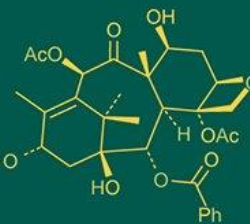
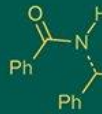
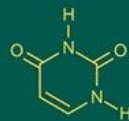
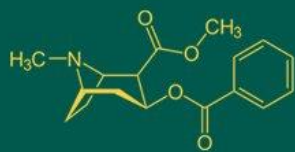


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## Disclosing the amazing vegetative growth, flowering behaviour and yield performance of various chrysanthemum (*Chrysanthemum morifolium*) varieties

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### Abstract

The purpose of this study was to investigate the genetic variability and varietal performance of chrysanthemum under the particular agro-climatic conditions of West Bengal. The study aimed to discover high-performing varieties and quantify critical genetic variables associated with yield and quality attributes, in order to aid selection efforts for improved chrysanthemum production in the West Bengal region. Sixteen genotypes of chrysanthemum were evaluated during 2016-17 in Randomized Complete Block Design with three replications. From the two years pooled data it was noticed that significant differences were observed among the genotypes for all vegetative, flowering and yield traits studied. Bidhan Madhuri exhibited marked increase in weight of flower (1184 gm per plant) followed by Basantika (1135 gm) and Bidhan Lalima (900.00 gm). Maximum loose flower yield was however noticed in Bidhan Lalima (1440 g per plant) which was followed by Bidhan Swapna (1199 g per plant). From overall performance it was observed that Bidhan Lalima, Bidhan Madhuri, and Bidhan Swapna may be recommended for loose flower production. Bidhan Gold, though was less productive in terms of loose flower yield but from quality point of view it may also be recommended.

**Keywords:** Cultivar, flowering duration, No. flowers/spray, wilting of flowering (days)

### Introduction

Chrysanthemum (*Chrysanthemum morifolium* L.) is one of the most important flower crops commercially grown in different parts of India. It is commonly known as Guldaudi, Autumn Queen or Queen of the East belonging to family Asteraceae. It is the native to the northern hemisphere chiefly Europe and Asia. The wide variation exhibited by large number of genotypes makes it conceivable for flower crop. The variations among chrysanthemum varieties are large in response to environment particularly temperature and the interaction between temperature and cultivar occur for every developmental trait (Pleog and Heuvelink *et al.*, 2006) [11]. The factors accounting for variation in growth and yield of crop plants are of very complex nature. The growth and yield are known to be influenced by the environment and the genetic potential to a great extent. The former is controllable to some extent through cultural practices while the later is governed by the heredity. However, the genetic makeup of any crop can be exploited only when they are subjected to favourable environmental conditions. Therefore, in any crop plant, information on genetic characters particularly which those contribute to economic characters would be very useful in planning breeding programme leading to effective selection. Various bio-metrical techniques have been developed to know the genetic architecture of quantitative characters. There was no comprehensive report on evaluation of Chrysanthemum cultivars for vegetative and flora parameter under agro climatic condition of west Bengal state, hence the present study was undertaken to study the performance of different Chrysanthemum cultivars under west Bengal region.

### Materials and Methods

The experiment was conducted with 16 genotypes of chrysanthemum viz. Bidhan Agnidev, Bidhan Lalima, Bidhan Swapna, Bidhan Antara, Bidhan Gold, Bidhan Mallika, Bidhan

Mallika, Bidhan Madhuri, Bidhan Tarun, Bidhan Jayanti, Bidhan Prava, Bidhan Subhasini, Bidhan Neeta, Bidhan Monami, Bidhan Basanti, Bidhan Purna, Basantika were planted according to randomized block design with three replications number of plants per replication 30 cuttings were planted with a spacing of 45 cm x 30 cm. This experiment was conducted at Horticultural Research Station, Mandouri, Faculty of Horticulture, Bidhan Chandra Krishi Vishwavidyalaya, Nadia. The site of experiment is situated at 23°N latitude and 89°E longitudes at an elevation of 9.75 meters from mean sea level. All planting materials were collected from AICRP on Floriculture, BCKV. Data were recorded for both vegetative and flowering attributes. Observations were recorded on all the indicating characters viz. Plant height (cm), No. of primary branches/plant, No. Of secondary branches/plant, No. of spray/plant, No. Flowers/spray, No. of days taken to flower bud appearance, No. of days to 50% flowering, wilting of flowering (days), No. of flowers/plant, Weight of flower/plant (g), Diameter of flower(cm), Reaction to pest and diseases, colour of flower as Per RHS. All agro-techniques were followed as per recommendations of this University.

## Results and Discussion

### Vegetative growth:

Vegetative growth is usually a good index of plant vigour, which may contribute towards greater productivity. It also serves as a guide to determine the suitable genotypes for

obtaining maximum yield. Data presented in Table-1 revealed that there was a significant variation in vegetative growth among the genotypes studied. The plant height is an important growth-related morphological character of plants. It is one of the essential criteria for screening of chrysanthemum varieties Highest plant height was recorded for genotype Bidhan Basanti (83.9 cm) whereas, lowest was recorded in Bidhan Neeta (44.6 cm). The variation in plant height can be attributed to genetic makeup of the particular genotype might be due to varietal characters responsible by a gene. As a genetically controlled factor, reported by Kanamadi and Patil (1993) [6], Barigidad and Patil (1992) [1], Singh *et al.* (2019) [16] in chrysanthemum. Performance of genotypes is also influenced by agro-climatic factors. The variations among chrysanthemum varieties are large in response to environment particularly temperature and the interaction between temperature and cultivar occur for every developmental trait. Similar findings are obtained by Pleog and Hauvelink, (2006) [11] and Singh *et al.*, (2008) [17]. Number of branches/plants is an important character, which signifies canopy shape and architecture of plant. Among the evaluated genotypes, Highest number of primary branches/plants was recorded in Bidhan Swapna (4.5) which was statistically comparable with Bidhan Monami (4.2) and No. of secondary branches/plant were found maximum in Bidhan Lalima (29.7) which was statistically comparable with Bidhan Madhuri (28.8).

**Table 1:** Morphogenetical characters on vegetative growth of new genotypes of Chrysanthemum.

| Name of the genotypes | Plant height (cm) |         |      | No. of primary branches/plant |         |      | No. of secondary branches/plant |         |      | No. of spray/Plant |         |       |
|-----------------------|-------------------|---------|------|-------------------------------|---------|------|---------------------------------|---------|------|--------------------|---------|-------|
|                       | I.                |         |      | II.                           |         |      | III.                            |         |      | IV.                |         |       |
|                       | 2016-17           | 2017-18 | Mean | 2016-17                       | 2017-18 | Mean | 2016-17                         | 2017-18 | Mean | 2016-17            | 2017-18 | Mean  |
| Bidhan Agnidev        | 63.7              | 75.0    | 69.3 | 2.3                           | 2.7     | 2.5  | 18.7                            | 17.3    | 18.0 | 62.3               | 65.3    | 63.8  |
| Bidhan Lalima         | 49.2              | 53.3    | 51.3 | 3.0                           | 3.3     | 3.2  | 30.7                            | 28.7    | 29.7 | 145.0              | 141.7   | 143.3 |
| Bidhan Swapna         | 57.3              | 63.3    | 60.3 | 4.3                           | 4.7     | 4.5  | 18.0                            | 17.0    | 17.5 | 95.0               | 91.7    | 93.3  |
| Bidhan Antara         | 48.5              | 47.3    | 47.9 | 1.7                           | 2.0     | 1.8  | 13.7                            | 14.7    | 14.2 | 55.0               | 57.7    | 56.3  |
| Bidhan Gold           | 44.1              | 52.0    | 48.1 | 1.7                           | 2.0     | 1.8  | 13.0                            | 13.3    | 13.2 | 65.0               | 67.0    | 66.0  |
| Bidhan Mallika        | 64.2              | 67.0    | 65.6 | 2.7                           | 2.7     | 2.7  | 20.3                            | 20.3    | 20.3 | 91.7               | 90.3    | 91.0  |
| Bidhan Madhuri        | 61.9              | 72.3    | 67.1 | 3.7                           | 4.0     | 3.8  | 28.3                            | 29.3    | 28.8 | 133.3              | 136.3   | 134.8 |
| Bidhan Tarun          | 59.8              | 56.3    | 58.1 | 2.7                           | 4.0     | 3.3  | 16.3                            | 17.7    | 17.0 | 73.7               | 76.3    | 75.0  |
| Bidhan Jayanti        | 42.8              | 46.7    | 44.7 | 3.3                           | 3.7     | 3.5  | 17.0                            | 18.0    | 17.5 | 71.7               | 73.3    | 72.5  |
| Bidhan Prava          | 48.3              | 45.0    | 46.7 | 1.7                           | 2.0     | 1.8  | 15.0                            | 16.0    | 15.5 | 51.7               | 50.7    | 51.2  |
| Bidhan Subhasini      | 44.3              | 49.7    | 47.0 | 2.7                           | 2.7     | 2.7  | 17.0                            | 18.0    | 17.5 | 70.7               | 72.7    | 71.7  |
| Bidhan Neeta          | 40.5              | 48.7    | 44.6 | 3.3                           | 3.7     | 3.5  | 9.7                             | 10.3    | 10.0 | 68.3               | 70.3    | 69.3  |
| Bidhan Monami         | 42.1              | 48.0    | 45.1 | 4.0                           | 4.3     | 4.2  | 15.7                            | 16.0    | 15.8 | 66.7               | 69.0    | 67.8  |
| Bidhan Basanti        | 86.2              | 81.7    | 83.9 | 3.7                           | 3.7     | 3.7  | 19.3                            | 20.0    | 19.7 | 129.7              | 127.0   | 128.3 |
| Bidhan Purna          | 68.4              | 72.6    | 70.5 | 3.0                           | 3.3     | 3.2  | 20.0                            | 22.4    | 21.2 | 86.0               | 84.0    | 85.0  |
| Basantika             | 63.7              | 75.0    | 69.3 | 2.3                           | 2.7     | 2.5  | 18.7                            | 17.3    | 18.0 | 62.3               | 65.3    | 63.8  |
| SE(±)                 | 1.96              | 1.86    |      | 0.53                          | 0.29    |      | 1.10                            | 0.81    |      | 4.07               | 3.79    |       |
| CD at 5%              | 5.81              | 5.52    |      | 1.57                          | 0.87    |      | 3.26                            | 2.41    |      | 12.08              | 11.25   |       |
| CV (%)                | 5.97              | 5.37    |      | 29.98                         | 15.03   |      | 10.42                           | 7.51    |      | 8.20               | 7.65    |       |

### Flowering behaviour

Significant variation was noticed in number of flowers per spray among the genotypes (Table-2). From pooled data mean the maximum number of flowers per spray was recorded in Bidhan Prava (5.3) and found to be at par with Bidhan Purna (5.0), however, minimum was recorded in Bidhan Gold (3.2). The variation in number of flowers per spray and spray length among the accessions was attributed to genotype of the plant, environmental influence and other cultural factors. Similar results for variation in number of flowers/sprays among the genotypes have also been reported (Punetha *et al.*, 2011) [12]. From Table 2.2.1A. ii, the pooled mean earliest flower bud initiation was exhibited by Bidhan

Madhuri (64.3 days) and it was on par with Bidhan Gold (64.7 days) and Bidhan Tarun (64.7 days) genotypes. While the maximum number of days for first flower bud appearance was taken by Bidhan Lalima (77.3 days). Number of days taken for flower bud appearance is an important character that signifies early or late flowering varieties which determines the flower availability in the market. Early or delay in flowering might also be genetically controlled characters in the varieties and it as stated by Behera *et al.* (2002) [3]. Similar results for variation in flowering duration among the genotypes have also been reported in chrysanthemum under different environmental conditions Peddi *et al.*, (2008) [10], Kumar, 2014 [7], Srilatha *et al.* (2015) [14] and Suvija *et al.*,

2016)<sup>[18]</sup>. The variation in time to flowering might be due to the genetic makeup or the influence of genotype and environment. The variation in time for flower bud appearance

of different chrysanthemum genotypes was also reported by Rao and Pratap (2006)<sup>[13]</sup> and Singh *et al.* (2008)<sup>[17]</sup> under different locations.

**Table 2:** Morphogenetical characters on flowering behaviour of new genotypes of Chrysanthemum.

| Name of the genotypes | No. Flowers/spray |         |      | No. of days taken to flower bud appearance |         |      | No. of days to 50% flowering |         |       | Wilting of flowering (days) |         |       |
|-----------------------|-------------------|---------|------|--------------------------------------------|---------|------|------------------------------|---------|-------|-----------------------------|---------|-------|
|                       | V                 |         |      | VI                                         |         |      | VII                          |         |       | VIII                        |         |       |
|                       | 2016-17           | 2017-18 | Mean | 2016-17                                    | 2017-18 | Mean | 2016-17                      | 2017-18 | Mean  | 2016-17                     | 2017-18 | Mean  |
| Bidhan Agnidev        | 3.3               | 3.7     | 3.5  | 69.7                                       | 72.3    | 71.0 | 124.7                        | 122.7   | 123.7 | 158.0                       | 165.0   | 161.5 |
| Bidhan Lalima         | 4.3               | 4.7     | 4.5  | 75.7                                       | 79.0    | 77.3 | 125.3                        | 123.3   | 124.3 | 157.0                       | 165.3   | 161.2 |
| Bidhan Swapna         | 3.7               | 4.0     | 3.8  | 67.3                                       | 70.7    | 69.0 | 124.7                        | 123.3   | 124.0 | 140.0                       | 168.0   | 154.0 |
| Bidhan Antara         | 4.3               | 4.3     | 4.3  | 67.7                                       | 67.0    | 67.3 | 124.3                        | 122.7   | 123.5 | 161.0                       | 161.7   | 161.3 |
| Bidhan Gold           | 3.0               | 3.3     | 3.2  | 67.0                                       | 62.3    | 64.7 | 120.7                        | 118.0   | 119.3 | 162.0                       | 165.0   | 163.5 |
| Bidhan Mallika        | 4.0               | 4.3     | 4.2  | 66.0                                       | 71.0    | 68.5 | 120.3                        | 117.7   | 119.0 | 162.0                       | 162.3   | 162.2 |
| Bidhan Madhuri        | 4.0               | 4.7     | 4.3  | 66.3                                       | 62.3    | 64.3 | 124.3                        | 125.7   | 125.0 | 155.0                       | 164.0   | 159.5 |
| Bidhan Tarun          | 4.0               | 4.7     | 4.3  | 66.0                                       | 63.3    | 64.7 | 121.7                        | 120.3   | 121.0 | 155.0                       | 153.0   | 154.0 |
| Bidhan Jayanti        | 3.0               | 3.7     | 3.3  | 66.7                                       | 66.3    | 66.5 | 117.7                        | 118.7   | 118.2 | 150.0                       | 159.7   | 154.8 |
| Bidhan Prava          | 5.0               | 5.7     | 5.3  | 71.3                                       | 76.7    | 74.0 | 127.0                        | 130.0   | 128.5 | 160.0                       | 164.0   | 162.0 |
| Bidhan Subhasini      | 3.3               | 4.0     | 3.7  | 65.3                                       | 69.0    | 67.2 | 120.7                        | 123.0   | 121.8 | 156.0                       | 162.0   | 159.0 |
| Bidhan Neeta          | 4.0               | 4.3     | 4.2  | 66.0                                       | 70.7    | 68.3 | 118.7                        | 117.0   | 117.8 | 152.0                       | 158.0   | 155.0 |
| Bidhan Monami         | 3.0               | 3.7     | 3.3  | 67.0                                       | 69.0    | 68.0 | 122.3                        | 125.3   | 123.8 | 158.0                       | 161.3   | 159.7 |
| Bidhan Basanti        | 4.0               | 4.7     | 4.3  | 68.7                                       | 73.7    | 71.2 | 133.0                        | 135.0   | 134.0 | 165.0                       | 168.3   | 166.7 |
| Bidhan Purna          | 5.7               | 4.3     | 5.0  | 71.3                                       | 72.0    | 71.7 | 125.0                        | 127.3   | 126.2 | 160.0                       | 162.0   | 161.0 |
| Basantika             | 3.3               | 4.0     | 3.7  | 64.3                                       | 73.3    | 68.8 | 122.3                        | 125.3   | 123.8 | 158.0                       | 164.3   | 161.5 |
| SE(±)                 | 0.26              | 0.27    |      | 1.66                                       | 1.74    |      | 1.75                         | 1.59    |       | 2.99                        | 2.19    |       |
| CD at 5%              | 0.78              | 0.82    |      | 4.92                                       | 5.15    |      | 5.18                         | 4.73    |       | 8.87                        | 6.50    |       |
| CV(%)                 | 11.48             | 11.09   |      | 4.21                                       | 4.28    |      | 2.46                         | 2.24    |       | 3.30                        | 2.33    |       |

From table-2 significantly maximum number of flowers per plant was produced in genotype Basantika (451.8) which was significantly superior over all other genotypes whereas, the genotype Bidhan Antara produced least number of flowers per plant (199.7). The number of flowers produced per plant may be directly related to increase in plant height, a greater number of branches, greater plant spread and number of leaves and accumulation of more photosynthates, thereby leading to the production of a greater number of flowers. The similar results were observed by Parul *et al.* (2011)<sup>[9]</sup>, Dhanumjaya and Sushma (2014)<sup>[4]</sup>, Jamaluddin *et al.* (2015)<sup>[5]</sup> and Suvija *et al.* (2016)<sup>[18]</sup> in chrysanthemum.

Among the chrysanthemum genotypes from the pooled mean, significantly highest Weight of flower per plant was recorded in the genotype Bidhan Lalima (1440.0 g) whereas, the

genotype Bidhan Antara registered least for weight of flower per plant (522.3 g). The variation among the genotypes was mainly because of increased flower size and number flowers per plant. Similar type of variations was observed by Baskaran *et al.* (2010)<sup>[2]</sup> and Suvija *et al.* (2016)<sup>[18]</sup> in chrysanthemum.

One of the most crucial characteristics for determining flower quality is flower diameter. Largest flower was recorded in genotype Bidhan Swapna (8.0 cm) and found to be at par with Bidhan Agnidev (7.4 cm) and Bidhan Lalima (7.4 cm); while smallest (3.9 cm) was recorded in Bidhan Basanti. Variation in flower diameter might be due to the genetic makeup of the genotypes and their interaction with prevailing environment conditions. Present findings are in concordance with the findings of Singh *et al.* (2017)<sup>[15]</sup> and Negi *et al.* (2015)<sup>[8]</sup>.

**Table 3:** Morphogenetical characters on yield traits of new genotypes of Chrysanthemum

| Name of the genotypes | No. of flowers/Plant |         |       | Weight of flower/Plant(g) |         |        | Diameter of flower (cm) |         |      |
|-----------------------|----------------------|---------|-------|---------------------------|---------|--------|-------------------------|---------|------|
|                       | IX                   |         |       | X                         |         |        | XI                      |         |      |
|                       | 2016-17              | 2017-18 | Mean  | 2016-17                   | 2017-18 | Mean   | 2016-17                 | 2017-18 | Mean |
| Bidhan Agnidev        | 433.3                | 183.3   | 308.3 | 650.0                     | 847.3   | 748.7  | 7.2                     | 7.7     | 7.4  |
| Bidhan Lalima         | 220.7                | 495.0   | 357.8 | 900.0                     | 1980.0  | 1440.0 | 7.2                     | 7.7     | 7.4  |
| Bidhan Swapna         | 174.7                | 326.7   | 250.7 | 790.0                     | 1608.3  | 1199.2 | 7.8                     | 8.2     | 8.0  |
| Bidhan Antara         | 191.7                | 207.7   | 199.7 | 421.7                     | 623.0   | 522.3  | 4.7                     | 5.1     | 4.9  |
| Bidhan Gold           | 525.0                | 199.0   | 362.0 | 633.3                     | 802.7   | 718.0  | 5.5                     | 5.6     | 5.5  |
| Bidhan Mallika        | 333.3                | 334.7   | 334.0 | 583.3                     | 1002.0  | 792.7  | 5.7                     | 5.8     | 5.8  |
| Bidhan Madhuri        | 219.7                | 415.0   | 317.3 | 1123.3                    | 1245.0  | 1184.2 | 5.7                     | 6.1     | 5.9  |
| Bidhan Tarun          | 358.0                | 313.0   | 335.5 | 310.0                     | 785.0   | 547.5  | 5.6                     | 5.7     | 5.7  |
| Bidhan Jayanti        | 323.0                | 211.7   | 267.3 | 635.0                     | 1058.3  | 846.7  | 7.0                     | 7.4     | 7.2  |
| Bidhan Prava          | 260.0                | 246.7   | 253.3 | 423.3                     | 740.0   | 581.7  | 6.5                     | 6.7     | 6.6  |
| Bidhan Subhasini      | 230.0                | 226.7   | 228.3 | 510.0                     | 780.0   | 645.0  | 7.3                     | 7.6     | 7.4  |
| Bidhan Neeta          | 253.0                | 248.0   | 250.5 | 800.0                     | 1276.7  | 1038.3 | 5.2                     | 5.5     | 5.4  |
| Bidhan Monami         | 215.0                | 209.0   | 212.0 | 520.0                     | 727.3   | 623.7  | 6.2                     | 6.4     | 6.3  |
| Bidhan Basanti        | 313.3                | 303.3   | 308.3 | 893.3                     | 1180.0  | 1036.7 | 3.7                     | 4.1     | 3.9  |
| Bidhan Purna          | 468.7                | 337.3   | 403.0 | 750.0                     | 1012.0  | 881.0  | 8.0                     | 7.2     | 7.6  |
| Basantika             | 472.0                | 431.7   | 451.8 | 976.7                     | 1293.3  | 1135.0 | 4.6                     | 4.8     | 4.7  |
| SE(±)                 | 13.33                | 12.00   |       | 79.44                     | 48.53   |        | 0.15                    | 0.11    |      |
| CD at 5%              | 39.6                 | 35.63   |       | 235.92                    | 144.12  |        | 0.45                    | 0.33    |      |
| CV(%)                 | 7.82                 | 7.15    |       | 20.48                     | 8.06    |        | 4.32                    | 3.05    |      |

**Table 4:** Morphogenetical characters on reaction to pest and diseases and colour of flower of new genotypes of Chrysanthemum

| Name of the genotypes | Reaction to pest and diseases | Colour of flower as Per RHS |
|-----------------------|-------------------------------|-----------------------------|
|                       | XII                           | XIII                        |
| Bidhan Agnidev        | Minimum                       | Dark Orange Red (RHS-20B)   |
| Bidhan Lalima         | Minimum                       | Purple Red                  |
| Bidhan Swapna         | Minimum                       | Pink(RHS-70C)               |
| Bidhan Antara         | Minimum                       | Red(RHS-47A)                |
| Bidhan Gold           | Minimum                       | Light Yellow(RHS-20A)       |
| Bidhan Mallika        | Minimum                       | Yellow(RHS-6A)              |
| Bidhan Madhuri        | Minimum                       | Light pink(RHS-65B)         |
| Bidhan Tarun          | Minimum                       | Pink Violet(RHS-75D)        |
| Bidhan Jayanti        | Minimum                       | Light yellow(RHS-20A)       |
| Bidhan Prava          | Minimum                       | Yellow(RHS-6A)              |
| Bidhan Subhasini      | Minimum                       | White                       |
| Bidhan Neeta          | Minimum                       | Brick Red                   |
| Bidhan Monami         | Minimum                       | Dark Pink red(RHS-51B)      |
| Bidhan Basanti        | Minimum                       | Yellow(RHS)                 |
| Bidhan Purna          | Minimum                       | Yellow(RHS)                 |
| Basantika             | Minimum                       | Yellow(RHS-6A)              |

### Conclusion

The study concludes by emphasizing the importance of plant height as a critical morphological indication in chrysanthemum variants that affects screening procedures. Variability in plant height among genotypes reflects underlying genetic factors, as reported by previous studies. Furthermore, environmental factors, particularly temperature, interact intricately with cultivars, impacting developmental traits. The observed variation in primary and secondary branches per plant can be attributed to genetic makeup, influencing plant vigour and branching patterns. Flowering characteristics, such as days to flower bud initiation and duration, vary among genotypes suggesting genetic control and environmental influences.

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