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Effect of different plant spacing and time of pinching on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* L.) cv. Ratlam Selection

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Abstract

The present investigation on “Effect of different plant spacing and time of pinching on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* L.) cv. Ratlam Selection” was conducted during August 2023 to January 2024 at Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand, Gujarat. The experimental material comprised of chrysanthemum (*Chrysanthemum morifolium* L.) cv. Ratlam Selection. The experiment was laid out in Factorial Randomized Block Design with three replications. The experiment was comprised of two factors viz., four spacing viz., S0 (45 × 30 cm), S1 (45 × 45 cm), S2 (60 × 45 cm) and S3 (60 × 60 cm) and three pinching levels viz., P0 (No pinching), P1 (Pinching at 30 DATP) and P2 (Pinching at 45 DATP). It was found that wider spacing and pinching at 30 DATP recorded maximum number of branches and plant spread (N-S and E-W). Whereas, closer spacing found maximum plant height, minimum days taken to first flower bud initiation and days taken to 50% flower opening of chrysanthemum.

Keywords: Growth, flowering, chrysanthemum, spacing, pinching, days after transplanting (DATP)

Introduction

Chrysanthemum (*Chrysanthemum morifolium* L.) is a significant plant that grows worldwide and it is typically grown as a pot plant, loose flower, or cut flower. The Greek words Chrysos, which means ‘golden’, and Anthos, which means ‘flower’, are the source of the English word ‘chrysanthemum’. It is a member of the Asteraceae family. There are 2n = 36, 45, 47, and 51 chromosomes. This flower is known as the ‘Queen of the East’. It is also known as ‘Gul-e-Daudi’ or ‘Glory of the East’ and it is the most widely used ‘florist’ flower. The standard type of chrysanthemum is a popular choice for floral arrangements and bouquets. Spray flower variations work well as loose flowers for religious offerings, garland, veni, and gajara. So far as commercial cultivation of chrysanthemum is concerned, the climatic factors are beyond the control of humans. Still, the growth and production of chrysanthemum can be improved to a large extent by the judicious use of fertilizers, variety, planting time, cultural operations like gap filling, weeding, irrigation, appropriate spacing and pinching etc. The flower production is affected to a large extent when plants are not placed at relevant spacing. Apart from this, pinching also plays an important role in plant growth and flowering production. Therefore, in the light of above facts the present investigation was undertaken to assess, refine and standardize spacing and pinching for optimum growth and flowering in chrysanthemum.

Materials and Methods

The experiment was conducted on “Effect of different plant spacing and time of pinching on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* L.) cv. Ratlam Selection” during August 2023 to January 2024 at Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand, Gujarat-388110. The experiment was comprised of two factors four spacing viz., S0 (45 × 30 cm), S1 (45 × 45 cm), S2 (60 × 45 cm) and S3 (60 × 60 cm) and three pinching levels viz., P0 (No pinching), P1 (Pinching at 30 DATP) and P2 (Pinching at 45 DATP). Twelve treatment combinations were tested in Factorial Randomized Block Design with three replications. The mean data recorded on

growth parameters plant height, number of branches, plant spread (North-South and East-West) at 60, 90, 120 and 150 DATP, while flowering parameters *viz.*, days taken to first flower bud initiation, days taken to 50% flower opening were subjected to statistical analysis following analysis of variance technique (Panse and Sukhatme, 1985) [13].

Results and Discussion

Effect of spacing

The data showed that significantly maximum plant height was recorded in closer spacing of 45 × 30 cm (S0) at 60 DATP (30.16 cm), 90 DATP (49.11 cm), 120 DATP (52.93 cm) and 150 DATP (55.04 cm). The greatest plant height was observed at the closer spacing of 45 × 30 cm (S0), likely due to intense competition for light, causing the main stem to elongate. Additionally, plants tend to grow vertically when crowded due to the shading effect from neighboring plants. Production of significantly taller plants under closest spacing has also been reported by Sonara *et al.* (2023) [18], Ahirwar *et al.* (2012) [1] and Rolaniya *et al.* (2017) [15] in African marigold.

The significantly maximum number of branches were recorded in wider spacing of 60 × 60 cm (S3) at 60 DATP (7.12), 90 DATP (11.20), 120 DATP (13.33) and 150 DATP (15.85). The highest number of branches was found in the wider spacing of 60 × 60 cm (S3). This result is likely because the plant population per unit area was lower in this wider spacing, providing each plant with more space to grow vigorously. Consequently, the plants received ample light, nutrients, and air. Similar results in African marigold were reported by Belorkar *et al.* (1992) [3], Ravindran *et al.* (1986) [14] and Nagdeve *et al.* (2023) [11] in annual chrysanthemum.

The significantly maximum plant spread (N-S) at 60 DATP (20.05 cm), 90 DATP (36.04 cm), 120 DATP (41.62 cm) and 150 DATP (47.78 cm) were recorded in wider spacing of 60 × 60 cm (S3). The increase in plant spread can be attributed to the greater availability of space, nutrients, and air in the widest spacing compared to the closest spacing. Similar findings were also reported by Ahirwar *et al.* (2012) [1], Chauhan and Ambast (2014) [4] and Nain *et al.* (2017) [12] in African marigold.

The significantly maximum plant spread (E-W) at 60 DATP (18.93 cm), 90 DATP (34.53 cm), 120 DATP (39.37 cm) and 150 DATP (41.30 cm) were observed in wider spacing of 60 × 60 cm (S3). The greater plant spread at wider spacing compared to closer spacing can be attributed to the increased availability of space, nutrients, and air. Similar findings were also reported by Ahirwar *et al.* (2012) [1], Chauhan and Ambast (2014) [4] and Nain *et al.* (2017) [12] in African marigold.

The data concerned with different levels of spacing resulted in days taken to first flower bud initiation (79.42) was found in closer spacing of 45 × 30 cm (S0). The early onset of flower bud initiation in plants at closer spacing could be attributed to increased competition among plants for nutrients, moisture, sunlight, and other resources, prompting them to enter the reproductive phase sooner. Similar findings were reported by Dali *et al.* (2023) [5] and Kour (2009) [8] in chrysanthemum.

The significantly minimum days taken to 50% flower opening (88.58) was recorded in closer spacing of 45 × 30 cm (S0). The early onset of 50% flower opening in plants grown at closer spacing may be due to increased

competition among plants for nutrients, moisture, sunlight, and other factors. Similar results were noted by Dali *et al.* (2023) [5] and Kour (2009) [8] in chrysanthemum.

Effect of pinching

The analysis of the given data showed significant difference in the height of plants at 60 DATP (33.07 cm), 90 DATP (53.34 cm), 120 DATP (54.26 cm) and 150 DATP (56.44 cm). The data revealed that a significantly maximum plant height was found in no pinching (P0) plant. The decrease in plant height after pinching primarily resulted from removing the top growth tissue, which suppressed upward growth and redirected plant resources from vertical to lateral growth. Similar results are also reported by Sonara *et al.* (2022), Baskaran and Abirami (2017) [2] in African marigold.

The significantly maximum number of branches was recorded in pinching at 30 DATP (P1) at 60 DATP (7.15), 90 DATP (13.07), 120 DATP (14.36) and 150 DATP (16.97). The increase in the number of branches due to the pinching treatment is likely because the axillary buds below the pinched stem were stimulated to grow more vigorously after the apical dominance was suppressed. As a result, more branches per plant were observed. Similar results were also found by Nagdeve *et al.* (2023) [11] in annual chrysanthemum, Baskaran and Abirami (2017) [2], Singh *et al.* (2017) [17] and Jyothi *et al.* (2018) [6] in marigold.

The significantly maximum plant spread (N-S) was found in pinching at 30 DATP (P1) at 60 DATP (21.24 cm), 90 DATP (39.43 cm), 120 DATP (46.13 cm) and 150 DATP (50.32 cm). The likely reason for greater plant spread with different pinching treatments is that pinching reduced the apical growth of the stem, leading to cell elongation and ultimately resulting in more branches per plant. Similar results were also recorded by Nagdeve *et al.* (2021) in annual chrysanthemum, Maharnor *et al.* (2011) [9], Mohanty *et al.* (2015) [10] and Jyothi *et al.* (2018) [6] in African marigold.

The significantly maximum plant spread (E-W) was observed in pinching at 30 DATP (P1) at 60 DATP (20.67 cm), 90 DATP (37.10 cm), 120 DATP (41.10 cm) and 150 DATP (43.27 cm). The increased plant spread under various pinching treatments may be due to cell elongation and the reduction of apical stem growth, ultimately leading to more branches per plant. Similar results were also recorded by Nagdeve *et al.* (2021) in annual chrysanthemum, Maharnor *et al.* (2011) [9], Mohanty *et al.* (2015) [10] and Jyothi *et al.* (2018) [6] in African marigold.

Among the different levels of pinching, no pinching plant recorded early flower bud initiation and it was found significantly minimum number of days (76.94). The shortest time for first flower bud initiation (76.94 days) occurred in the no pinching treatment. The delay in bud initiation in pinching treatments, particularly in plants pinched later, could be due to the removal of vegetative growth which delays the plant's physiological maturity needed to induce flower bud formation. Early bud initiation was observed in the no pinching treatment, whereas delayed bud initiation was noted in the pinched plants.

The significantly minimum number of days taken to 50% flower opening (85.99) was recorded in no pinching (P0) plant. The delay in flowering due to pinching treatment may be associated with the timing of first flower bud appearance and flower opening. Pinching delayed the appearance of the first flower bud and subsequent flower opening, resulting in

delayed flowering, particularly in plants that were pinched later. Present findings are in line with reports of Sailaja *et al.* (2014) [16] in China aster and Kholiya *et al.* (2020) [7] in African marigold cv. Pusa Narangi Gainda

et al. (2014) [16] in China aster and Kholiya *et al.* (2020) [7] in African marigold cv. Pusa Narangi Gainda

Table 1: Effect of spacing and pinching on plant height and number of branches of chrysanthemum

Treatment	Plant height (cm)				Number of branches per plant			
	60 DATP	90 DATP	120 DATP	150 DATP	60 DATP	90 DATP	120 DATP	150 DATP
Spacing (S)								
S0: 45 × 30 cm	30.16	49.11	52.93	55.04	5.88	8.93	9.87	12.27
S1: 45 × 45 cm	28.22	46.73	50.99	52.61	5.94	9.18	10.39	13.47
S2: 60 × 45 cm	26.43	45.17	49.77	51.50	6.00	10.22	11.49	13.83
S3: 60 × 60 cm	25.42	42.00	48.86	50.68	7.12	11.20	13.33	15.85
S.Em.±	0.96	1.51	0.81	1.07	0.31	0.39	0.38	0.38
CD @ 5%	2.72	4.29	2.32	3.06	0.88	1.10	1.07	1.08
Pinching (P)								
P0: No pinching	33.07	53.34	54.26	56.44	5.52	6.62	8.31	11.06
P1: 30 DATP	27.02	44.78	50.47	52.43	7.15	13.07	14.36	16.97
P2: 45 DATP	22.58	39.14	47.18	48.50	6.03	9.97	11.13	13.53
S.Em.±	0.83	1.30	0.71	0.93	0.27	0.28	0.33	0.33
CD @ 5%	2.36	3.71	2.01	2.65	0.76	0.79	0.93	0.93
Interaction effect (S × P)								
S.Em.±	1.66	2.61	1.41	1.86	0.53	0.56	0.65	0.66
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS
CV%	10.41	9.88	4.82	6.14	14.82	9.79	10.02	8.20

Table 2: Effect of spacing and pinching on plant spread (N-S and E-W) of chrysanthemum

Treatment	Plant spread (N-S) (cm)				Plant spread (E-W) (cm)			
	60 DATP	90 DATP	120 DATP	150 DATP	60 DATP	90 DATP	120 DATP	150 DATP
Spacing (S)								
S0: 45 × 30 cm	16.87	30.88	38.14	41.33	16.79	31.06	35.42	37.17
S1: 45 × 45 cm	18.36	33.26	38.64	45.09	17.83	32.69	36.17	37.64
S2: 60 × 45 cm	19.01	34.13	39.50	46.27	18.25	33.27	37.74	39.99
S3: 60 × 60 cm	20.05	36.04	41.62	47.78	18.93	34.53	39.37	41.30
S.Em.±	0.53	1.15	0.69	1.51	0.50	0.57	0.77	0.76
CD @ 5%	1.51	3.18	1.96	4.29	1.42	1.63	2.20	2.15
Pinching (P)								
P0: No pinching	14.94	28.94	33.30	40.00	14.67	29.13	32.90	34.75
P1: 30 DATP	21.24	39.43	46.13	50.32	20.67	37.10	41.10	43.27
P2: 45 DATP	19.53	32.36	38.99	45.03	18.52	32.43	37.52	39.04
S.Em.±	0.46	1.00	0.60	1.30	0.43	0.50	0.67	0.65
CD @ 5%	1.30	2.75	1.70	3.71	1.23	1.41	1.90	1.86
Interaction effect (S × P)								
S.Em.±	0.92	1.99	1.19	2.61	0.86	0.99	1.34	1.31
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS
CV%	8.55	9.69	5.24	10.01	8.34	5.24	6.23	5.81

Table 3: Effect of spacing and pinching on days taken to first flower bud initiation and days taken to 50% flower opening of chrysanthemum

Treatment	Days taken to first flower bud initiation	Days taken to 50% flower opening
Spacing (S)		
S0: 45 × 30 cm	79.42	88.58
S1: 45 × 45 cm	80.47	89.61
S2: 60 × 45 cm	81.71	90.84
S3: 60 × 60 cm	82.99	91.67
S.Em.±	0.88	0.52
CD @ 5%	2.51	1.47
Pinching (P)		
P0: No pinching	76.94	85.99
P1: 30 DATP	85.63	94.79
P2: 45 DATP	80.87	89.74
S.Em.±	0.76	0.45
CD @ 5%	2.17	1.27
Interaction effect (S × P)		
S.Em.±	1.53	0.89
CD @ 5%	NS	NS
CV%	3.26	1.71

Conclusion

From the present investigation it can be concluded that wider spacing and pinching at 30 DATP recorded maximum number of branches and plant spread (N-S and E-W). Whereas, closer spacing gives maximum plant height, minimum days taken to first bud initiation and days taken to 50% flower opening of chrysanthemum.

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