1	9.94^{bcdefg}	11.15^{bcd}	10.54^{d}	Arka Yellow Gold	9.50^{defghij}	11.16^{bcd}	10.33^{de}
Arka Kirti	9.75^{cdefgh}	10.63^{cdef}	10.19^{de}	BCC-24	8.13^{klmn}	10.04^{defgh}	9.08^{h}
Arka Chandrakath	8.25^{jklm}	8.00^{lmno}	8.13^{jkl}	Punjab Gold	8.18^{jklm}	7.66^{mno}	7.92^{kl}
Bidhan Antara	11.25^{ab}	9.79^{efghij}	10.52^{d}	Arka Chandrika	9.05^{efghijkl}	7.29^{no}	8.17^{jkl}
Nanako Yellow	10.25^{bcde}	9.38^{fghijk}	9.81^{efg}	BCC-38	8.73^{fghijkl}	10.05^{defg}	9.39^{fgh}
Nanako White	10.06^{bcdef}	8.75^{hijklm}	9.41^{fgh}	BCC-79	7.70^{lmno}	9.05^{ghijkl}	8.37^{ijk}
White Anemone	8.12^{klmn}	10.13^{defg}	9.12^{gh}	Arka Usha Kiran	11.75^{a}	11.63^{bc}	11.69^{b}
White Prolific	7.75^{lmno}	9.76^{efghij}	8.75^{hij}	Arka Pink Star	6.71^{o}	6.78^{o}	6.74^{n}
Yellow Baby	9.73^{cdefghi}	11.83^{bc}	10.78^{cd}	Rekha	6.78^{no}	8.38^{klmn}	7.58^{lm}
Aparajita	10.80^{abcd}	10.73^{cde}	10.76^{cd}	Coffee	8.68^{ghijkl}	10.03^{defgh}	9.35^{fgh}
Basanti	11.23^{ab}	13.88^{a}	12.55^{a}	Autumn Joy	9.23^{efghijk}	11.12^{bcd}	10.17^{de}
Flirt	8.10^{klmn}	7.70^{mno}	7.90^{kl}	Vasanthika	8.11^{klmn}	8.33^{klmn}	8.22^{ijkl}
Geetanjali	8.55^{hijkl}	10.10^{defg}	9.32^{fgh}	BCC-29	6.63^{o}	7.73^{mno}	7.18^{mn}
Jaya	9.68^{cdefghi}	9.90^{defghi}	9.79^{efg}	SEm±	0.47	0.45	0.24
NBRI Little Kusum	10.75^{abcd}	11.83^{bc}	11.29^{bc}	CD (p=0.05)	1.36	1.29	0.69

shown of 138.75, 131.30 and 135.03 days was observed in Sweata Singar (V_{22}) in first year, second year and pooled respectively whereas minimum days for first bud colour shown (78.88 and 78.25 days) was observed in Geetanjali (V_{19}) in second year and pooled respectively while in first year (2018–19) Jaya (V_{20}) reported minimum days for first bud colour shown (77.37 days).

3.11. Days for first flower full blooming (days)

It is evident from the table 7 that the days for first flower full blooming varied significantly among these genotypes. The result revealed that Arka Yellow Gold (V_2) reported the maximum days for first flower full blooming of 143.82 and 144.60 days in the second year and pooled respectively while in the first year Sweta Singar (V_{22}) reported the maximum days for first flower full blooming (146.50 days). The minimum days for first flower full blooming (88.88 and 88.50 days) was observed in Geetanjali (V_{19}) in second year and pooled respectively while in the first year Jaya (V_{20}) reported the minimum days for first flower full blooming (86.50 days). Flower opening discrepancies were ascribed to genotype genetic composition (Behera et al., 2002; Vasanthachari, 2003). The genotype that blooms early also harvests early, and the number of days to first harvest is determined by varietal character (Laxmi et al., 2008 and Swaroop et al., 2008).

3.12. Days taken for 50% flowering (days)

Among the forty genotypes the maximum days taken for 50% flowering of 158.00 days was observed in Sweta Singar (V_{10}) in first year while the maximum days taken for 50% flowering of 151.99 and 154.57 days were observed in second year and pooled respectively in Arka Yellow Gold whereas minimum days taken for 50% flowering of 98.45 was observed in Jaya in first year while 96.60 and 99.58 days were observed in Getanjaliin second year and pooled respectively.

3.13. Days for first flower wilting (days)

Among the forty genotypes the maximum days for first flower wilting of 18.50, 17.93 and 18.21 days was observed in Bidhan Antara (V_{10}) in first year, second year and pooled respectively while minimum days for first flower wilting (12.25 and 13.33 days) was observed in BCC-79 (V_{33}) in first year and pooled respectively whereas in the first year

Table 7: Days for first bud initiation and first bud colour shown of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Days for first bud initiation (Days)			Days for first bud colour shown (Days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	91.31^{fghi}	83.80^{fghi}	87.55^{jklmn}	110.13^{g}	104.16^{jklm}	107.14^{lm}
Local Yellow-2	86.94^{hijk}	80.38^{hijkl}	83.66^{mnopq}	119.63^{d}	103.78^{klmn}	111.70^{ghi}
Heritage	78.84^{klmno}	70.46^{nopqrs}	74.65^{tuvwx}	101.63^{l}	95.30^{qr}	98.46^{qrs}
Shukla	67.79^{rst}	75.95^{jklmno}	71.87^{vwxy}	80.25^{r}	97.34^{opqr}	88.79^{tu}
Anmol	86.50^{ijkl}	81.83^{ghij}	84.16^{lmnop}	114.25^{f}	102.75^{lmnop}	108.50^{jkl}
Doddabelegere	73.79^{nopqrst}	81.00^{ghijk}	77.39^{qrstuv}	106.88^{ij}	109.13^{hijk}	108.00^{kl}
Doddabelegere-1	75.84^{nopqr}	68.53^{opqrs}	72.18^{uvwxy}	87.63^{op}	86.50^{s}	87.06^{u}
Arka Kirti	78.50^{lmnop}	85.84^{efgh}	82.17^{nopqr}	107.13^{hij}	115.30^{cdefgh}	111.21^{ghij}
Arka Chandrakath	95.07^{defgh}	88.28^{defg}	91.67^{ghijk}	118.38^{d}	115.50^{cdefg}	116.94^{ef}
Bidhan Antara	80.44^{jklmn}	73.93^{klmnopq}	77.19^{rstuv}	105.38^{jk}	97.81^{nopqr}	101.59^{opq}
Nanako Yellow	67.38st	74.97^{jklmnop}	71.17^{vwxy}	79.00^{rs}	96.90^{pqr}	87.95^{u}
Nanako White	74.81^{nopqrs}	66.79^{qrs}	70.80^{wxy}	98.38^{m}	94.11^{r}	96.24^{s}
White Anemone	77.01^{mnopq}	67.86^{pqrs}	72.43^{uvwxy}	85.13^{q}	86.25^{s}	85.69^{u}
White Prolific	69.80^{qrst}	65.69^{rs}	67.74^{yz}	85.25^{pq}	79.27^{t}	82.26^{v}
Yellow Baby	70.85^{opqrst}	77.74^{ijklmn}	74.29^{tuvwx}	94.75^{n}	99.16^{mnopqr}	96.95^{s}
Aparajita	76.51^{nopq}	82.30^{ghij}	79.40^{pqrst}	99.25^{lm}	101.23^{lmnopq}	100.24^{pqr}
Basanti	108.29^{b}	98.80^{bc}	103.54^{bc}	122.63^{c}	118.03^{cdef}	120.33^{cd}
Flirt	105.75^{bc}	95.89^{bcd}	100.82^{bcde}	123.88^{c}	113.80^{efgh}	118.84^{de}
Geetanjali	58.73^{u}	64.86^{s}	61.79^{z}	77.63^{s}	78.88^{t}	78.25^{w}
Jaya	65.61^{tu}	69.29^{opqrs}	67.45^{yz}	77.37^{s}	84.78st	81.07^{vw}
NBRI Little Kusum	74.47^{nopqrs}	78.32^{hijklm}	76.39^{rstuvw}	95.50^{n}	98.28^{lmnopqr}	96.89^{s}
Sweta Singar	121.41^{a}	114.38^{a}	117.89^{a}	138.75^{a}	131.30^{a}	135.03^{a}
Vijay Kiran	70.24^{pqrst}	78.28^{hijklmn}	74.26^{tuvwx}	99.25^{lm}	109.37^{ghijk}	104.31^{mno}
White Dolley	77.63^{mnopq}	72.75^{lmnopqr}	75.19^{stuvwx}	104.38^{k}	102.13^{lmnop}	103.25^{nop}
Winter Queen	89.91^{ghi}	83.89^{fghi}	86.90^{klmno}	116.63^{ef}	106.36^{ijkl}	111.49^{ghij}
Marigold	107.59^{b}	100.59^{b}	104.09^{b}	122.88^{c}	114.35^{defgh}	118.61^{de}
BCC-4	95.06^{defgh}	96.13^{bc}	95.59^{efghi}	104.88^{jk}	102.38^{lmnop}	103.63^{no}
Arka Yellow Gold	101.62^{bcd}	94.79^{bcd}	98.20^{bcdef}	132.00^{b}	120.44^{bcd}	126.22^{b}
BCC-24	87.99^{ghij}	92.30^{cde}	90.15^{hijkl}	106.00^{jk}	112.28^{fghi}	109.14^{ijkl}
Punjab Gold	99.18^{cdef}	92.29^{cde}	95.73^{defghi}	117.38^{de}	110.18^{ghij}	113.78^{fgh}
Arka Chandrika	100.03^{bcde}	96.02^{bcd}	98.02^{bcdefg}	130.63^{b}	126.40^{ab}	128.51^{b}
BCC-38	105.75^{bc}	98.25^{bc}	102.00^{bcd}	124.00^{c}	121.50^{bc}	122.75^{c}
BCC-79	95.63^{defg}	99.04^{bc}	97.33^{cdefg}	114.75^{f}	118.80^{cde}	116.78^{ef}
Arka Usha Kiran	86.98^{hijk}	92.35^{cde}	89.66^{ijklm}	108.50^{ghi}	112.96^{efgh}	110.73^{hijk}
Arka Pink Star	65.83^{tu}	72.29^{mnopqrs}	69.06^{xy}	88.88^{o}	94.43^{r}	91.65^{t}
Rekha	75.93^{nopqr}	80.91^{ghijk}	78.42^{pqrstu}	99.75^{lm}	103.34^{klmno}	101.54^{opq}
Coffee	84.89^{ijklm}	77.30^{ijklmn}	81.09^{opqrs}	101.25^{l}	93.29^{r}	97.27^{rs}
Autumn Joy	95.39^{defg}	91.31^{cdef}	93.35^{fghij}	119.25^{d}	117.00^{cdef}	118.13^{de}

Table 7: Continue...

Genotype	Days for first bud initiation (Days)			Days for first bud colour shown (Days)		
	2018–19	2019–20	Pool_ _	2018–19	2019–20	Pooled
Vasanthika	85.96^{ijkl}	82.79^{ghij}	84.37^{lmnop}	107.00^{ij}	102.60^{lmnop}	104.80^{mn}
BCC-29	92.02^{efghi}	100.61^{b}	96.31^{defgh}	109.50^{gh}	118.31^{cdef}	113.90^{fg}
SEm±	2.89	2.73	2.23	0.85	2.17	1.10
CD (p=0.05)	8.28	7.83	6.38	2.43	6.20	3.16

Table 8: Days for first flower full blooming and days taken for 50% flowering of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Days for first flower full blooming (Days)			Days taken for 50% flowering (Days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	122.28^{h}	118.27^{hijklm}	120.28^{i}	131.50^{ghijkl}	127.91^{hijklmn}	129.70^{ijklm}
Local Yellow-2	132.27^{de}	116.26^{jklm}	124.26^{fgh}	141.08^{cde}	137.68^{defg}	139.38^{bcde}
Heritage	111.63^{l}	104.75^{opq}	108.19^{o}	118.54^{opqr}	114.51^{qrs}	116.52^{qrs}
Shukla	93.13^{p}	112.25^{mn}	102.69^{p}	102.68^{tu}	122.46^{lmnopq}	112.57^{s}
Anmol	124.00^{gh}	115.95^{hijklm}	119.97^{ij}	135.13^{defghi}	126.05^{klmno}	130.59^{hijkl}
Doddabelegere	118.00^{ij}	121.13^{ghijk}	119.56^{ijk}	133.76^{efghij}	136.99^{defg}	135.38^{defghi}
Doddabelegere-1	100.88^{n}	100.13^{qrs}	100.50^{pq}	116.51^{qr}	112.50^{rst}	114.50^{qrs}
Arka Kirti	118.63^{i}	125.89^{efg}	122.26^{ghi}	129.72^{ghijkl}	134.38^{efghij}	132.05^{ghijk}
Arka Chandrakath	129.88^{f}	124.63^{fgh}	127.25^{ef}	140.00^{cdef}	136.20^{defgh}	138.10^{cdef}
Bidhan Antara	116.88^{ijk}	115.00^{klmn}	115.94^{kl}	131.10^{ghijkl}	127.62^{ijklmno}	129.36^{jklmn}
Nanako Yellow	90.38^{q}	112.44^{mn}	101.41^{pq}	107.52st	119.51^{opqr}	113.51^{rs}
Nanako White	111.00^{l}	108.50^{nop}	109.75^{no}	123.67^{lmnopq}	115.66^{pqrs}	119.66^{pq}
White Anemone	95.25^{op}	96.88^{rs}	96.06^{rs}	104.96^{tu}	105.17^{t}	105.07^{tu}
White Prolific	96.13^{o}	92.82st	94.47^{s}	114.46^{rs}	107.49st	110.97st
Yellow Baby	108.00^{m}	115.06^{klmn}	111.53^{mno}	116.62^{pqr}	121.82^{mnopq}	119.22^{pqr}
Aparajita	112.38^{l}	113.13^{mn}	112.75^{lmn}	124.25^{klmnopq}	122.72^{lmnopq}	123.48^{nop}
Basanti	133.63^{d}	132.88^{cde}	133.25^{cd}	146.97^{bc}	141.29^{cdef}	144.13^{b}
Flirt	133.75^{cd}	127.31^{efg}	130.53^{de}	146.99^{bc}	135.45^{defghi}	141.22^{bcd}
Geetanjali	88.13^{r}	88.88^{t}	88.50^{t}	102.56^{tu}	96.60^{u}	99.58^{u}
Jaya	86.50^{r}	94.26^{rst}	90.38^{t}	98.45^{u}	107.60st	103.02^{u}
NBRI Little Kusum	108.63^{m}	111.45^{mno}	110.04^{no}	123.48^{lmnopq}	125.59^{lmno}	124.53^{mnop}
Sweta Singar	146.50^{a}	140.42^{ab}	143.46^{a}	158.00^{a}	151.12^{ab}	154.56^{a}
Vijay Kiran	112.00^{l}	120.70^{ghijkl}	116.35^{jkl}	124.61^{klmnop}	130.72^{ghijkl}	127.66^{klmno}
White Dolley	114.75^{k}	115.24^{hijklmn}	114.99^{lm}	128.34^{hijklm}	130.41^{ghijkl}	129.38^{jklmn}
Winter Queen	125.75^{g}	116.48^{ijklm}	121.12^{hi}	136.47^{defg}	129.60^{ghijklmn}	133.03^{fghijk}
Marigold	130.63^{ef}	123.61^{fghi}	127.12^{ef}	142.82^{cd}	134.10^{fghijk}	138.46^{bcdef}
BCC-4	114.88^{k}	113.31^{mn}	114.09^{lm}	125.99^{jklmno}	121.12^{nopq}	123.55^{nop}
Arka Yellow Gold	145.38^{a}	143.82^{a}	144.60^{a}	157.15^{a}	151.99^{a}	154.57^{a}
BCC-24	116.13^{jk}	122.43^{fghij}	119.28^{ijk}	131.92^{fghijk}	135.80^{defghi}	133.86^{efghij}
Punjab Gold	129.88^{f}	123.75^{fghi}	126.81^{ef}	140.22^{cde}	135.77^{defghi}	137.99^{cdefg}
Arka Chandrika	141.50^{b}	137.49^{abc}	139.50^{b}	154.62^{ab}	147.90^{abc}	151.26^{a}

Table 8: Continue...

Genotype	Days for first flower full blooming (Days)			Days taken for 50% flowering (Days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
BCC-38	135.88^{c}	135.38^{bcd}	135.63^{c}	146.10^{c}	142.62^{cde}	144.36^{b}
BCC-79	123.75^{gh}	127.07^{efg}	125.41^{fg}	135.80^{defgh}	143.44^{bcd}	139.62^{bcde}
Arka Usha Kiran	118.38^{i}	124.78^{fgh}	121.58^{hi}	131.93^{fghijk}	139.49^{def}	135.71^{cdefgh}
Arka Pink Star	95.88^{o}	101.60^{pqr}	98.74^{qr}	107.44st	116.01^{pqr}	111.72^{s}
Rekha	111.00^{l}	117.94^{hijklm}	114.47^{lm}	119.49^{nopqr}	126.88^{jklmno}	123.19^{op}
Coffee	110.88^{l}	112.00^{mno}	111.44^{mno}	120.41mnopqr	125.10^{lmno}	122.75^{op}
Autumn Joy	131.25^{ef}	128.75^{def}	130.00^{de}	142.77^{cd}	139.94^{cdef}	141.35^{bc}
Vasanthika	115.88^{jk}	113.63lmn	114.75^{lm}	127.16^{ijklmn}	122.99^{lmnop}	125.07^{lmnop}
BCC-29	117.88^{ij}	121.69^{fghijk}	119.78^{ij}	129.99^{ghijkl}	136.62^{defg}	133.31^{fghijk}
SEm±	0.75	2.57	1.32	2.83	2.91	2.09
CD (p=0.05)	2.14	7.34	3.78	8.09	8.32	5.97

Table 9: Days for first flower wilting and days for last flower wilting of different spray chrysanthemum genotypes in Terai region of West Bengal

Genotype	Days for first flower wilting (Days)			Days for last flower wilting (Days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Local yellow	13.97^{klmno}	15.79^{bcdef}	14.88^{fghijklmno}	11.63^{efgh}	12.08^{cdefghij}	11.85^{fghijklmn}
Local Yellow-2	15.73^{cdefghij}	16.88^{ab}	16.30^{bcdef}	12.88^{def}	13.25^{bcde}	13.06^{def}
Heritage	14.93^{ghijkl}	16.05^{abcde}	15.49^{bcdefghijk}	12.63^{defg}	13.00^{bcdefg}	12.81^{defghi}
Shukla	13.94^{klmno}	15.00^{bcdefghi}	14.47^{ijklmnop}	11.48^{fghijk}	12.88^{cdefg}	12.18^{fghijklm}
Anmol	15.00^{fghijkl}	14.75^{cdefghi}	14.88^{fghijklmno}	12.75^{defg}	11.98^{defghij}	12.36^{efghijk}
Doddabelegere	14.98^{fghijkl}	16.01^{abcde}	15.49^{bcdefghijk}	11.96^{efgh}	13.62^{abcd}	12.79^{defghij}
Doddabelegere-1	16.50^{bcdefgh}	13.34^{ghijk}	14.92^{fghijklmno}	13.88^{bcd}	10.79^{ijklm}	12.33^{efghijk}
Arka Kirti	15.88^{cdefghij}	14.90^{bcdefghi}	15.39^{cdefghijkl}	11.86^{efgh}	11.28^{fghijklm}	11.57^{jklmno}
Arka Chandrakath	13.75^{klmnop}	14.75^{cdefghi}	14.25^{jklmnop}	11.00^{hijkl}	11.80^{efghijk}	11.40^{klmno}
Bidhan Antara	18.50^{a}	17.93^{a}	18.21^{a}	16.17^{a}	15.25^{a}	15.71^{a}
Nanako Yellow	16.25^{bcdefghi}	16.88^{ab}	16.56^{bcd}	13.88^{bcd}	13.80^{abc}	13.84^{bcd}
Nanako White	16.63^{bcdef}	15.25^{bcdefgh}	15.94^{bcdefgh}	14.63^{abc}	13.18^{bcde}	13.90^{bcd}
White Anemone	16.29^{bcdefghi}	14.77^{cdefghi}	15.53^{bcdefghijk}	11.86^{efgh}	10.87^{hijklm}	11.36^{klmnop}
White Prolific	14.88^{hijklm}	14.87^{bcdefghi}	14.87^{fghijklmno}	11.73^{efghi}	10.80^{ijklm}	11.26^{klmnop}
Yellow Baby	13.98^{klmno}	15.00^{bcdefghi}	14.49^{ijklmnop}	10.08^{jklm}	10.77^{ijklm}	10.42^{opqrs}
Aparajita	17.63^{ab}	16.06^{abcde}	16.84^{ab}	14.88^{ab}	13.00^{bcdefg}	13.94^{bcd}
Basanti	17.00^{abcd}	15.80^{bcdef}	16.40^{bcde}	14.75^{abc}	13.88^{abc}	14.31^{bc}
Flirt	15.07^{fghijkl}	14.55^{defghij}	14.81^{ghijklmno}	12.18^{efgh}	12.32^{cdefghij}	12.25^{fghijkl}
Geetanjali	14.76^{ijklmn}	14.63^{defghi}	14.69^{hijklmnop}	10.74^{hijkl}	11.24^{ghijklm}	10.99^{mnopq}
Jaya	16.75^{bcde}	15.67^{bcdef}	16.21^{bcdefg}	14.18^{bcd}	12.79^{cdefg}	13.48^{cde}
NBRI Little Kusum	14.75^{ijklmn}	15.38^{bcdefg}	15.06^{efghijklmn}	9.78^{lm}	12.21^{cdefghij}	10.99^{mnopq}
Sweta Singar	14.24^{jklmno}	15.00^{bcdefghi}	14.62^{hijklmnop}	11.88^{efgh}	12.86^{cdefg}	12.37^{efghijk}
Vijay Kiran	17.25^{abc}	16.13^{abcde}	16.69^{ab}	15.25^{ab}	14.75^{ab}	15.00^{ab}
White Dolley	13.50^{lmnop}	14.25^{defghijk}	13.87^{mnop}	9.61^{lm}	10.69^{jklm}	10.15^{pqrs}
Winter Queen	13.69^{lmnop}	14.55^{defghij}	14.12^{klmnop}	11.98^{efgh}	10.16^{klmn}	11.07^{lmnopq}

Table 9: Continue...

Genotype	Days for first flower wilting (Days)			Days for last flower wilting (Days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Marigold	14.38^{jklmno}	16.80^{abc}	15.59^{bcdefghij}	11.20^{ghijkl}	12.70^{cdefg}	11.95^{fghijklmn}
BCC-4	14.72^{ijklmn}	14.22^{defghijk}	14.47^{ijklmnop}	11.00^{hijkl}	10.58^{jklm}	10.79^{nopqr}
Arka Yellow Gold	13.14^{nop}	14.13^{efghijk}	13.63^{nop}	11.88^{efgh}	11.70^{efghijkl}	11.79^{ghijklmn}
BCC-24	15.41^{defghijk}	12.52^{jk}	13.96^{lmnop}	10.00^{klm}	8.75^{n}	9.38^{s}
Punjab Gold	14.88^{hijklm}	13.83^{fghijk}	14.35^{ijklmnop}	10.77^{hijkl}	9.94^{lmn}	10.35^{opqrs}
Arka Chandrika	16.59^{bcdefg}	16.29^{abcd}	16.44^{bcde}	13.25^{cde}	12.70^{cdefg}	12.98^{defg}
BCC-38	14.95^{ghijkl}	12.27^{k}	13.61^{op}	9.98^{klm}	9.78^{mn}	9.88^{qrs}
BCC-79	12.25^{p}	14.42^{defghij}	13.33^{p}	8.68^{m}	10.72^{jklm}	9.70^{rs}
Arka Usha Kiran	15.75^{cdefghij}	14.63^{defghi}	15.19^{defghijklm}	13.25^{cde}	12.63^{cdefgh}	12.94^{defgh}
Arka Pink Star	14.63^{ijklmno}	15.50^{bcdef}	15.06^{efghijklmn}	11.85^{efgh}	13.88^{abc}	12.86^{defghi}
Rekha	16.88^{abcd}	14.63^{defghi}	15.75^{bcdefghi}	13.25^{cde}	12.75^{cdefg}	13.00^{defg}
Coffee	13.25^{mnop}	16.77^{abc}	15.01^{efghijklmno}	10.25^{ijklm}	13.08^{bcdef}	11.66^{ijklmn}
Autumn Joy	16.23^{bcdefghi}	13.05^{ijk}	14.64^{hijklmnop}	13.88^{bcd}	10.52^{jklmn}	12.20^{fghijklm}
Vasanthika	13.04^{op}	15.25^{bcdefgh}	14.14^{klmnop}	10.91^{hijkl}	12.53^{cdefghi}	11.72^{hijklmn}
BCC-29	15.13^{efghijkl}	13.28^{hijk}	14.20^{jklmnop}	12.93^{def}	10.69^{jklm}	11.81^{ghijklmn}
SEm±	0.58	0.73	0.50	0.55	0.63	0.42
CD (p=0.05)	1.67	2.09	1.44	1.59	1.80	1.22

minimum days for first flower wilting (12.27 days) was observed in BCC-38 (V_{32}).

3.14. Days for last flower wilting (days)

The result revealed that Bidhan Antara (V_{10}) reported the maximum days for last flower wilting of 16.17, 15.25 and 15.71 days in the first year (2018–19), second year (2019–20) and pooled respectively. The minimum days for last flower wilting (8.75 and 9.38 days) was observed in BCC-24 (V_{15}) in second year and pooled respectively while in the first year (2018–19) minimum days for last flower wilting (8.68 days) was observed in BCC-79 (V_{33}).

4. CONCLUSION

Genotypes Jaya, Vasanthika, Marigold, Local Yellow-2, White Prolific and A1 collection were recommended as cut flower production whereas Yellow Baby, White Anemone, Usha Kiran, Aparajita, Basanti, Bidhan Antara, Sweata Singar and White Dolley for the production of loose flowers. Because of their abundant, consistent branching and blooming, the genotypes Bidhan Antara, Local Yellow-2, Doddabelegere-1, Yellow Baby, White Anemone, Sweata Singar and Winter Queen could be chosen for potted plants and garden displays.

5. FURTHER RESEARCH

Further these genotypes will be evaluated for molecular difference and further crossing or breeding programmes.

6. ACKNOWLEDGEMENT

Authors are thankful to Dean, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya for providing the necessary facilities.

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