

Classification of Various Genotypes of Chrysanthemum (*Dendranthemagrandiflora* Tzvelev)

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ABSTRACT

The study was carried out on 30 genotypes of Chrysanthemum in Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2019-2020. Sufficient genetic variability was observed among the genotypes for various characters. The genotypes were categorized on the basis of morphological (flowering) characteristics. Out of 30 genotypes, five genotypes took less than 55 days to first flower bud while sixteen genotypes were grouped in medium (55-60 days) and nine in late (>60 days) category. Two genotypes took less than 70 days to flower opening while twenty one took 70-90 days and seven genotypes took >90 days. Three genotypes showed less than 30 days, seven genotypes between 30-40 days and twenty genotypes showed more than 40 days duration of flowering. Nineteen genotypes had <50, two genotypes had between 50-100 and nine genotype had >100 number of buds per plant. Seven genotypes had <5 cm flower diameter, twenty one had 5-10 cm and two genotypes had >10 cm. Fresh weight of ten flowers was less (<30 g) in twenty

one, medium (30-40 g) in one and more (>40 g) in eight genotypes. Twenty genotypes had <50, five had between 50-100 and five had >100 flowers per plant. Dry weight of ten flowers was less (<10 g) in twenty five, medium (10-15 g) in five and more (>15 g) in five genotypes. Flower yield/plant was less (<50 g) in nine, medium (50-150 g) in twelve and more (>150 g) in nine genotypes. Flower yield/hectare was found less (<5000 kg) in ten, medium (5000-10000 kg) in eight and more (>10000 kg) in twelve genotypes.

Keywords Chrysanthemum, Genotypes, Flowering characters.

INTRODUCTION

This genus Chrysanthemum (*Chrysanthemum morifolium*) belongs to the family composite, also known as Guldaudi, Autumn queen, Queen of East and also known as National Flower of Japan. Flower industry has tremendous potential in India. Globally in floriculture market, chrysanthemum comes among the top cut flower after rose. It ranks second after rose cut flower trade and fifth as pot plant (Negi *et al.* 2015). Chrysanthemum is very popular flower crop for using in exhibitions as cut flowers, pot mums and borders. It is very popular as loose flower and

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is used for making veni, garlands, bouquets and also for offering to God for worship. The spray varieties are used in raising flower bed, edging, mixed borders, hanging baskets, pot plants, front row planting and window boxes. This flower owns various colors like pink, white, lavender, yellow, bronze, orange, salmon red and shapes and designs like spider, quilled, pompon, anemone. Chrysanthemum is very attractive and beautiful flowering plant, having many varieties in the world (Joshi *et al.* 2010). The flower yield and flower quality are primarily varietal traits, but climate has also a huge impact. The performance of the genotype varies with the region, season and other growing conditions (Singh *et al.* 2017). Chrysanthemum covers 2090 ha area in production of 14930 MT of cut flower and 185240 MT of loose flower and in India during 2015-2016 (Anonymous 2018). In India it is commercially cultivated in Tamil Nadu, Nasik, Maharashtra, Kota-Rajasthan, Gujarat, West Bengal and in Haryana it is mostly grown in Ambala, Faridabad and Gurgaon. In chrysanthemum, hybridizing and inducing mutations were responsible for expanding the genetic divide, resulting in a variety of plant types and new color forms. The key research activities included the characterization of germplasm and enrichment and their use in breeding programs, the creation of new and novel varieties through selection, hybridization, *in vitro* and *in vivo* mutagenesis, disease management, postharvest physiology, programmed blooming, molecular techniques, tissue culture and to standardized agro-techniques (Datta 2015). Looking at the importance and commercial potential there is an urgent need to conserve and characterize the available variability, its evolution and to identify potential genotypes which would result in further improvement and develop cultivar for specific uses. Thus, effective breeding program is possible

by proper evaluation of the available germplasm for yield and their contributing characters. The genetic improvement of any crop depends on the genetic variability present in the available germplasm. This also necessitates the partitioning of the observed phenotypic variability into heritable and non-heritable components of variation. Keeping in the view the above facts the present study has been designed for the systematic improvement of chrysanthemum to study growth, flowering and yield attributing characters in various genotypes of chrysanthemum.

MATERIALS AND METHODS

The study was carried out on 30 genotypes of Chrysanthemum (Table 2) in Department of Horticulture, CCS Haryana Agricultural University, Hisar situated at 29°10' North latitude and 75°46' East longitude with an elevation of 215.2 meters above Mean Sea Level during 2019-2020. Hisar is characterized by semi-arid climate with hot and dry summer and cold winter. The experiment was conducted in Randomized Block Design with three replications. The sowing was done in 1.5m × 1.5m plot size with 30cm × 30cm spacing. The soil of the experimental site was analyzed for different characteristics (Tables 1-7). The soil was loamy in texture, low in available nitrogen, medium in available phosphorus, high in potash and medium in organic carbon. Well rotten farmyard manure @ 5 kg/m² was uniformly mixed as a basal dose in the soil a fortnight before transplanting of seedling. The fertilizers were applied @ 10: 8: 8 g m⁻² of nitrogen, phosphorus and potassium. Half quantity of nitrogen and full phosphorus and potassium was applied before transplanting while the remaining half dose of nitrogen was applied after one month transplanting. The observations were recorded on following pa-

Table 1. Characteristics of experimental soil.

Components	Contents	Method of determination
Available nitrogen (kg ha ⁻¹)	129.7	Alkaline permanganate method (Subbiah and Asija 1956)
Available phosphorus (kg P ₂ O ₅ ha ⁻¹)	27.7	Olsen's method (Olsen <i>et al.</i> 1954)
Available potassium (kg K ₂ O ha ⁻¹)	421.1	Flame photometric method (Jackson 1973)
pH	8.5	1:2 soil water suspension (Jackson 1967)
EC (dS m ⁻¹)	0.62	1:2 soil water suspension (Jackson 1967)
Organic carbon (%)	0.51	Walkley and Black rapid titration method (Piper 1966)

Table 2. Various sources of genotypes of chrysanthemum used in experiment.

No.	Genotypes	Source
10	Pusa Sona, Star Yellow, Pusa Centnary, Thichen Queen, Pusa Guldata, Star White, Pusa Shwet, Pusa Aditya, Tata Century, Pusa Chitrksha	Division of Floriculture, IARI, New Delhi
10	White Gadget, Bicolor Aruba, Ping Pong Yellow, Red Borolo, Orange Dazzle, Pink Sensation, Potenza Pink, Purple Lima, Papaya Clever, Green Button Lorenzo	Dahiya Nursey, Sonipat (Haryana)
10	Classic Beauty, Biscuit Parcel, Pink cloud, Haldighathi, HYDC 12, Bright yellow, Red Glamour, Mayur, Golden Splendour, Garden Beauty	Agri Tourism Center, CCS HAU Hisar

rameters:

Days taken to first flower bud : The appearance of flower buds in the representative plants from each replication were recorded and days taken were

counted and divided into three groups : Early (<50 days), Medium (50-60 days) and Late (>60 days).

Days taken to first flower opening : The appearance

Table 3. Plants dry weight and days taken to first bud initiation in various genotypes of chrysanthemum.

Genotypes	Days taken to first bud initiation during 2019	Days taken to first bud initiation during 2020	Days taken to first bud initiation (Pooled)	Days taken to first flower opening during 2019	Days taken to first flower opening during 2020	Days taken to first flower opening (Pooled)
Pusa Sona	57.87	53.33	55.60	68.60	63.82	66.21
Star Yellow	59.47	55.82	57.64	71.93	72.81	72.37
Pusa Centnary	61.27	58.18	59.72	88.27	87.65	87.96
Thichen Queen	57.47	53.81	55.64	83.27	81.67	82.47
Pusa Guldata	58.80	60.23	59.52	81.73	83.51	82.62
Star White	61.93	62.70	62.32	94.87	95.25	95.06
Pusa Shwet	61.93	57.88	59.91	91.73	93.81	92.77
Pusa Aditya	60.93	60.96	60.95	84.73	81.36	83.05
Tata Century	60.33	59.50	59.92	82.40	82.92	82.66
Pusa Chitrksha	60.33	58.00	59.17	85.67	83.24	84.45
White Gadget	58.73	52.14	55.44	78.87	75.25	77.06
Bicolor Aruba	62.33	62.10	62.22	90.53	85.94	88.24
Ping Pong Yellow	52.53	54.57	53.55	79.07	79.76	79.41
Red Borolo	57.80	56.47	57.14	79.00	78.10	78.55
Orange Dazzle	51.53	50.73	51.13	70.93	68.88	69.91
Pink Sensation	59.53	57.81	58.67	80.87	80.59	80.73
Potenza Pink	57.47	57.66	57.57	84.07	85.88	84.97
Purple Lima	56.07	55.93	56.00	76.87	76.78	76.82
Papaya Clever	56.20	58.26	57.23	88.33	91.25	89.79
Green Button Lorenzo	54.93	53.28	54.11	77.80	73.41	75.60
Classic Beauty	60.20	61.67	60.94	85.07	88.39	86.73
Biscuit Parcel	56.00	61.28	58.64	86.33	89.43	87.88
Pink cloud	55.40	53.16	54.28	81.53	77.82	79.68
Haldighathi	56.47	62.05	59.26	89.27	91.44	90.36
HYDC 12	56.93	58.37	57.65	82.93	78.06	80.50
Bright yellow	57.13	60.45	58.79	84.67	85.83	85.25
Red Glamour	58.47	52.50	55.49	92.00	92.94	92.47
Mayur	57.47	51.18	54.32	93.60	96.25	94.92
Golden Splendour	57.07	62.45	59.76	94.07	92.11	93.09
Garden Beauty	54.93	51.78	53.36	92.20	93.06	92.63
CD 5%	0.73	4.21	2.20	1.09	3.87	2.05

of first flower on the representative plants from each plots were recorded and days taken were counted and it is divided into three groups as: Early (< 80 days), Medium (80-100 days) and Late (> 100 days).

Duration of flowering (days) : The number of days taken from the date of first flower opening to the last flower constituted the duration of flowering were recorded on representative plants in each plot. Duration of flowering is grouped into three categories : Early (< 30 days), Medium (30-40 days) and Late (> 40 days).

Number of buds per plant : The total number of buds per plant were recorded on the representative plants in each plot and grouped into three categories: Low (< 50), Medium (50-100) and more (> 100).

Number of flowers per plant : The total number of flowers per plant were recorded on the representative plants in each plot and classified in three groups: Low (< 50), Medium (50-100) and more (> 100).

Flower diameter (cm) : Flower diameter was recorded by using digital Vernier's calliper at full bloom stage. Mean of five flowers from each representative plant in each replication was expressed in centimeters and classified into following categories: Small (< 5 cm), Medium (5-10 cm) and Big (> 10 cm).

Fresh weight of flowers (g) : The mean weight of ten flowers plucked randomly from each representative plant was recorded immediately after harvest and expressed in grams. It was classified into three categories:

Table 4. Days taken to first flower opening and duration of flowering in various genotypes of chrysanthemum.

Genotypes	Duration of flowering during 2019	Duration of flowering during 2020	Duration of flowering during (Pooled)	Flower diameter (cm) during 2019	Flower diameter (cm) during 2020	Flower diameter (Pooled)
Pusa Sona	66.00	62.07	64.03	3.98	3.10	3.54
Star Yellow	84.00	82.88	83.44	8.76	8.05	8.41
Pusa Centnary	58.40	57.01	57.71	9.07	8.66	8.87
Thichen Queen	72.67	73.02	72.85	9.59	9.00	9.30
Pusa Guldata	63.53	61.91	62.72	4.35	4.02	4.19
Star White	49.13	46.83	47.98	11.11	11.20	11.16
Pusa Shwet	52.00	52.98	52.49	8.62	8.09	8.36
Pusa Aditya	25.00	24.90	24.95	6.07	5.94	6.01
Tata Century	59.73	58.06	58.90	10.95	11.07	11.01
Pusa Chitrksha	41.00	40.58	40.79	5.01	4.66	4.83
White Gadget	60.07	57.33	58.70	4.02	4.11	4.07
Bicolor Aruba	48.00	47.45	47.73	5.47	5.24	5.35
Ping Pong Yellow	38.53	38.22	38.38	4.50	4.22	4.37
Red Borolo	61.00	57.59	59.30	6.05	5.95	6.00
Orange Dazzle	59.00	57.19	58.10	6.68	6.46	6.57
Pink Sensation	31.00	30.93	30.97	5.03	5.17	5.10
Potenza Pink	40.00	40.65	40.32	5.11	4.91	5.01
Purple Lima	69.33	67.53	68.43	6.27	6.31	6.29
Papaya Clever	42.47	43.77	43.15	7.51	7.14	7.33
Green Button Lorenzo	50.80	52.75	51.78	3.22	3.03	3.13
Classic Beauty	59.40	67.56	63.48	5.86	5.34	5.60
Biscuit Parcel	41.07	42.81	41.94	4.26	3.98	4.12
Pink cloud	73.00	72.53	72.77	5.95	5.85	5.90
Haldighathi	59.87	63.18	61.52	4.26	4.14	4.20
HYDC 12	39.27	38.37	38.82	5.82	5.22	5.52
Bright yellow	29.53	27.52	28.53	6.61	6.20	6.41
Red Glamour	47.67	48.98	48.32	5.52	5.26	5.39
Mayur	34.67	34.97	34.82	6.85	6.97	6.91
Golden Splendour	48.00	48.09	48.05	5.96	5.89	5.93
Garden Beauty	28.80	29.51	29.16	8.73	8.53	8.63
CD 5%	1.99	3.11	2.11	0.30	0.34	0.24

Table 5. No. of buds per plant and no. of flowers per plant in various genotypes of chrysanthemum.

Genotype	No. of buds per plant during 2019	No. of buds per plant during 2020	No. of buds per plant (pooled)	No. of flowers per plant during 2019	No. of flowers per plant during 2020	No. of flowers per plant (pooled)
Pusa Sona	185.13	178.68	178.84	169.13	167.81	168.31
Star Yellow	25.73	24.52	25.36	10.87	10.23	10.55
Pusa Centnary	28.10	26.73	27.41	12.87	11.37	12.12
Thichen Queen	22.30	22.82	22.56	12.53	12.93	12.73
Pusa Guldata	179.00	178.32	178.66	164.80	162.59	163.69
Star White	20.10	20.84	20.47	17.13	20.96	19.22
Pusa Shwet	132.70	131.54	132.12	118.60	119.32	118.96
Pusa Aditya	112.40	110.91	111.61	99.40	96.54	97.97
Tata Century	18.30	15.75	17.03	10.53	10.57	10.55
Pusa Chitrksha	189.30	186.76	188.03	174.80	172.45	173.62
White Gadget	116.80	113.00	114.90	93.27	92.30	92.78
Bicolor Aruba	18.73	17.49	18.05	14.27	13.17	13.72
Ping Pong Yellow	16.67	14.71	15.71	11.53	11.38	11.49
Red Borolo	26.27	26.21	26.01	21.40	21.75	21.58
Orange Dazzle	14.73	13.26	13.93	10.53	10.98	10.76
Pink Sensation	42.80	39.94	41.27	37.00	35.69	36.34
Potenza Pink	29.67	29.15	29.37	20.80	22.02	21.41
Purple Lima	37.87	36.91	37.21	22.80	23.49	23.15
Papaya Clever	17.80	16.10	16.75	12.73	11.78	12.26
Green Button Lorenzo	39.30	39.36	39.33	25.13	23.36	24.25
Classic Beauty	84.20	81.87	83.04	74.53	73.89	74.21
Biscuit Parcel	105.30	102.59	103.95	95.47	99.39	96.63
Pink cloud	130.70	123.44	127.07	109.60	104.81	107.20
Haldighathi	59.53	56.45	57.67	49.67	47.42	48.55
HYDC 12	47.40	47.06	47.23	37.60	37.37	37.48
Bright yellow	34.53	35.02	34.91	28.53	24.88	26.71
Red Glamour	29.13	26.30	27.60	20.87	19.09	19.98
Mayur	118.80	116.86	118.13	98.87	95.10	96.99
Golden Splendour	25.67	24.66	25.28	19.20	21.13	20.17
Garden Beauty	17.47	16.70	17.05	10.13	10.35	10.24
CD 5%	6.93	3.35	3.11	4.74	3.57	2.55

Less (< 30 g), Medium (30-40 g) and High (> 40 g).

Dry weight of ten flowers (g) : The flowers taken for dry weight were dried under shade till the reduction in weight become constant then the average weight was recorded as dry weight of ten flowers and expressed in grams. It was classified into three categories: Less (< 10 g), Medium (10-15 g) and More (> 15 g).

Flower yield per plant (g) : The mean fresh weight of a flower multiplied by number of flowers per plant constituted the flower yield per plant and expressed in grams. Flower yield/hectare was divided into Less (<50g), Medium (50-150g) and More (>150g).

Flower yield per hectare (kg) : The flower

yield per plant was converted to hectare basis which reflect the yield per hectare. Flower yield/hectare was divided into Less (<5000 kg), Medium (5000-10,000 kg) and More (>10,000 kg).

Statistical analysis

The data obtained on various characters were subjected to statistical analysis in accordance with Panse and Sukhatme (1995).

RESULTS AND DISCUSSION

The present study revealed that there is enough scope for the development of superior varieties due to presence of high significant variability among the

Table 6. Flower diameter and fresh weight of 10 flowers in various genotypes of chrysanthemum.

Genotypes	Fresh weight of 10 flowers (g) during 2019	Fresh weight of 10 flowers (g) during 2020	Fresh weight of 10 flowers (g) (pooled)	Dry weight of 10 flowers during 2019	Dry weight of 10 flowers during 2020	Dry weight of 10 flowers (pooled)
Pusa Sona	6.60	5.28	5.94	1.61	1.26	1.44
Star Yellow	151.22	150.26	150.74	14.55	12.80	13.68
Pusa Centnary	104.52	100.06	102.29	10.09	9.63	9.86
Thichen Queen	119.36	118.70	119.03	10.63	10.01	10.32
Pusa Guldata	18.91	17.78	18.35	2.49	2.22	2.36
Star White	106.01	104.25	105.13	12.35	12.00	12.18
Pusa Shwet	22.67	24.25	23.46	2.82	2.36	2.59
Pusa Aditya	11.40	12.74	12.07	1.17	1.16	1.17
Tata Century	101.62	93.17	97.39	10.79	9.76	10.28
Pusa Chitrksha	13.96	13.27	13.62	1.03	0.88	0.96
White Gadget	9.61	8.95	9.28	2.02	2.00	2.01
Bicolor Aruba	8.43	8.24	8.34	2.02	1.75	1.89
Ping Pong Yellow	61.64	60.38	61.01	5.11	5.18	5.14
Red Borolo	15.11	13.38	14.25	3.60	3.26	3.43
Orange Dazzle	71.97	72.40	72.19	4.95	4.74	4.85
Pink Sensation	13.45	13.29	13.37	2.30	2.20	2.25
Potenza Pink	21.74	20.89	21.32	3.51	3.15	3.33
Purple Lima	61.39	60.92	61.16	6.14	5.49	5.82
Papaya Clever	15.76	15.62	15.69	26.86	4.43	4.48
Green Button Lorenzo	38.88	38.28	38.58	3.79	3.63	3.71
Classic Beauty	19.72	18.71	19.21	1.94	1.72	1.83
Biscuit Parcel	20.53	19.72	20.13	1.98	2.42	2.20
Pink cloud	20.66	19.93	20.30	1.72	1.47	1.60
Haldighathi	17.61	17.85	17.73	1.66	1.30	1.48
HYDC 12	14.64	15.71	15.17	1.46	1.09	1.28
Bright yellow	14.47	13.85	14.16	1.44	1.20	1.32
Red Glamour	14.02	12.05	13.04	2.28	2.56	2.42
Mayur	16.46	15.87	16.16	1.59	1.55	1.57
Golden Splendour	17.75	16.93	17.34	1.62	1.46	1.54
Garden Beauty	12.10	12.66	12.38	1.49	1.34	1.41
CD 5%	3.97	1.80	2.66	11.72	0.34	0.28

genotypes. The results of the study are presented as follows :

Days taken to first flower bud : Five genotypes took less than 55 days to first flower bud while sixteen genotypes were grouped in Medium (55-60 days) and nine in Late (>60 days) category.

Table 1. Classification of chrysanthemum genotypes on the basis of days taken to first flower bud.

Less (<55 days)	Ping Pong Yellow, Orange Dazzle, Green Button Lorenzo, Mayur, Garden Beauty	Late (>60 days)	Classic Beauty, Bicolor Aruba, Pusa Aditya, Star White
Medium (55-60 days)	Tata Century, Red Glamour, Golden Splendour, Star Yellow, Papaya Clever, Pusa Guldata, Bright Yellow, Thichen Queen, Pusa Shwet, Pusa Chitrksha, White Gadget, Haldighathi, Pusa Sona, Pusa Centnary, Red Borolo, Potenza Pink, Pink Sensation, Purple Lima, Pink Cloud, Biscuit Parcel, HYDC 12	Days taken to first flower opening: Two genotypes took less than 70 days to flower opening while twenty one genotypes were grouped in Medium (70-90 days)	

Table 7. Dry weight of 10 flowers and flower yield per plant in various genotypes of chrysanthemum.

Genotypes	Flower yield/ hectare (kg) during 2019	Flower yield/ hectare (kg) during 2020	Flower yield/ hectare (pooled)	Flower yield per plant (g) during 2019	Flower yield per plant (g) during 2020	Flower yield per plant (pooled)
Pusa Sona	9503.11	7384.48	8443.79	114.04	88.62	101.33
Star Yellow	13694.87	12813.91	13254.39	164.34	153.77	159.05
Pusa Centnary	11208.36	9476.93	10324.64	134.50	113.73	124.11
Thichen Queen	12457.27	12791.14	12624.20	149.49	153.50	151.49
Pusa Guldata	25978.14	24104.96	25041.54	311.74	289.26	300.50
Star White	17796.38	18221.28	18008.83	213.56	218.66	216.11
Pusa Shwet	22376.33	24107.39	23241.86	268.52	289.29	278.91
Pusa Aditya	9447.72	10256.14	9851.93	113.37	123.08	118.22
Tata Century	8927.86	8193.43	8560.65	107.13	98.32	102.73
Pusa Chitrksha	20316.42	19081.54	19698.98	243.80	228.98	236.39
White Gadget	7473.78	6887.64	7180.71	89.69	82.65	86.17
Bicolor Aruba	1003.67	904.00	953.84	12.04	10.85	11.45
Ping Pong Yellow	5957.94	5725.99	5841.97	71.50	68.72	70.11
Red Borolo	2683.94	2423.79	2553.86	32.21	29.08	30.64
Orange Dazzle	6313.19	6633.78	6473.48	75.76	79.61	77.68
Pink Sensation	4148.11	3951.40	4049.75	49.78	47.42	48.60
Potenza Pink	3782.63	3827.32	3804.73	45.39	45.93	45.66
Purple Lima	11629.00	11926.43	11777.71	139.55	143.14	141.34
Papaya Clever	1670.64	1534.55	1602.59	20.05	18.42	19.23
Green Button Lorenzo	8148.42	7443.28	7795.84	97.78	89.32	93.55
Classic Beauty	12253.65	11519.75	11886.70	147.04	138.24	142.64
Biscuit Parcel	17133.08	16335.05	16734.07	205.60	196.02	200.81
Pink cloud	18869.00	17405.04	18137.02	226.43	208.86	217.65
Haldighati	7290.69	7056.48	7173.58	87.49	84.68	86.09
HYDC 12	4584.74	4892.99	4738.86	55.02	58.72	56.87
Bright yellow	3440.25	2868.82	3154.54	41.28	34.43	37.85
Red Glamour	2424.28	1916.07	2170.17	29.09	23.00	26.05
Mayur	13540.78	12577.50	13059.13	162.49	150.93	156.71
Golden Splendor	2839.67	2981.17	2910.42	34.08	35.78	34.93
Garden Beauty	1022.17	1092.17	1057.17	12.27	13.11	12.69
CD 5%	1591.52	1143.51		19.10	13.68	

and seven in Late (>90 days) category.

Table 2. Classification of chrysanthemum genotypes on the basis of days taken to first flower opening.

Less (<70 days)
Medium
(70-90 days)

Pusa Sona, Orange Dazzle

Tata Century, Star Yellow, Papaya Clever, Pusa Guldata, Bright Yellow, Thichen Queen, Pusa Chitrksha, White Gadget, Pusa Centnary, Red Borolo, Potenza Pink, Pink Sensation, Purple Lima, Pink Cloud, Biscuit Parcel, HYDC 12, Ping Pong Yellow, Green Button Lorenzo, Classic Beauty, Bicolor Aruba, Pusa Aditya

Late (>90 days)

Star White, Pusa Shwet, Haldighati, Red Glamour, Mayur, Golden Splendour, Garden Beauty

Duration of flowering : On the basis of length of flowering period, three genotypes showed less than 30 days of duration of flowering. Medium duration of flowering (30-40 days) was observed in seven genotypes and long period of flowering was observed in twenty genotypes.

Table 3. Classification of chrysanthemum genotypes on the basis of duration of flowering.

Less (<30 days)

Pusa Aditya, Garden beauty, Bright Yellow

Medium (30-40 days) Ping Pong Yellow, Pink Sen

Late(>40 days)-20 sation, HYDC 12, Mayur
Tata Century, Star Yellow,
Papaya Clever, Pusa Guldata,
Thichen Queen, Pusa Chitrk-
sha, White Gadget, Pusa
Centnary, Red Borolo, Potenza
Pink, Purple Lima, Pink Cloud,
Biscuit Parcel, Green Button
Lorenzo, Classic Beauty,
Bicolor Aruba, Star White,
Pusa Shwet, Haldighati, Red
Glamour, Golden Splendour,
Pusa Sona, Orange Dazzle

Number of buds per plant: Nineteen genotypes grouped into <50 while two genotypes were grouped in Medium (50-100) and nine genotype in more (>100) category.

Table 4. Classification of chrysanthemum genotypes on the basis of no. of buds per plant.

Less (<50)	Star Yellow, Pusa Centnary, Thichen Queen, Star White, Tata Century, Bicolor Aruba, Ping Pong Yellow, Red Borolo, Orange Dazzle, Pink Sensation, Potenza Pink, Purple Lima, Papaya Clever, Green Button Lorenzo, HYDC 12, Bright Yellow, Red Glamour, Golden Splendour, Garden Beauty
Medium (50-100)	Classic Beauty, Haldighati
More (>100)	Pusa Sona, Pusa Guldata, Pu- sa Shwet, Pusa Aditya, Pu- sa Chitrksha, White Gadget, Pink Cloud, Biscuit Parcel, Mayur

Number of flowers per plant: Twenty genotypes grouped into <50 while five genotypes were grouped in Medium (50-100) and five genotypes in More (>100) category.

Table 5. Classification of chrysanthemum genotypes on the basis of no. of flowers per plant.

Less (<50)	Star Yellow, Pusa Centnary,
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Medium (50-100)	Thichen Queen, Star White, Tata Century, Bicolor Aruba, Ping Pong Yellow, Red Borolo, Orange Dazzle, Pink Sensa- tion, Potenza Pink, Purple Lima, Papaya Clever, Green Button Lorenzo, HYDC 12, Bright Yellow, Red Glamour Golden Splendour, Garden Beauty, Haldighati
More (>100)	Pusa Aditya, White Gadget, Biscuit Parcel, Classic Beauty, Mayur Pusa Sona, Pusa Guldata, Pu- sa Shwet, Pusa Chitrksha, Pink Cloud

Flower diameter (cm): Flower diameter was categorized into three groups according to the size of flower. The first group was small (<5 cm) and it included seven genotypes. Medium (5-10 cm) group had twenty one genotypes and two genotypes were included in Large (>10 cm) group.

Table 6. Classification of chrysanthemum genotypes on the basis of flower diameter.

Small (<5cm)	Pusa Sona, Pusa Guldata, White Gadget, Ping Pong Yel- low, Green Button Lorenzo, Biscuit Parcel, Haldighati
Medium (5-10cm)	Pusa Aditya, Classic Beauty, Mayur, Star Yellow, Pusa Cent- nary, Thichen Queen, Bicolor Aruba, Red Borolo, Orange Dazzle, Pink Sensation, Po- tenza Pink, Purple Lima, Papa- ya Clever, HYDC 12, Bright Yellow, Red Glamour, Golden Splendour, Garden Beauty, Pusa Shwet, Pusa Chitrksha, Pink Cloud
Large (>10cm)	Star White, Tata Century

Fresh weight of flower (g): Fresh weight of ten flowers was divided into Less (<30 g), Medium (30-40 g) and More (>40 g). Twenty one genotypes were observed in less weight category, one in medium

weight category and eight in more.

Table 7. Classification of chrysanthemum genotypes on the basis of fresh weight of flower.

Less (<30g)	Pusa Aditya, Classic Beauty, Mayur, Bicolor Aruba, Red Borolo, Pink Sensation, Potenza Pink, Papaya Clever, HYDC 12, Bright Yellow, Red Glamour, Golden Splendour, Garden Beauty, Pusa Shwet, Pusa Chitrksha, Pink Cloud, Pusa Sona, Pusa Guldata, White Gadget, Biscuit Parcel, Haldighati
Medium (30-40g)	Green Button Lorenzo
More (>40g)	Star Yellow, Pusa Centnary, Thichen Queen, Star White, Tata Century, Ping Pong Yellow, Orange Dazzle, Purple Lima

Dry weight of flower (g) : Dry weight of ten flowers was divided into Less (<10 g), Medium (10-15g) and More (>15 g). Twenty five genotypes were observed in less weight category and five in medium weight category and no. genotype was observed in more category.

Table 8. Classification of chrysanthemum genotypes on the basis of dry weight of flower.

Less (<10g)	Pusa Aditya, Classic Beauty, Mayur, Bicolor Aruba, Red Borolo, Pink Sensation, Potenza Pink, Papaya Clever, HYDC 12, Bright Yellow, Red Glamour, Golden Splendour, Garden Beauty, Pusa Shwet, Pusa Chitrksha, Pink Cloud, Pusa Sona, Pusa Guldata, White Gadget, Biscuit Parcel, Haldighati, Ping Pong Yellow, Orange Dazzle, Purple Lima, Green Button Lorenzo
Medium (10-15g)	Star Yellow, Pusa Centnary, Thichen Queen, Tata Century, Star White
More (>15g)	-

Flower yield/plant (g): Flower yield/plant was divided into Less (<50 g), Medium (50-150g) and More (>150 g). Nine genotypes were observed in less weight category and twelve in medium weight category and nine genotypes were observed in more.

Table 9. Classification of chrysanthemum genotypes on the basis of flower yield/plant.

Less (<50g)	Golden Splendour, Garden Beauty, Bright Yellow, Red Glamour, Papaya Clever, Pink Sensation, Potenza Pink, Red Borolo, Bicolor Aruba
Medium (50-150g)	Pusa Aditya, Classic Beauty, HYDC 12, Pusa Sona, White Gadget, Haldighati, Ping Pong Yellow, Orange Dazzle, Purple Lima, Green Button Lorenzo, Pusa Centnary, Tata Century
More (>150g)	Star Yellow, Pusa Guldata, Star White, Thichen Queen, Pusa Shwet, Pusa Chitrksha, Biscuit Parcel, Pink Cloud, Mayur

Flower yield/hectare (kg) : Flower yield/hectare was divided into Less (<5000 kg), Medium (5000-10, 000 kg) and More (>10, 000 kg). Ten genotypes were observed in less weight category and eight in medium weight category and twelve genotypes were observed in more.

Table 10. Classification of chrysanthemum genotypes on the basis of flower yield/hectare.

Less (<5000 kg)	Bicolor Aruba, Red Borolo, Pink Sensation, Potenza Pink, Papaya Clever, HYDC 12, Bright Yellow, Red Glamour, Golden Splendour, Garden Beauty
Medium (5000-10,000 kg)	Pusa Aditya, Pusa Sona, White Gadget, Haldighati, Ping Pong Yellow, Orange Dazzle, Green Button Lorenzo, Tata Century

More (>10000g) Biscuit Parcel, Pink Cloud, Mayur, Classic Beauty, Purple Lima, Pusa Guldata, Star White, Thichen Queen, Pusa Shwet, Pusa Chitrksha, Star Yellow, Pusa Centnary

Similar variation for plant height among genotypes was also observed by Madam *et al.* (2016), Kumar *et al.* (2014), Banerji *et al.* (2012) Rao and Pratap (2006) in chrysanthemum genotypes. The characters such as plant growth habit, plant height, plant spread, stem color, stem diameter, stalk shape, leaf margin, flower color, leaf color, flower size, stem pubescence, number of branches per plant, days taken to first flower opening, duration of flowering and discflorete can be used in selection criteria for suitable breeding methodology. Similar findings were also observed by Madam *et al.* (2016), Kumar *et al.* (2014), Banerji *et al.* (2012), Rao and Pratap (2006), Singh *et al.* (2017), Negi *et al.* (2019) in chrysanthemum. The varietal characterization study may be used in developing the passport data of genotype which can be used in DUS testing (Distinctness, Uniformity, Stability) for registration under Plant Variety Protection and Farmers' Right Act 2001.

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