Biological Forum – An International Journal **13(1): 169-175(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) Genotypes for Plant Growth Characters

Sonia Singh[1] and A.K. Godara[2]
[1]College of Horticulture, Maharana Partap Horticultural University, Karnal (Haryana), India.
[2]Department of Horticulture, CCS Haryana Agricultural University, Hisar (Haryana), India.

(Corresponding author: Sonia Singh)
(Received 28 December 2020, Accepted 10 March, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The study was carried out on 30 genotypes of Chrysanthemum in Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2019-2020. The results of the study revealed that among 30 genotypes, three genotypes were found dwarf (<30cm), twelve medium (30-40 cm) and fifteen were tall (>40cm). Similarly, plant spread in twelve genotypes was less (<25 cm), medium (25-35cm) in eleven and more (>35cm) in seven genotypes. Stem diameter was found less (<0.5 cm) in ten genotypes, medium (0.5 to 1.0cm) in eighteen and more (>1.0cm) in two genotypes. The stalk length was found small (< 5cm) in five genotypes, medium (5-10 cm) in twenty one and big (>10 cm) in four genotypes. Number of primary branches per plant was found less (<5) in five, medium (5-10) in fifteen and more (>10) in ten genotypes. Fresh weight of plant was found less (<150 g) in seven, medium (150-300g) in sixteen and more (>330 g) in seven genotypes. Dry weight of plant was found less (<50g) in four, medium (50-100 g) in seven and more (>100g) in nineteen genotypes. Maximum plant height (60.39cm) was recorded in Golden Splendor while minimum was recorded in Pusa Sona (19.42cm). Maximum plant spread was recorded in Pink cloud (52.88cm) and minimum was recorded in Ping pong yellow (17.85cm). Maximum stem diameter was recorded in Garden Beauty (1.64cm) while minimum was recorded in Purple Lima (0.27cm). Maximum stalk length was exhibited in Red Borola (13.61cm) and minimum was recorded in Pusa Sona (3.26cm). Maximum number of branches per plant was recorded in White Gadget (23.31) and minimum were recorded in Potenza Pink (5.59). Maximum fresh weight was recorded in Pusa Guldata (506.44g) and minimum was recorded in Potenza Pink (83.16). Maximum dry weight of plant was recorded in Pusa Guldata (237.38g) while minimum was recorded in Red Borolo (40.91g). This information will be helpful for breeder to use these genotypes in further breeding programmes and in DUS testing for registration of variety under PPV& FR act, 2001.

Keywords: Chrysanthemum, genotypes, flowering characters, Growth parameters

INTRODUCTION

Chrysanthemum (*Chrysanthemum grandiflora*) belongs to the family *Asteraceae*, is known as Guldaudi, Autumn queen, Queen of East and National Flower of Japan. Flower industry has tremendous potential in India. Globally in floriculture market, chrysanthemum ranks second after rose cut flower trade and fifth as pot plant (Negi *et al.*, 2015). It is very popular as loose flower, and is used for making veni, garlands, bouquets and also for offering to God for worship. The wide variation exhibited by large numbers of species and shapes of blooms make this crop a multipurpose flower crop. The Spray verities 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). For successful planning and execution of crop improvement programme in chrysanthemum, which is highly heterozygous, basic information on leaf, stem, flowers and other characters are necessary to be used in architecture of desired plant type. Diverse parameters are helpful in identification of best combiners for use in breeding programme and in finding correct taxonomic identity of the genotypes as well as for getting rid of cultivar synonymity by means of morphological characterization. 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. Keeping in the view the above facts the present study was designed to study plant growth characters in various genotypes of chrysanthemum.

MATERIALS AND METHODS

The study was carried out on 30 genotypes of Chrysanthemum (Table 1) at 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 alkaline (pH 8.5) having 0.51 organic carbon, 130kg/ha available nitrogen, 27kg/ha P_2O_5, 421kg/ha K_2O. 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/m^2 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 parameters:

Plant height (cm): For measurement of plant height five plants were selected at random from each plot. Plant height was measured from the base of the plant upto tip of apical shoot with the help of meter rod at full bloom stage and expressed in centimeters. On the basis of height, following three categories were made: Short (< 30 cm), Medium (30-40 cm) and Tall (> 40 cm).

Plant spread (cm): Plant spread was recorded by measuring the distance covered by the plant in North-South and East-West directions and taking mean of sum for representative plants from each plot. On the basis of spread following three categories were made: Less (<25 cm), Medium (25-35 cm) and More (>35 cm).

Stem diameter (cm): Stem diameter of the plants were measured by using digital Vernier's caliper and mean of five representative plant in each replication which is expressed in centimetres and classified as: Small (< 5 cm), Medium (5-10 cm) and Big (> 10 cm).

Stalk length (cm): Size of stalk was recorded at full bloom stage by using digital Vernier's caliper. Mean of five stalks from each representative plant in each replication is classified as: Small (<5 cm), Medium (5-10 cm) and Big (>10 cm).

Number of primary branches/plants: The number of branches arising from the main stem was counted at the time of full bloom on five representative plants in each replication and were divided into three categories- Less (<5), Medium (5-10) and more (>10).

Fresh weight of plant (g): The mean weight of five plants randomly from each representative plant was recorded immediately after harvest which was expressed in grams and categorized as Less (< 150 g), Medium (150-300 g) and more (> 300 g).

Dry weight of plant (g): The plants 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 plants which was expressed in grams and categorized in Less (< 50 g), Medium (50-100 g) and More (> 100 g).

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

RESULTS AND DISCUSSION

The result of two year study revealed that significant differences were observed among the genotypes. A wide range of variability among genotypes was observed for various characters. Out of thirty genotypes, sixteen genotypes exhibited compact plant growth habit while fourteen genotypes showed wider crotch angle with open growth habit. The branching habit was basal in fourteen genotypes, middle branching in ten genotypes, top branching in one genotype and in five genotypes full branching was observed. Nineteen genotypes showed green colour, two genotypes showed light green colour and nine genotypes showed purple strips. Only one genotype (Pusa Sona) showed smooth stem and twenty nine genotypes showed ridged stems. Fourteen genotypes were glabrous and sixteen genotypes were found non-glabrous. Seven genotypes showed light green colour, twenty one genotypes showed dark green colour and two genotypes showed green colour. Seventeen genotypes narrow pointed leaflets were observed while in thirteen genotypes oval pointed leaflets were observed. Thirteen genotypes had serrated, fourteen had highly serrated and three had smooth leaflet margin. Based on smoothness of leaf surface, thirteen genotypes were non glabrous while seventeen were glabrous. On the basis of disc twenty two genotypes were placed in visible while eight were non-visible category. On the basis of flower types, twenty one genotypes were placed in Spray type while eight were placed as standard and one genotype was observed as semi double (Table 1&2).

Plant height: Out of thirty genotypes, three genotypes were grouped into dwarf (<30 cm). Twelve genotypes grouped into medium category (30-40 cm) and fifteen genotypes were grouped in tall (>40 cm). Maximum plant height (61.47 and 59.32 cm) was recorded in Golden Splendor followed by Star yellow (60.73 and 57.19 cm) and minimum plant height was recorded in Pusa Sona (20.40 and 18.43) followed by Potenza Pink (30.20 and 27.58) during 2019 and 2020 respectively (Table 3).

Table 1: Classification of Chrysanthemum genotypes on the basis of Plant characters.

Name of Genotype	Plant growth habit	Branching habit	Stem colour	Stem shape	Stem pubescence	Leaf colour
Pusa Sona	Open	Full branching	Green	Smooth	Glabrous	Dark green
Star Yellow	Compact	Middle branching	Green	Rigid	Non-glabrous	Light green
Pusa Centnary	Open	Basal branching	Green	Rigid	Non-glabrous	Light green
Thichen Queen	Compact	Middle branching	Green	Rigid	Non-glabrous	Light green
Pusa Guldata	Open	Basal branching	Green	Rigid	Non-glabrous	Dark green
Star White	Compact	Middle branching	Purple strips	Rigid	Non-glabrous	Dark green
Pusa Shwet	Open	Basal branching	Green	Rigid	Non-glabrous	Dark green
Pusa Aditya	Open	Basal branching	Green	Rigid	Non-glabrous	Dark green
Tata Century	Compact	Middle branching	Green	Rigid	Non-glabrous	Dark green
Pusa Chitrksha	Open	Basal branching	Green	Rigid	Glabrous	Dark green
White Gadget	Open	Full branching	Purple strips	Rigid	Glabrous	Dark green
Bicolor Aruba	Compact	Basal branching	Purple strips	Rigid	Non-glabrous	Dark green
Ping Pong Yellow	Compact	Middle branching	Green	Rigid	Non-glabrous	Dark green
Red Borolo	Open	Basal branching	Purple strips	Rigid	Non-glabrous	Dark green
Orange Dazzle	Compact	Top Branching	Green	Rigid	Glabrous	Dark green
Pink Sensation	Compact	Basal branching	Green	Rigid	Glabrous	Dark green
Potenza Pink	Compact	Basal branching	Green	Rigid	Glabrous	Dark green
Purple Lima	Compact	Middle branching	Purple strips	Rigid	Non-glabrous	Dark green
Papaya Clever	Compact	Basal branching	Light green	Rigid	Non-glabrous	Light green
Green Button Lorenzo	Compact	Basal branching	Light green	Rigid	Glabrous	Light green
Classic Beauty	Open	Basal branching	Green strips	Rigid	Glabrous	Light green
Biscuit Parcel	Open	Basal branching	Purple strips	Rigid	Glabrous	Green
Pink cloud	Open	Full branching	Green strips	Rigid	Glabrous	Dark green
Haldighati	Open	Full branching	Green strips	Rigid	Non-glabrous	Light green
HYDC 12	Compact	Middle branching	Purple strips	Rigid	Glabrous	Dark green
Bright yellow	Compact	Middle branching	Purple strips	Rigid	Glabrous	Dark green
Red Glamour	Compact	Middle branching	Green strips	Rigid	Non-glabrous	Dark green
Mayur	Open	Full branching	Green strips	Rigid	Non-glabrous	Green
Golden Splendour	Open	Basal branching	Purple strips	Rigid	Glabrous	Dark green
Garden Beauty	Compact	Middle branching	green	Rigid	Glabrous	Light green

Table 2: Classification of Chrysanthemum genotypes on the basis of Plant characters.

Name of Genotype	Leaflet shape	Leaflet margin	Leaf pubescence	Disc floret	Flower type
Pusa Sona	Narrow pointed	Serrated	Glabrous	Visible	SPRAY
Star Yellow	Oval pointed	Highly serrated	Non-glabrous	Not visible	STANDRED
Pusa Centnary	Oval pointed	Highly serrated	Non-glabrous	Not visible	STANDRED
Thichen Queen	Narrow pointed	Serrated	Non-glabrous	Not visible	STANDRED
Pusa Guldata	Oval pointed	Serrated	Glabrous	Visible	SPRAY
Star White	Oval pointed	smooth	Glabrous	Not visible	STANDRED
Pusa Shwet	Narrow pointed	Highly serrated	Glabrous	Visible	SPRAY
Pusa Aditya	Narrow pointed	Highly serrated	Glabrous	Visible	SPRAY
Tata Century	Oval pointed	Serrated	Glabrous	Not visible	STANDRED
Pusa Chitrksha	Narrow pointed	Serrated	Glabrous	Visible	SPRAY
White Gadget	Narrow pointed	Serrated	Non-glabrous	Visible	SPRAY
Bicolor Aruba	Narrow pointed	Highly serrated	Glabrous	Visible	SPRAY
Ping Pong Yellow	Oval pointed	Serrated	Glabrous	Not visible	SPRAY
Red Borolo	Oval pointed	Highly serrated	Glabrous	Visible	SPRAY
Orange Dazzle	Narrow pointed	Highly serrated	Glabrous	Visible	STANDRED
Pink Sensation	Oval pointed	Serrated	Glabrous	Visible	SPRAY
Potenza Pink	Oval pointed	Serrated	Glabrous	Visible	SPRAY
Purple Lima	Narrow pointed	Highly serrated	Glabrous	Not visible	STANDRED
Papaya Clever	Oval Pointed	Serrated	Glabrous	Visible	SPRAY
Green Button Lorenzo	Narrow pointed	Serrated	Glabrous	Not visible	SPRAY
Classic Beauty	Narrow pointed	Highly serrated	Non-glabrous	Visible	spray
Biscuit Parcel	Narrow pointed	Highly serrated	Glabrous	Visible	spray

Pink cloud	Narrow pointed	Highly serrated	Non-glabrous	Visible	spray
Haldighati	Narrow pointed	Highly serrated	Non-glabrous	Visible	spray
HYDC 12	oval pointed	smooth	Non-glabrous	Visible	semi double
Bright yellow	oval pointed	smooth	Non-glabrous	Visible	STANDRED
Red Glamour	oval pointed	Serrated	Non-glabrous	Visible	SPRAY
Mayur	Narrow pointed	Serrated	Non-glabrous	Visible	spray
Golden Splendour	Narrow pointed	Highly serrated	Non-glabrous	Visible	spray
Garden Beauty	Narrow pointed	Highly serrated	Non-glabrous	Visible	SPRAY

Table 3: Plant height, plant spread, Stem diameter and No. of primary branches in various genotypes of chrysanthemum.

Genotypes	Plant Height (cm)			Plant Spread (cm)			Stem diameter (cm)			No. of primary branches		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Pusa Sona	20.40	18.43	19.42	22.33	20.27	21.30	0.62	0.57	0.59	4.53	3.96	4.25
Star Yellow	60.73	57.19	58.96	24.07	22.27	23.17	0.72	0.65	0.69	10.00	9.48	9.74
Pusa Centnary	50.60	46.40	48.50	31.30	31.53	31.42	0.61	0.57	0.59	5.07	4.29	4.68
Thichen Queen	34.60	31.54	33.07	28.57	29.97	29.27	0.80	0.78	0.79	6.93	6.05	6.49
Pusa Guldata	49.73	46.65	48.19	39.67	39.67	39.67	0.42	0.36	0.39	8.07	6.93	7.50
Star White	56.00	52.92	54.46	30.37	30.93	30.65	0.85	0.81	0.83	6.07	5.58	5.83
Pusa Shwet	50.27	47.15	48.71	38.41	37.10	37.76	1.13	0.96	1.05	13.87	12.51	13.19
Pusa Aditya	40.00	35.63	37.81	31.87	32.23	32.05	0.97	0.91	0.94	16.07	14.40	15.24
Tata Century	55.53	52.13	53.83	31.33	31.27	31.32	0.80	0.75	0.78	7.87	7.20	7.54
Pusa Chitrksha	47.67	44.67	46.17	32.60	31.33	31.97	0.80	0.77	0.78	10.87	9.93	10.40
White Gadget	30.33	28.23	29.28	22.03	21.63	21.83	0.77	0.72	0.75	24.13	22.49	23.31
Bicolor Aruba	35.20	33.19	34.19	24.93	24.60	24.77	0.84	0.78	0.81	4.93	4.33	4.63
Ping Pong Yellow	33.93	31.69	32.81	18.07	17.43	17.75	0.61	0.55	0.58	6.13	5.31	5.72
Red Borolo	48.13	44.64	46.39	19.07	17.60	18.33	0.59	0.54	0.56	14.07	12.89	13.48
Orange Dazzle	38.07	36.09	37.08	19.10	19.57	19.33	0.44	0.41	0.43	6.67	5.06	5.86
Pink Sensation	36.00	32.05	34.03	21.40	20.25	20.82	0.35	0.31	0.33	3.87	3.83	3.85
Potenza Pink	30.20	27.58	28.89	20.23	19.63	19.93	0.37	0.33	0.35	2.87	2.32	2.59
Purple Lima	40.20	37.50	38.85	24.20	23.53	23.87	0.29	0.25	0.27	6.87	5.97	6.42
Papaya Clever	42.13	39.65	40.89	21.23	20.50	20.87	0.53	0.52	0.53	5.80	5.01	5.40
Green Button Lorenzo	37.20	33.74	35.47	21.60	21.13	21.37	0.39	0.33	0.36	7.00	6.26	6.63
Classic Beauty	44.53	42.94	43.74	32.53	30.70	31.62	0.56	0.51	0.53	13.40	11.79	12.60
Biscuit Parcel	41.33	37.59	39.46	37.00	35.48	36.24	0.42	0.38	0.40	15.07	12.97	14.02
Pink cloud	42.67	40.27	41.47	53.73	52.03	52.88	0.85	0.78	0.82	22.13	20.65	21.39
Haldighati	60.47	56.44	58.45	48.77	45.43	47.10	0.54	0.51	0.52	10.73	9.89	10.31
HYDC 12	49.80	45.55	47.68	34.23	32.67	33.45	0.37	0.35	0.36	9.87	9.74	9.80
Bright yellow	56.33	54.10	55.22	33.55	34.73	34.14	0.41	0.38	0.39	10.53	8.90	9.72
Red Glamour	43.67	41.60	42.63	28.83	24.79	26.81	0.85	0.82	0.83	7.67	7.14	7.40
Mayur	33.27	31.30	32.28	32.03	30.43	31.23	0.34	0.30	0.32	12.67	11.62	12.15
Golden Splendor	61.47	59.32	60.39	36.23	35.67	35.95	0.86	0.76	0.81	10.40	9.29	9.85
Garden Beauty	33.60	31.66	32.63	36.33	35.70	36.02	1.29	1.99	1.64	8.93	9.03	8.98
C.D. (P=0.05)	**1.84**	**1.89**		**3.37**	**2.01**		**0.12**	**0.04**		**0.86**	**0.88**	

Plant spread: On the basis of plant spread, twelve genotypes were grouped into less (<25 cm). Eleven genotypes were grouped in to medium category (25-35 cm) and seven genotypes were grouped in more (>35 cm). Maximum plant spread was recorded in genotype Pink cloud (53.73 and 52.03 cm) followed by Haldighati (48.77 and 45.43 cm) while minimum plant spread was recorded in Ping pong yellow (18.07 and 17.43 cm) followed by Red Borolo (19.07 and 17.60cm) which was at par with Orange Dazzle (19.07 and 19.57cm) during 2019 and 2020 respectively (Table 3).

Stem diameter: On the basis of stem diameter ten genotypes were grouped into less (<0.5 cm). Eighteen genotypes were grouped in to medium category (0.5 to 1.0 cm) and two genotypes were grouped in more (>1.0 cm).

Maximum stem diameter was recorded in genotype Garden Beauty (1.29 and 1.99 cm) followed by Pusa Shwet (1.13 and 0.96 cm) while minimum stem diameter was recorded in Purple Lima (0.29 and 0.25 cm) followed by Mayur (0.34 and 0.30 cm) during 2019 and 2020 respectively (Table 3).

Number of Primary branches per plant: On the basis of number of primary branches per plant five genotypes were grouped into less (<5). Fifteen genotypes were grouped into medium category (5-10) and ten genotypes were grouped into more (>10). Maximum number of branches per plant were recorded in White Gadget (24.13 and 22.48) followed by Pink Cloud (22.13 and 20.65) and minimum were recorded in genotype Potenza Pink (2.87 and 2.31) followed by Pink Sensation (3.87 and 3.83) during 2019 and 2020 respectively (Table 3).

Stalk length: The stalk length was grouped into three types according to the length of the stalk. The first group had small (< 5 cm) stalks which included five genotypes. Medium (5-10 cm) group had twenty one genotypes and four genotypes were included in big (>10 cm) group. Maximum stalk length was exhibited in genotype Red Borola (14.32 and 12.91) followed by Tichen Queen (12.43 and 12.01 cm) and minimum was recorded in Pusa Sona (3.48 and 3.04) followed by White Gadget (3.74 and 3.25) during 2019 and 2020 respectively (Table 4).

Table 4: Stalk length, Plants fresh weight and Plants dry weight in various genotypes of chrysanthemum.

Genotypes	Stalk length (cm)			Plants fresh weight (g)			Plants dry weight (g)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Pusa Sona	3.48	3.04	3.26	246.14	231.89	239.02	123.05	110.36	116.71
Star Yellow	8.60	8.45	8.52	352.09	342.49	347.29	167.02	151.06	159.04
Pusa Centnary	9.14	9.01	9.07	331.98	316.79	324.39	154.54	140.16	147.35
Thichen Queen	12.43	12.01	12.22	295.85	275.18	285.51	139.59	124.23	131.91
Pusa Guldata	4.79	3.75	4.27	512.26	500.61	506.44	246.09	228.66	237.38
Star White	11.97	10.79	11.38	277.77	264.37	271.07	113.17	105.81	109.49
Pusa Shwet	8.65	7.94	8.30	283.81	267.73	275.77	161.73	142.95	152.34
Pusa Aditya	7.61	6.92	7.27	241.79	230.28	236.04	113.41	104.09	108.75
Tata Century	7.56	6.79	7.18	388.97	371.00	379.99	149.13	125.56	137.34
Pusa Chitrksha	4.48	3.88	4.18	425.28	410.84	418.06	189.97	166.61	178.29
White Gadget	3.74	3.25	3.49	358.78	319.43	339.11	149.90	138.43	144.16
Bicolor Aruba	8.51	7.71	8.11	113.37	99.83	106.60	51.47	50.02	50.75
Ping Pong Yellow	10.18	9.18	9.68	125.91	106.23	116.07	50.22	43.81	47.01
Red Borolo	14.32	12.91	13.61	85.87	81.41	83.64	41.15	36.42	38.79
Orange Dazzle	8.55	8.12	8.33	118.30	106.42	112.29	46.65	39.78	43.21
Pink Sensation	7.95	7.59	7.77	244.71	222.26	233.48	94.06	87.95	91.01
Potenza Pink	9.22	8.65	8.94	87.02	79.29	83.16	42.74	39.09	40.91
Purple Lima	7.85	6.63	7.24	182.06	168.87	175.46	79.43	71.68	75.56
Papaya Clever	6.07	5.96	6.02	105.44	95.52	100.48	51.99	48.33	50.16
Green Button Lorenzo	10.46	9.94	10.20	113.22	94.75	103.98	57.47	51.73	54.60
Classic Beauty	8.79	7.55	8.17	261.43	239.76	250.60	116.75	105.46	111.10
Biscuit Parcel	8.42	7.88	8.15	268.89	257.46	263.18	104.26	96.23	100.24
Pink cloud	8.66	7.15	7.91	253.87	239.80	246.84	102.44	89.91	96.18
Haldighati	9.13	8.29	8.71	258.17	252.68	255.43	107.56	102.04	104.80
HYDC 12	8.92	8.00	8.46	160.26	152.37	156.32	69.38	61.80	65.59
Bright yellow	5.08	4.22	4.65	246.31	237.98	242.15	107.13	100.68	103.91
Red Glamour	9.81	8.77	9.29	267.80	237.14	252.47	197.72	120.11	125.58
Mayur	6.00	5.23	5.62	356.28	340.75	348.52	139.34	118.19	128.76
Golden Splendor	7.26	6.96	7.11	250.44	241.63	246.04	110.12	103.36	106.74
Garden Beauty	10.06	8.80	9.43	260.02	249.30	254.66	111.59	104.45	108.02
C.D. (P=0.05)	**0.47**	**721.00**		**14.15**	**10.32**		**34.00**	**7.34**	

Fresh weight of plant (g): Fresh weight of plant was divided into less (<150 g), medium (150-300g) and more (>330 g). Seven genotypes were observed in less weight category, sixteen in medium and seven in more weight category. Maximum fresh weight was recorded in Pusa Guldata (512.26 and 500.61) followed by Pusa Chitraksha (425.28 and 410.85) and minimum fresh weight was recorded in Potenza Pink (2.87 and 2.31) followed by Pink Sensation (3.87 and 3.83) during 2019 and 2020 respectively (Table 4).

Dry weight of plant (g): Dry weight of plant was divided into <50 g, medium (50-100 g) and high (>100g). Four genotypes were observed in less weight category, seven genotypes in medium weight category and nineteen genotypes in more. Maximum dry weight of plant was recorded in Pusa Guldata (246.09 and 228.66g) followed by Red Glamour (197.72 and 120.11g) and minimum dry weight of plant was recorded in Red Borolo (41.15 and 36.42) followed by Potenza Pink (42.74 and 9.09) during 2019 and 2020 respectively (Table 4).

Negi *et al.,* 2019 conducted study on nineteen genotypes of chrysanthemum and reported that maximum plant height was recorded in genotype UHFSChr128 (120.33cm), maximum number of stems per plant in UHFSChr 131 (6.67), minimum number of days for visible flower bud formation (76.07 days) in genotype Surf. Mishra *et al.,* (2006 a) also carried out a study to evaluate genetic variability studies in spray chrysanthemum in which cultivars showed wide range of variability for plant height, number of branches per plant, first flower bud appearance, number of flowers per plant, flower diameter, duration of flowering, average flower weight, flower yield. The higher plant height obtained from plants could be attributed to increased photosynthetic capacity of the plants in asters (Vrsek *et al.,* 2006). Similar variation for plant height among genotypes was also observed by Madam *et al.,* (2016), Kumar *et al.,* (2014), Banerji *et al.,* (2012) and Rao and Pratap (2006) in chrysanthemum genotypes. The result indicates increase in plant spread with corresponding increased number of branches per plant. Variation in number of branches per plants among the genotypes might be due to genetic makeup of chrysanthemum genotype (Kumar *et al*., 2015). Singh *et al.,* 2019 also conducted the similar study and evaluated the chrysanthemum genotypes on the basis of various vegetative and reproductive parameters. Plants with more height are generally considered as ideal for cut flower production, whereas medium to short with erect stem are preferred as compared to taller plants in Chrysanthemum under open field condition to evade staking. Plants with short height are ideal for bedding and pot plant production. It is concluded from the study that Maximum plant Golden Splendor genotype is tallest while genotype Pusa Sona is shortest in height. Maximum plant spread is in Pink cloud and minimum in Ping pong yellow. Garden Beauty has maximum stem diameter and Purple Lima has minimum. Red Borola has maximum stalk length and Pusa Sona has minimum. White Gadget has maximum number of branches per plant and Potenza Pink has minimum. Maximum fresh & dry weight was recorded in Pusa Guldata. On the basis of these information, genotypes can be selected for further breeding programmes.

REFERENCES

Anonymous, (2018). Ministry of Agriculture, Government of India. (https://www.indiastat.com/)

Banerji, B.K., Batra, A. and Dwivedi, A.K. (2012). Morphological and biochemical characterization of chrysanthemum. *Journal of Horticultural Sciences*, **7**(1): 51-55.

Datta, S. K. (2015). Indian Floriculture–Role of CSIR. Regency Publications, A Division of Astral International (P) Ltd, New Delhi.

Jackson, M.L. (1967). Soil Chemical Analysis. Asia Publishing House, Bombay.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, India.

Joshi, M., Verma, L.R. and Masu, M.M. (2010). Performance of different varieties of chrysanthemum in respect of growth, flowering and flower yield under north Gujarat condition. *The Asian J. Hort.,* **4**(2): 292-294.

Kumar, A., Dubey, P., Patanwar, M. and Sharma, R. (2015). Evaluation of chrysanthemum varieties for loose flower production in Chhattisgarh plains. *Trends in Bioscience*, **8**(1): 175-77.

Kumar, S., Kumar, M., Malik, S., Singh, M.K. and Kumar, S. (2014). Evaluation of chrysanthemum (*Dendranthema grandiflora* Tzvelev) genotypes using morphological characters under climatic conditions of western UP. *Annals of Horticulture*, **7**(2): 162-165.

Madam, A. R., Jyothi, K.U., Vani, V.S., Reddy, A.R. and Ambati, R. (2016). Vegetative growth and flower yield as influenced by different chrysanthemum (*Dendranthema grandiflora* Tzvelev) cultivars in alfisols of coastal Andhra Pradesh. *Annals of Horticulture*, **9**(1): 21-24.

Mishra, H.N., Das, J.N. and Palai, S.K. (2006). Genetic variability studies in spray type chrysanthemum. *Orissa J. Horti.,* **34**(1): 8-12.

Negi, R., Jarial, K., Kumar, S. and Dhiman, S.R. (2015). Evaluation of different cultivars of chrysanthemum suitable for low hill conditions of Himachal Pradesh. *J. Hill Agr.*, **6**(2): 144-146.

Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, T.A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circular U.S. Dept. Agric. pp 939.

Panse, V.G. and Sukhatme, P.V. (1995). Statistical Methods for Agricultural Workers. ICAR, New Delhi. pp 359.

Piper, C.S. (1966). Soil and Plant Analysis. Hans Publisher, Bombay.

Rao, M. and Pratap, M. (2006). Evaluation of varieties and variability studies in chrysanthemum (*Dendranthema grandiflora* Tzvelev.). *J. Orn. Hort.*, **9**: 221-23.

Negi, R., Dhiman, S.R. and Gupta, Y.C. (2019). Studies on Growth and Flowering Behavior of Newly Evolved Genotypes of Chrysanthemum (*Dendranthema grandiflora Tzvelev*) for Loose Flower Production. *Int. J. Curr. Microbiol. App. Sci.*, **8**(11): 341-346. doi: https://doi.org/10.20546/ijcmas.2019.811.043

Singh, L.J., Khangjarakpam, G., Shadukan, R. and Dhua, R.S. (2019). Quality characterization of new chrysanthemum genotypes. *Journal of Pharmacognosy and Phytochemistry*, **8**(4): 1611-1617.

Subbiah, B.V. and Asija, G. L. (1956). A rapid procedure for the determination of available nitrogen in soils. *Curr. Sci.*, **25**: 259-260.

Vrsek, I., Zidovec, V. Poje, M. and Coga, L. (2006). Influence of photoperiod and growth retardant on the growth and flowering of New England aster. *Acta Hort.*, **711**: 301–306.

Walkley, A. J. and Black, C.A. (1934). An estimation of method for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Sci.*, **27**: 29–38.

How to cite this article: Singh, Sonia, Godara, A.K. and Sheokand, R.S. (2021). Evaluation of chrysanthemum (*Dendranthema grandiflora* Tzvelev) Genotypes for Plant Growth characters. *Biological Forum – An International Journal*, **13**(1): 169-175.