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Influence of various planting distances on growth and flowering of Annual Chrysanthemum(*Chrysanthemum coronarium* L.)

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ABSTRACT

The Present investigation to study the influence of various planting distances on growth and flowering of Annual Chrysanthemum (*Chrysanthemum coronarium*) was under taken in form of a field trial at the Agricultural Research Station, Institute of Agricultural Sciences , Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar during 2019-20.Result of the study indicated that among four different spacings viz., 30 cmX30 cm(S_1),40 cmX30 cm (S_2), 60 cm X40 cm (S_3) and 60 cm X60 cm (S_4) tried, plants with maximum spread (N-S), number of primary branches, weight of individual flower and weight of flowers per plant (495.91 g)were recorded under 60 cm X60 cm (S_4) widest spacing. On the other hand the lowest weight (11.90 kg) of flowers per plot as well as per hectare(13.77 t) were recorded under the widest spacing of 60 cm x 60 cm. Although plants grown under the closest spacing (S_1) recorded minimum values with respect to plant spread, number of leaves and primary branches, weight of individual flower, weight of flowers per plant(427.22g), flower yield in terms of weight per plot (42.39 kg) and per hectare (49.06 t) was the highest under the closest spacing of 30 cm x30 cm(S_1). Parameter like days to 50% flowering was not significantly influenced by various spacing treatments.Hence, it was concluded that adoption of closest spacing of 30cm x 30cm was most suitable practice for maximizing flower yield in annual chrysanthemum cv. Local which may be recommended to the flower growers for its commercial cultivation.

Key words: Plant spread, number of primary branches, days taken for 50% flowering, individual flower weight, weight of flowers per plant, weight of flowers per plot.

Introduction

Annual chrysanthemum(*Chrysanthemum coronarium* L.) is one of the popular commercial flowers which is grown in various parts of India. It is used both as cut and loose flowers. As cut flower, it is used as a filler during preparation of bouquet along with other flowers. Besides, it is also used in the vase for table arrangement. As loose flower it is used alone or in combination with marigold and other flowers for making garlands as well as for religious offerings. Although this flower is extensively used in the state of Odisha as loose flower and its popularity is next to marigold, it is mostly used as a garden plant in beds and borders. Its commercial cultivation has not yet been started because of unavailability of suitable horticultural practices to the flower growers of the state.

Among different crop management practices to increase production and quality of various annual flowers including annual chrysanthemum, cultural manipulation of growth and flowering through proper planting density assumes greater significance. Spacing or planting density influences, plant growth and yield of flowers in terms of number, size and weight through modifying the microclimate at the close vicinity of the plants exerting a considerable influence on the performance of the crop. Hence, in the present investigation an attempt was made to determine the influence of different planting densities on growth and yield of flowers in annual chrysanthemum and to find out the optimum spacing for maximization of production of quality flowers.

Materials and methods

The present investigation to study effect of spacing on growth and flowering of Annual Chrysanthemum (*Chrysanthemum coronarium*) was carried out in form of a field trial at the Agricultural Research Station,Institute of Agricultural Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar during 2019-20.The experiment was conducted following Factorial Randomized Block Design consisting of two factors viz., spacing and pinching as treatments. In this study four levels of spacing viz., S_1 (30cmX30cm), S_2 (40cmX30cm), S_3 (60cmX40cm) & S_4 (60cmX60cm) as main plot treatments and three levels of pinching viz., P_0 (No pinching), P_1 (Single pinching i.e. 30 days after transplanting) & P_2 (Double pinching i.e 30 and 45 days after transplanting) as sub plot treatments under each main plot treatment were included which were replicated thrice. Observations on various growth and flowering parameters such as plant spread (North-South), number of primary branches and individual flower weight were recorded after two and three months of transplanting. Besides, other flowering components and flower characters such as days taken for 50% flowering, weight of flowers per plant and weight of flowers per plot were also recorded under various treatments. Yield of flowers per hectare was computed from the per plot(8.64m^2 area) yield data. All the data concerning various growth parameters, flowering components and flower characters were analyzed statistically. The treatment effects were tested by 'F' test at 5 % level of significance. The critical difference at 5 % level was calculated for comparing treatment means.

Plant Spread (North-South)

It was found that significant difference in plant spread was observed due to various levels of spacing during both the observations (Table 1) . It was significantly higher under wider spacing of 60 cm X 60 cm (S_4) which was reduced with reduction in planting distance and the lowest was observed under the closest spacing of 30cm X 30cm (S_1). However, the spread recorded under closest spacing i.e. 30cm X 30cm (S_1) and the next closer spacing i.e. 40cm X 30cm (S_2) were statistically comparable with each other. The same trend was observed during both the observations with respect to this parameter. Plant spread of 65.47 cm. 54.15 cm, 44.60 cm and 39.94 cm were recorded under S_4, S_3, S_2& S_1 respectively after two months of transplanting. The same were 71.80 cm (S_4), 59.22 cm (S_3), 48.29 cm (S_2) and 45.01 cm (S_1), after three months of planting. Similar findings also have been reported by Pavan Kumar *et al* (2014) and Bhargav *et al* (2016) who found that increase in plant spacing resulted in increase in plant spread in china aster. This might be due to the availability of larger space for vegetative growth of the plants and lack of competition for the productive factors viz., nutrients, water, light etc.

Number of primary branches

Significant difference existed among various levels of spacing with respect to number of primary branches per plant recorded after two and three months of transplanting (Table 1) irrespective of pinching treatments. Maximum number of branches (23.18) were produced in plants grown at the widest spacing of 60cm X 60cm (S_4) which was followed by and at par with same recorded under 60cm X 40cm i.e. S_3 (22.29) and 40cm X 30cm i.e. S_2 (21.07) during the first observation recorded after two months of planting. The minimum (18.93) was recorded under the closest spacing of 30cm X 30cm (S_1). However, it was at par with 40cm X 30cm (P_2) spacing. After three months of planting the maximum number of branches (27.00) were also recorded in plants grown at the widest spacing of 60cm X 60cm (S_4) and it was followed by the same recorded under 60cm X 40cm (S_3) which had 25.68 branches without showing significant variation from each other. On the other hand the minimum number of branches (21.67) were recorded under the closest spacing of 30cm X 30cm (S_1).However, it was at par with the spacing level of 40cm X 30cm (S_2) which produced 23.67 branches per plant.

Production of more number of branches under wider spacing compared to closer spacing has also been reported by Mahananda *et al* (2015) in annual chrysanthemum, *Khobragade et al* (2012) in china aster. This may be attributed to availability of more space between plants, better up take of nutrients and sun light due to less competition among the plants.

Days taken for 50% flowering

Data presented in Table.1 revealed that production of 50 % of flowering was observed to be earliest (51.02 days) when the plants were grown at a spacing of 40cm X 30cm (S_2) and almost similar (51.87 days) under the closest spacing of 30cm X 30cm (S_1). On the other hand maximum delay was noticed under the widest spacing of 60cm X 60cm (S_4) which took 53.24 days for the same. However, various level of spacing could not influence the time taken for 50% flowering significantly in annual chrysanthemum plants. Similar results have also been reported by Khobragade *et al* (2012) who observed that planting distances did not influence the days to flower bud emergence significantly in china aster.

Individual flower weight

The data in Table. 1 indicated that irrespective of pinching treatments, average weight of individual flower in annual chrysanthemum was maximum in plants grown at the widest spacing of 60cm X 60cm(S_4) which decreased with decrease in the planting distance and the minimum was produced under the closest spacing of 30cm X 30cm(S_1) during both the observations, However, after two months of planting the average flower weight recorded under S_4 (2.51 g), S_3 (2.46 g) and S_2 (2.44 g) were statistically comparable with each other. Similarly, the individual flower weight under S_1 (2.37 g), S_2 and S_3 did not show any significant variation from each other. After three months of planting individual flower weight under S_4, S_3, S_2 and S_1 were 2.03 g, 1.97 g, 1.86 g, and 1.77 g respectively. However, the average weight of individual flower under S_4 and S_3 remained at par.

Maximum weight of individual flower observed under wider spacing might be due to favorable conditions like availability of nutrients, soil moisture and sun light to individual plant under wider spacing as compared to closer spacing. The present findings are in accordance with the result obtained by Bhat and Shephered (2007) & Singh *et al* (2018) in marigold, Bhargav *et al* (2016) in china aster.

Weight of flowers per plant

It was found that maximum weight (495.91 g) of flowers per plant was produced under the widest spacing of 60cm X 60cm (S_4) irrespective of pinching treatments which showed a decreasing trend with decrease in planting distance (Table 2). It was followed by the same recorded under 60cm X 40cm (S_3) and 40cm X 30cm (S_2) which recorded 458.76g and 441.62g per plant respectively. The minimum (427.22g) was recorded under the closest spacing of 30cm X 30cm(S_1). However, flower weight per plant under S_4, S_3 and S_2 and S_3, S_2 and S_1 were statistically comparable with each other. Similar results have been obtained by Bhargav *et al* (2016) in china aster and Singh *et al* (2018) in African marigold who reported that production of maximum number of flowers under wider spacing seemed to be mainly due to more number of branches per plant and also less competition among the plants for nutrients and light, while flower weight per plant was directly correlated with number of flowers per plant, hence more weight of flowers per plant was recorded under wider spacing as compared to closer spacing.

Weight of flowers per plot

The data indicated that significant influence of various levels of spacing was noticed on total weight of flowers produced per plot (8.64 m^2 area) irrespective of pinching treatments(Table 2). It was the maximum (42.39 kg) under the closest spacing of 30cm X 30cm (S_1)which was followed by the next wider spacing of 40cm X 30cm i.e. S_2 (23.07 kg) and both the treatments differed significantly from each other as well as from other spacing treatments. Reduction in yield was observed with increase in spacing levels and the lowest weight (11.90 kg) was recorded in plants grown at the widest spacing of 60cm X 60cm(S_4). However, it was at par (16.51 kg) with same recorded under 60 cm X 40 cm (S_3) spacing treatment. The result of the present study is in close agreement with Dorajeerao *et al* (2012) and Khobragade *et al* (2012) who also reported increased yield of flowers under closer spacing in garland chrysanthemum and china aster respectively. Production of more number of flowers per plot appeared to be the main contributing factor for recording higher weight of flowers under closer spacing. Although weight of flowers per individual plant was higher under wider spacing it could not compensate the yield per plot because of higher plant population under closer spacing.

Weight of flowers per hectare

Data on total weight of flowers per hectare as influenced by various spacing treatments were analyzed statistically and presented in Table.2

It was seen from the Table 2 that total yield of flowers per hectare on weight basis was significantly influenced by various levels of spacing. It was maximum (49.06 t) under closest spacing of 30cm X 30cm (S_1) which was followed by the same recorded under 40 cm X30 cm spacing ie, S_2 (26.70 t/ha) and both the treatments were significantly different from each other as well as from other spacing treatments. It was further observed that with increase in spacing levels there was reduction in flower yield and the minimum (13.77 t/ha)was observed under widest spacing of 60cm X 60cm(S_4). However, it was at par with S_3 (40 cm X40 cm) which recorded 19.11 t of flowers per hectare. Similar findings have been reported by Kour (2009) and Singh *et al* (2018) & Nain *et al* (2017) who observed higher yield of flowers per hectare in chrysanthemum and African marigold respectively on weight basis under closer spacing as compared to wider spacing.

Table-1.Effect of planting distance on plant spread(N-S), number of primary branches, individual flower weight and days to 50% flowering in annual chrysanthemum var. Local

Treatments	Plant spread(N-S) (cm)		Number of primary branches		Individual flower weight (g)		Days taken for 50% flowering
	After 2 months	After 3 months	After 2 months	After 3 months	After 2 months	After 3 months	
Spacing(S)							
S_1(30cm X30 cm)	39.94	45.01	18.93	21.67	2.37	1.77	51.87
S_2 (40cm X30 cm)	44.60	48.29	21.07	23.67	2.44	1.86	51.02
S_3 (60cmX 40 cm)	54.15	59.22	22.29	25.68	2.46	1.97	52.64
S_4 (60cm X60cm)	65.47	71.80	23.18	27.00	2.51	2.03	53.24
SE(m) ±	1.19	1.15	0.48	0.48	0.02	0.01	0.72
CD at 5%	5.80	5.63	2.34	2.35	0.12	0.07	NS

Table 2.Effect of planting distance on weight of flowers per plant, per plot and per hectare, in annual chrysanthemum var. Local

Treatments	Weight of flowers per plant(g)	Weight of flowers per plot(kg)	Weight. of flowers per hectare(t)
Spacing(S)			
S_1 (30cm X30 cm)	427.22	42.39	49.06
S_2 (40cm X30 cm)	441.62	23.07	26.70
S_3 (60cmX 40 cm)	458.76	16.51	19.11
S_4 (60cm X60cm)	495.91	11.90	13.77
SE(m) ±	12.12	1.05	1.22
CD at 5%	59.04	5.14	5.95

Conclusion

Based on the result of the present study it was concluded that among four different spacings tried, plants grown under the widest spacing of 60 cm X60 cm (S_4) exhibited better performance with respect to several growth and flowering parameters. Plants with maximum spread (N-S), number of primary branches, weight of individual flower and weight of flowers per plant were recorded under 60cm x 60cm (S_4) spacing. However, lowest weight of flowers per plot as well as per hectare was recorded under the widest spacing of 60cm x 60cm.

On the other hand, plants grown under the closest spacing (S_1) recorded minimum values with respect to plant spread(N-S), number of primary branches, weight of individual flower and weight of flowers per plant. How ever, flower yield in terms of weight per plot as well as per hectare was the highest under the closest spacing of 30 cm X30 cm. Parameterlike days taken to 50% flowering was not significantly influenced due to various spacing treatments.

Since the ultimate aim of any crop production programme is to maximize the yield through an ideal crop management practices, in the present investigation it was found that adoption of closest spacing of 30cm X 30cm was the most suitable practice for maximizing flower yield in annual chrysanthemum cv. Local which may be recommended to the flower growers for its commercial cultivation.

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