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Response of staggered planting and pinching time on growth and flower yield of annual chrysanthemum

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Abstract
The experiment entitled "Effect of staggered planting and pinching time on growth and flower yield of annual chrysanthemum" during the year 2024-25 was undertaken at Horticulture Section, College of Agriculture, Nagpur. The treatment comprises of two factors; Factor A consist of four staggered planting dates *viz*., (Third week of September, first week of October, third week of October and first week of November) and Factor B consist of four pinching time *viz*., (No pinching, pinching at 30 DAT, pinching at 45 DAT and pinching at 30 and 45 DAT) in all sixteen treatment combinations planted in Factorial Randomized Block Design (FRBD) with three replications. Results revealed that, minimum plant height with maximum number of branches plant^{-1}, diameter of stem, plant spread both the direction E-W and N-S were significantly recorded in the treatment planting on first week of October and treatment pinching at 30 and 45 DAT. The dwarf plant was obtained in treatment pinching at 30 and 45 DAT. Number of flowers plant^{-1} (51.18 and 53.88 respectively) was significantly recorded maximum in treatment planting on first week of October with treatment pinching at 30 and 45 DAT. Whereas, flower yield plant^{-1} (199.01 g and 201.19 g respectively), plot^{-1} (4.98 kg and 5.03 kg respectively) and hectare^{-1} (11.06 t and 11.18 t respectively) were significantly recorded maximum in the treatment planting on first week of October with treatment pinching at 30 DAT. As regard to the B:C ratio, the treatment planting on first week of October and treatment pinching at 30 DAT recorded maximum B:C ratio (1.60 and 1.62 respectively).

Keywords: Annual chrysanthemum, staggered planting, pinching time, B:C ratio

Introduction
Floriculture is one of the most significant subfields of horticulture, which includes landscape gardening, decorative plants and cut or loose flowers. In the year 2023-24 India produces 2,284,000 tonnes of loose flowers and 947,000 tonnes of cut flowers annually on 285,000 hectares of floral land (Anon. 2023). In India loose flowers commercially grown in certain pockets of Maharashtra, Karnataka, Bihar, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and West Bengal. Annual chrysanthemum, botanically known as *Chrysanthemum coronarium* L. which it is also popularly known as 'Garland chrysanthemum or Edible chrysanthemum or Crown daisy' it is belongs to Asteraceae family. The crop is relatively shorter in duration, photo-insensitive and flowering is observed entire year in moderate climatic conditions (Teja *et al*., 2017) [14]. Flower of annual chrysanthemum has a great demand during various functions, festivals, marriages for floral decorations in Maharashtra. It is also utilized in landscape gardening as bedding material, cut flowers, and loose flowers. It is mostly used to prepare flower decorations, garland, veni, and gajra.

Among various crop management practices, staggered planting is one technique for increasing flower production and quality. It involves planting the same crop at different times to extend the harvest and maintain a steady supply of produce in the market. Whereas, pinching in annual chrysanthemum involves removing the growing tip, encourages branching, reduces plant height, and can delay flowering. These practices promote a bushier plant with more number of flowers, ultimately influenced flower yield with quality flowers.

Therefore, the present investigation was undertaken to study the best planting and pinching time for better vegetative growth and flower yield with higher B:C ratio of annual chrysanthemum.

Materials and Methods

The present experiment was carried out during rabi season of year 2024-25 at the Experimental Unit, Horticulture Section, College of Agriculture, Nagpur. The experimental soil had medium to sandy clay structure, moderately uniform and well drained. There were, sixteen treatment combinations consist of two factors. Factor A consist of four dates of staggered planting *viz*., (Third week of September, first week of October, third week of October and first week of November) and Factor B consist of four pinching time *viz*., (No pinching, pinching at 30 DAT, pinching at 45 DAT and pinching at 30 and 45 DAT). The experiment was laid out in Factorial Randomized Block Design with three replications. The experiment was laid out in flat bed with gross plot size was 2.25 m x 1.80 m. The seedling of annual chrysanthemum was prepared on nursery bed and 30 days old seedling was transplanted in the main field at spacing of 45 cm x 30 cm. The inorganic fertilizer 100 kg N, 50 kg P 50 kg K hectare^{-1} was applied in the form of urea, SSP and MOP to all the experimental plots, as the source of NPK respectively. The entire dose of P and K along with half dose of N was applied at the time of transplanting and remaining half dose of N was applied 30 DAT.

As regard the treatments, the staggered planting was done as per the treatment and pinching was carried out at 30, 45 and 30 and 45 DAT as per treatments. The observations in respect of growth parameters i.e., plant height, number of branches plant^{-1}, diameter of stem, plant spread and yield parameters i.e., number of flowers plant^{-1}, flower yield plant^{-1}, plot^{-1} and hectare^{-1} and B:C ratio were recorded.

The data recorded in each parameter were analyzed by ANOVA techniques, described by Panse and Sukhatme (1967) [12]. The treatment mean was compared using critical difference values and calculated at 5 percent significance level.

Results and Discussion

Growth parameters

a. Effect of staggered planting on vegetative growth parameters: The data from Table 1 exhibited the significant difference among the staggered planting on vegetative growth parameters. Plant height (91.70 cm), number of branches plant^{-1} (29.52), stem diameter (1.54 cm) and plant spread E-W (55.68 cm) and N-S (51.01 cm) were recorded significantly maximum in treatment planting on first week of October followed by treatment planting on third week of October. Significantly minimum plant height (85.72 cm), number of branches plant^{-1} (27.57), stem diameter (1.40 cm) and plant spread E-W (48.89 cm) and N-S (46.15 cm) were recorded in treatment planting on first week of November.

Increased vegetative growth parameters in October planting might be attributed to favourable climatic condition such as temperature, light intensity, short day plant, soil moisture content which facilitate; which enhance nutrient uptake which facilitate better vegetative growth. These results are in close conformity with Sharma *et al*. (2015) [13] in garland chrysanthemum, Hawa *et al*. (2021) [6] and Mohanty *et al*. (2023) [9] in annual chrysanthemum.

b. Effect of pinching time on vegetative growth parameters: The data from Table 1 exhibited the significant difference among the pinching time on vegetative growth parameters. Significantly minimum plant height (76.79 cm) with maximum number of branches plant^{-1} (34.43), stem diameter (1.58 cm) and plant spread E-W (56.08 cm) and N-S (54.61 cm) were recorded in treatment pinching at 30 and 45 DAT. Significantly maximum plant height (100.40 cm) with minimum number of branches plant^{-1} (21.96), stem diameter (1.41 cm) and plant spread E-W (48.02 cm) and N-S (44.49 cm) were recorded in treatment No pinching.

Pinching treatments shows significant variation particularly in double pinching, these restricted the apical dominance and diverted energy toward lateral shoot development, thus resulting better vegetative growth. These results are in close conformity with Badge *et al*. (2017) [3], Nagdeve *et al*. (2021) [11], Hawa *et al*. (2021) [6], Jena *et al*. (2021) [7] and Amalseda *et al*. (2024) [1] in annual chrysanthemum.

c. Interaction effect: Interaction effect of staggered planting and pinching time in all vegetative growth parameters were found non-significant.

Table 1: Vegetative growth parameters as influenced by staggered planting and pinching time in annual chrysanthemum

Treatments	Plant height (cm)	Number of branches plant^{-1}	Diameter of stem (cm)	Plant spread (cm)	
				E-W	N-S
A) Staggered Planting (D)					
D_1: Third week of September	88.50	28.78	1.47	51.76	48.49
D_2: First week of October	91.70	29.52	1.54	55.68	51.01
D_3: Third week of October	90.70	29.15	1.48	52.17	50.92
D_4: First week of November	85.72	27.57	1.40	48.89	46.15
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.37	0.48	0.01	0.82	1.08
CD at 5%	1.08	1.39	0.04	2.38	3.12
B) Pinching Time (P)					
P_0: No pinching	100.40	21.96	1.41	48.02	44.49
P_1: Pinching at 30 DAT	91.13	30.42	1.47	52.60	49.22
P_2: Pinching at 45 DAT	88.29	28.20	1.44	51.80	48.26
P_3: Pinching at 30 and 45 DAT	76.79	34.43	1.58	56.08	54.61
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.37	0.48	0.01	0.82	1.08
CD at 5%	1.08	1.39	0.04	2.38	3.12
C) Interaction effect (D X P)					
'F' test	N.S.	N.S.	N.S.	N.S.	N.S.
SE (m)±	0.75	0.96	0.04	1.64	2.15
CD at 5%	-	-	-	-	-

Note: A: Staggered planting, B:-Pinching time, C:-Interaction effect and N.S.:-Non-significant

2. Yield parameters

a. Effect of staggered planting on yield parameters: The data from Table 2 exhibited the significant difference among the staggered planting on flower yield parameters. Significantly maximum number of flower plant^{-1} (51.18), flower yield plant^{-1} (199.01 g), plot^{-1} (4.98 kg) and ha^{-1} (11.06 t) was recorded in the treatment planting on first week of October followed by treatment planting on third week of October. Significantly minimum number of flower plant^{-1} (43.70), flower yield plant^{-1} (187.95 g), plot^{-1} (4.70 kg) and ha^{-1} (10.45 t) was recorded in the treatment planting on first week of November. Whereas, maximum B:C ratio (1.63) was recorded in the treatment planting on first week of October and minimum B:C ratio (1.54) was recorded in the treatment planting on first week of November.

This indicates that early October planting creates favorable conditions for better growth, flower production and yield in annual chrysanthemum. These results are in close conformity with Jyothi *et al*. (2018) [8] in marigold and Thumar *et al*. (2020) [15] in chrysanthemum, Hawa *et al*. (2021) [6] in annual chrysanthemum.

b. Effect of pinching time on yield parameters: The data from Table 2 exhibited the significant difference among the pinching time on flower yield parameters. Significantly maximum number of flower plant^{-1} (53.88) was recorded in treatment pinching at 30 and 45 DAT followed by treatment pinching at 30 DAT (49.67). Whereas, the minimum number of flower plant^{-1} was recorded in treatment No pinching (40.72). Flower yield plant^{-1} (201.19 g), plot^{-1} (5.03 kg), ha^{-1} (11.18 t) was recorded significantly maximum in the treatment pinching at 30 DAT followed by treatment pinching at 45 DAT. Flower yield plant^{-1} (184.82 g), plot^{-1} (4.62 kg) and ha^{-1} (10.27 t) was recorded significantly minimum in the treatment pinching at 30 and 45 DAT. Whereas, maximum B:C ratio (1.65) was recorded in the treatment pinching at 30 DAT and minimum B:C ratio (1.51) was recorded in the treatment pinching at 30 and 45 DAT.

The increase in flower yield due to pinching treatment might be due to the reason that the pinched plants obtained superior vegetative growth. These results are in close conformity with Halagi *et al*. (2023) [4] in African marigold, Badge *et al*. (2017) [3] and Nagdeve *et al*. (2021) [11] and Jena *et al*. (2021) [7] in annual chrysanthemum.

c. Interaction effect: The data from Table 2 exhibited the significant differences among the staggered planting dates and pinching time on flower yield parameters. Significantly maximum number of flower plant^{-1} was recorded in treatment combination planting on first week of October with pinching at 30 and 45 DAT (57.87). The maximum flower yield plant^{-1} (213.47 g), plot^{-1} (5.34 kg), ha^{-1} (11.87 t) and B:C ratio (1.75) was recorded in treatment combination first week of October with pinching at 30 DAT followed by the treatment combination first week of October with pinching at 45 DAT. The minimum flower yield plant^{-1} (180.82 g), plot^{-1} (4.52 kg), ha^{-1} (10.04 t) and B:C ratio (1.47) was recorded in treatment combination first week of November with pinching at 30 and 45 DAT. These results are in close conformity with Jyothi *et al*. (2018) [8] in marigold, Moon *et al*. (2017) [10] in gaillardia and Hawa *et al*. (2021) [6] in annual chrysanthemum.

Table 2: Yield parameters and B:C ratio as influenced by staggered planting and pinching time in annual chrysanthemum

Treatments	Number of flower plant^{-1}	Flower yield plant^{-1} (g)	Flower yield plot^{-1} (kg)	Flower yield ha^{-1} (t)	B:C ratio
A) Staggered Planting (D)					
D_1: Third week of September	45.92	189.50	4.74	10.53	1.55
D_2: First week of October	51.18	199.01	4.98	11.06	1.63
D_3: Third week of October	49.12	192.68	4.82	10.70	1.58
D_4: First week of November	43.70	187.95	4.70	10.45	1.54
'F' test	Sig.	Sig.	Sig.	Sig.	-
SE (m)±	0.46	0.94	0.02	0.05	-
CD at 5%	1.33	2.73	0.07	0.15	-
B) Pinching Time (P)					
P_0: No pinching	40.72	186.30	4.66	10.35	1.54
P_1: Pinching at 30 DAT	49.67	201.19	5.03	11.18	1.65
P_2: Pinching at 45 DAT	45.65	196.83	4.93	10.94	1.61
P_3: Pinching at 30 and 45 DAT	53.88	184.82	4.62	10.27	1.51
'F' test	Sig.	Sig.	Sig.	Sig.	-
SE (m)±	0.46	0.94	0.02	0.05	-
CD at 5%	1.33	2.73	0.07	0.15	-
C) Interaction effect (D X P)					
D_1P_0	39.13	184.40	4.61	10.25	1.52
D_1P_1	47.87	197.60	4.94	10.99	1.62
D_1P_2	44.40	193.07	4.83	10.73	1.58
D_1P_3	52.27	182.93	4.57	10.16	1.49
D_2P_0	43.33	190.40	4.76	10.59	1.57
D_2P_1	54.80	213.47	5.34	11.87	1.75
D_2P_2	48.73	202.87	5.08	11.28	1.66
D_2P_3	57.87	189.31	4.73	10.52	1.54
D_3P_0	41.53	187.53	4.68	10.41	1.54
D_3P_1	52.00	200.43	5.01	11.13	1.64
D_3P_2	48.53	196.40	4.91	10.92	1.61
D_3P_3	54.40	186.37	4.66	10.36	1.52
D_4P_0	38.87	182.87	4.58	10.17	1.51
D_4P_1	44.00	193.27	4.83	10.74	1.58
D_4P_2	40.93	195.00	4.88	10.84	1.60
D_4P_3	51.00	180.82	4.52	10.04	1.47
'F' test	Sig.	Sig.	Sig.	Sig.	-
SE (m)±	0.92	1.88	0.05	0.10	-
CD at 5%	2.66	5.45	0.14	0.30	-

Note: A:-Staggered planting, B:-Pinching time and C:-Interaction effect

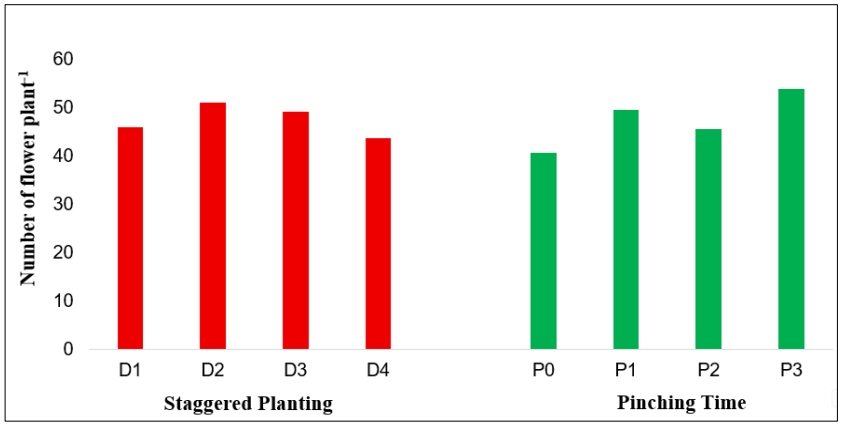

Fig 1: Number of flower plant^{-1} as influenced by staggered planting and pinching time in annual chrysanthemum

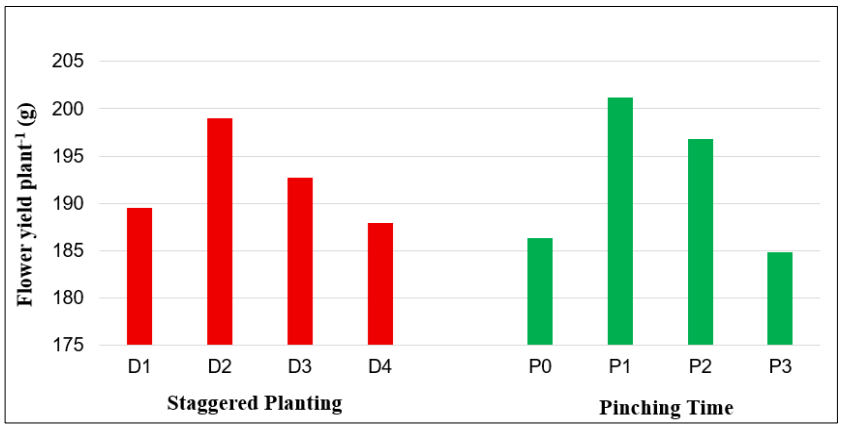

Fig 2: Flower yield plant^{-1} as influenced by staggered planting and pinching time in annual chrysanthemum chrysanthemum

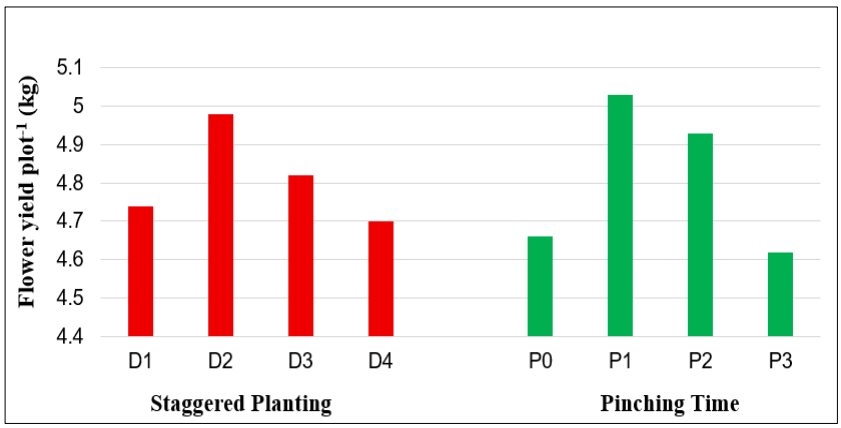

Fig 3: Flower yield plot^{-1} as influenced by staggered planting and pinching time in annual chrysanthemum

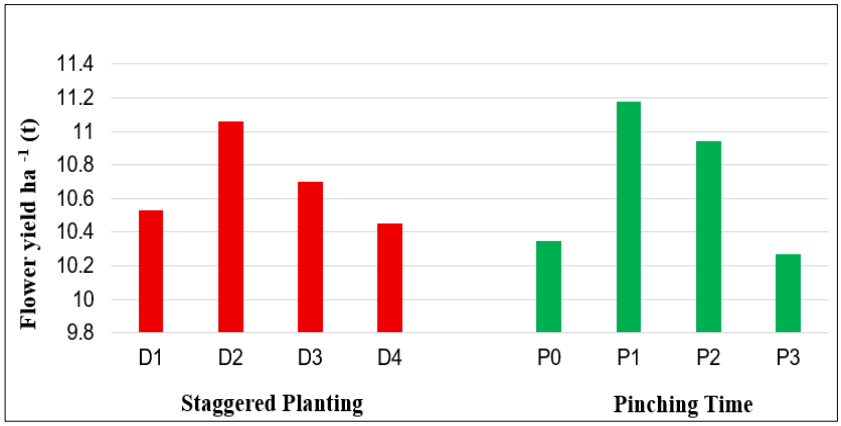

Fig 4: Flower yield ha^{-1} as influenced by staggered planting and pinching time in annual chrysanthemum

Conclusion

From the above experimental data, it can be concluded that, maximum number of branches plant^{-1}, diameter of stem, plant spread were recorded in the treatment planting on first week of October and pinching at 30 and 45 DAT. Whereas, maximum plant height was recorded in treatment staggered planting on first week of October and treatment No pinching. In case of yield parameters, number of flowers plant^{-1} was recorded maximum in the treatment planting on first week of October with pinching at 30 and 45 DAT. Flower yield plant^{-1}, plot^{-1} and hectare^{-1} and B:C ratio were recorded maximum in the treatment planting on first week of October with pinching at 30 DAT.

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