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Effect of planting time and pinching on growth of annual chrysanthemum

RA Hawa, SU Gondane and DM Panchbhai

Abstract

The field experiment was carried out at Horticulture section, Rural Institute, Pipri-Wardha (Maharashtra), India; with objective to find out effect of planting time and pinching on growth of annual chrysanthemum. Treatments comprising five planting times viz. 15th September, 1st October, 15th October, 1st November and 15th November and four pinching treatments viz. No pinching, pinching at 30 DAT, pinching at 45 DAT and pinching at 30 and 45 DAT during the year 2010-11 and 2011-12. Among the planting times, 15th October planting resulted in significantly maximum plant height, number of branches per plant and diameter of main stem at 60, 75 and 90 days after planting, spread of plant at 50% flowering, biomass of plant (fresh) and biomass of plant (dry). Among the pinching treatments, control treatment resulted in significantly maximum plant height at 45, 60, 75 and 90 days after planting. Significantly maximum number of branches per plant was noticed in single pinching at 30 days at 60, 75 and 90 days after planting and also maximum spread of the plant, biomass of plant (fresh) and biomass of plant (dry), whereas more diameter of main stem was recorded in double pinching at 30 and 45 days after transplanting at 45, 60, 75 and 90 days after transplanting.

Keywords: Annual chrysanthemum, planting time, pinching, transplanting

Introduction

Chrysanthemum is a member of family Asteraceae. Annual chrysanthemum comprise of three species viz., *Chrysanthemum segtum* (corn marigold), *Chrysanthemum carinatum* (tricoloured chrysanthemum) and *Chrysanthemum coronarium* (crown daisy or garland chrysanthemum). The crown daisy or garland chrysanthemum is a native to Southern Europe, is a branching annual with a finely cut foliage reaching a height up to a meter, size of flowers varies from 2.2 to 4 cm and colour is usually in shades yellow and white with cream zone at the center (Vishnu Swarup, 1967)^[15].

The growers are attracted towards annual chrysanthemum flowers as its of short duration, to produce marketable attractive good keeping quality flowers. Annual chrysanthemum is generally tall growing, with a view to get a dwarf bushy plant and for getting quality flowers, experiment was conducted on "Effect of planting time and pinching on growth of annual chrysanthemum".

Materials and methods

The field experiment was conducted at Horticulture Section, Rural Institute, Pipri, Wardha during the years 2010-11 and 2011-12. The experiment was laid out in factorial randomized block design with 20 treatment combinations and three replications. The treatment comprised two factors, factor A comprised with five planting times viz., 15th September (T₀), 1st October (T₁), 15th October (T₂), 1st November (T₃), and 15th November (T₄). Factor B comprised four pinching treatments viz., No pinching (P₀), pinching at 30 DAT (P₁), pinching at 45 DAT (P₂) and pinching at 30 and 45 DAT (P₃).

Local seeds of annual chrysanthemum were sown on raised nursery beds. Thirty five days healthy and uniform seedlings were transplanted in prepared flat beds on five different dates at a spacing of 45x30 cm. All recommended cultural operations were followed during crop growth. Pinching operations were done as per treatments. Observation on growth parameters were recorded and collected data was statistically analysed as per Gomez and Gomez (1984)^[6].

Results and Discussion

The result obtained from the present investigation as well as relevant discussion regarding the growth have been summarized under the following heads.

Effect of planting time and pinching on height of plant

Effect of planting time: The data in respect of height of plant (Table1) revealed that, the effect of planting time was found significant at all stages of plant growth except at the 30 DAT

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during both the years of experimentation. However, at all the successive stages of plant growth from 30 DAT to 90 DAT, 15th October planting had produced (23.04 and 20.51, 46.53 and 41.01, 66.84 and 59.38, 84.84 and 75.29, 92.35 and 83.39 cm respectively) maximum plant height, followed by 1st October planting (22.71 and 20.17, 44.92 and 39.41, 64.99 and 57.36, 82.01 and 73.67, 89.68 and 82.31 cm respectively). Whereas, minimum plant height at 30, 45 and 60 DAT (22.00 and 19.48, 43.02 and 37.24, 63.04 and 55.77 cm respectively) was recorded in 15th November planting and, minimum plant height at 75 and 90 DAT (79.81 and 70.67, 87.07 and 79.39 cm respectively) was recorded in 15th September planting during the year 2010-11 and 2011-12 respectively.

The growth recorded at all the successive stages of plant growth in 15th October planting might be due to congenial climatic conditions available to the plant. Thus, it indicates that the pattern of grand growth of plant was enhanced due to more congenial humidity (85 – 89 %) coupled with higher

degree of temperature (20°C - 35°C) exist during the period of investigation. Tallest plants of annual chrysanthemum have also been reported with early planting (5th October) by Jane *et al.* (2001) [8] and better plant height was noticed in 20th October planting by Dhatt and Kumar (2010) [4] in larkspur.

Effect of pinching: The data presented in the Table1 revealed that, the height of the plant recorded at 45, 60, 75 and 90 DAT was significantly influenced by different treatments of pinching. However, the plant height at 30 DAT was found non-significant. At all the successive stages of plant growth from 45 to 90 DAT, control treatment i.e. no pinching had produced (47.53 and 41.28, 70.40 and 62.30, 90.67 and 80.62, 94.89 and 86.54 cm) maximum plant height followed by, single pinching at 30 days after transplanting (43.37 and 37.98, 64.59 and 57.12, 81.23 and 72.92, 89.43 and 81.55 cm). Whereas, minimum plant height at 45 to 90 DAT (41.86

Table 1: Plant height as influenced by planting time and pinching

Treatments	Plant height (cm)									
	30 DAT		45 DAT		60 DAT		75 DAT		90 DAT	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
A. Planting time (T)										
T ₀ – 15 th September	22.52	19.42	43.26	37.62	62.73	55.24	79.81	70.67	87.07	79.39
T ₁ – 1 st October	22.71	20.17	44.92	39.41	64.99	57.36	82.01	73.67	89.68	82.31
T ₂ – 15 th October	23.04	20.51	46.53	41.01	66.84	59.38	84.84	75.29	92.35	83.39
T ₃ – 1 st November	22.13	20.08	44.32	38.21	64.68	56.45	81.73	72.84	89.58	81.25
T ₄ – 15 th November	22.00	19.48	43.02	37.24	63.04	55.77	80.00	71.91	87.30	80.30
F test	NS	NS	Sig.							
SE (m) ±	0.80	0.71	0.80	0.83	0.97	0.93	1.18	1.00	1.25	0.90
C.D. at 5 %	--	--	2.30	2.37	2.77	2.67	3.38	2.86	3.59	2.59
B. Pinching (P)										
P ₀ – No pinching	23.43	20.69	47.53	41.28	70.40	62.30	90.67	80.62	94.89	86.54
P ₁ – 30 DAT	21.81	19.28	43.37	37.98	64.59	57.12	81.23	72.92	89.43	81.55
P ₂ – 45 DAT	23.17	20.60	44.87	38.95	62.38	54.98	78.87	70.28	87.61	79.80
P ₃ – 30 & 45 DAT	21.50	19.15	41.86	36.59	60.45	52.95	75.94	67.68	84.86	77.42
F test	NS	NS	Sig.							
SE (m) ±	0.71	0.63	0.72	0.74	0.87	0.83	1.06	0.89	1.12	0.81
C.D. at 5 %	--	--	2.06	2.12	2.48	2.39	3.03	2.56	3.21	2.31
C. Interaction (TxP)										
F test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	1.60	1.41	1.61	1.66	1.94	1.87	2.37	2.00	2.51	1.81
C.D. at 5 %	--	--	--	--	--	--	--	--	--	--

and 36.59, 60.45 and 52.95, 75.94 and 67.68, 84.86 and 77.42 cm) was recorded in double pinching at 30 and 45 days after transplanting, during the year 2010-11 and 2011-12 respectively.

It is clear from Table1 that plant height was increased as pinching performed at later growth stages of plant. In pinching, removal of the apical growth or topmost of the shoots from plant which arrested the vertical growth of plant and reduced plant height. Obviously that, more plant height was produced by control treatment (no pinching) and reduction in plant height was found due to pinching treatments. These results are in close agreement with findings of Arora and Khanna (1986) [1] and Patil and Kale (1991) [10] who observed reduction in plant height by pinching in marigold, Yassin and Pappiah (1990) [16] and Pawar (2001) [11] in chrysanthemum and Gnyandev (2006) [5] in China aster. The similar results were also noticed by yoo-young kweon *et al.* (1999) [17] in chrysanthemum and Shivankar (2010) [14] in annual chrysanthemum.

Effect of planting time and pinching on number of branches per plant

Effect of planting time: The data presented in the Table2 revealed that, during both the years of experimentation number of branches per plant recorded at 60, 75 and 90 DAT was significantly influenced by different planting time. However, number of branches per plant at 30 and 45 DAT was found non-significant. At all the successive stages of plant growth from 60 to 90 DAT, maximum number of branches per plant was recorded (17.20 and 16.57, 27.00 and 25.38, 30.47 and 28.73) in 15th October planting, whereas, minimum number of branches per plant were recorded (15.00 and 14.30, 24.62 and 22.82, 27.85 and 25.70) on 15th November planting, during the year 2010-11 and 2011-12. It is inferred from the data reported (Table2) that, in early stage of growth, no effect on number of branches of annual chrysanthemum was observed as evident in 30 DAT and 45 DAT. It may be due to the fact that the apical bud predominates to utilize food material more for enhancing the

height of plant and less for the lateral growth. Never the less the shoot apex regulates the growth and development of lateral buds and branches. Therefore, the average number of branches produced by annual chrysanthemum planted on 15th October was as high as 30.47 in a set of existing weather conditions. The results obtained during this investigation are in close agreement with the findings of Guruprasad and Reddy (2001) [7] in China aster, Jane *et al.* (2001) [8] in annual chrysanthemum, Dhatt and Kumar (2010) [4] in larkspur and

Pakhale *et al.* (2012) [9] in African marigold.

Effect of pinching: The data from Table 2 indicated that, the number of branches per plant was significantly influenced by different pinching treatments at all growth stages except at 30 and 45 days after transplanting. At all the successive stages of plant growth from 60 to 90 DAT, maximum number of branches per plant were recorded (18.68 and 17.97, 28.72 and 26.60, 32.53

Table 2: Number of branches per plant as influenced by planting time and pinching

Treatment	Number of branches per plant									
	30 DAT		45 DAT		60 DAT		75 DAT		90 DAT	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Planting time (T)										
T ₀ – 15 th September	4.22	4.17	8.80	8.87	15.17	14.55	24.85	23.02	28.12	26.33
T ₁ – 1 st October	4.28	4.18	9.02	9.05	16.30	15.58	26.07	24.15	29.52	27.78
T ₂ – 15 th October	4.33	4.30	9.12	9.13	17.20	16.57	27.00	25.38	30.47	28.73
T ₃ – 1 st November	4.22	4.18	8.87	8.92	16.15	15.43	25.77	23.80	29.13	26.90
T ₄ – 15 th November	4.17	4.13	8.75	8.68	15.00	14.30	24.62	22.82	27.85	25.70
F test	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.08	0.07	0.34	0.20	.045	0.53	0.54	0.57	0.58	0.70
C.D. at 5 %	--	--	--	--	1.28	1.51	1.56	1.63	1.65	2.01
Pinching (P)										
P ₀ – No pinching	4.23	4.19	8.19	8.65	12.59	11.93	19.76	18.75	21.44	20.37
P ₁ – 30 DAT	4.24	4.19	9.01	8.84	18.68	17.97	28.72	26.60	32.53	30.31
P ₂ – 45 DAT	4.29	4.23	9.16	9.04	16.20	15.51	27.21	25.13	31.48	29.27
P ₃ – 30 & 45 DAT	4.21	4.17	9.28	9.19	16.39	15.73	26.95	24.85	30.61	28.41
F test	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.07	0.06	0.31	0.18	0.40	0.47	0.49	0.51	0.52	0.63
C.D. at 5 %	--	--	--	--	1.15	1.35	1.39	1.46	1.48	1.80
Interaction (TxP)										
F test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	0.17	0.14	0.68	0.39	0.90	1.05	1.09	1.14	1.15	1.40
C.D. at 5 %	--	--	--	--	--	--	--	--	--	--

branches per plant were recorded (12.59 and 11.93, 19.76 and 18.75, 21.44 and 20.37) in control treatment i.e. no pinching, during the year 2010-11 and 2011-12 respectively. Thus maximum branches per plant were recorded in early single pinching i.e. 30 DAT. In pinching, the apical portion of main stem was pinched and therefore, more side branches were formed below pinched portion. This was due to diversion of carbohydrates or food material towards the auxiliary vegetative buds below pinched portion. These results are in close agreement with the findings of Pawar (2001) [11] and Rakesh *et al.* (2003) [12] in chrysanthemum. Similar results were observed by Yassin and Pappiah (1990) [16] in chrysanthemum and Sehrawat *et al.* (2003) [13] in marigold. Both of them noticed increase in number of branches when plants were pinched at 30 DAT.

Effect of planting time and pinching on diameter of main stem:

Effect of planting time: It is seen from the data presented in Table 3 that, the diameter of main stem recorded at 45, 60, 75 and 90 days after transplanting was significantly influenced by different planting dates during both the years. However, the diameter of main stem at 30 days after transplanting was found non-significant. At all the successive stages of plant growth from 45 to 90 DAT, maximum diameter of main stem was found (1.67 and 1.65, 2.19 and 2.17, 2.42 and 2.39, 2.74 and 2.67) in 15th October planting whereas, minimum diameter of main stem was recorded (1.52 and 1.48, 1.94 and

1.92, 2.23 and 2.19, 2.53 and 2.45) in 15th November planting, during the year 2010-11 and 2011-12 respectively.

The survival and eventual success has necessitated close coordination of anatomical form and physiological functions of the plant vascular network enables to transmit regulatory agents those help to coordinate the whole organism in respect to more localized environmental cues.

Thus the bolder stem to the extent of 2.74 cm dimension was measured in annual chrysanthemum planted on 15th October. This stout stem is stronger enough to support a 1m herbaceous plant of annual chrysanthemum without dislodging. Results obtained during this investigation are in contrast with the results obtained by Pakhale *et al.* (2012) [9] who obtained maximum stem diameter in African marigold when the transplanting was done in first week of June.

Effect of pinching: The data presented in the Table 3 revealed that, diameter of main stem recorded at 45, 60, 75 and 90 days after transplanting was significantly influenced by different treatments of pinching. However, diameter of main stem was found non-significant at 30 days after transplanting. At 45 DAT, maximum diameter of main stem was found (1.66 and 1.62 cm) in double pinching at 30 and 45 days after transplanting. However, at 60 to 90 DAT, maximum diameter of main stem was found (2.12 and 2.09, 2.38 and 2.34, 2.71 and 2.64 cm) in single pinching at 30 days after transplanting. Whereas, minimum diameter of main stem at 45 to 90

Table 3: Diameter of main stem as influenced by planting time and Pinching

Treatment	Diameter of main stem (cm)									
	30 DAT		45 DAT		60 DAT		75 DAT		90 DAT	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Planting time (T)										
T ₀ – 15 th September	0.59	0.59	1.54	1.51	1.97	1.94	2.24	2.21	2.55	2.51
T ₁ – 1 st October	0.61	0.61	1.65	1.61	2.15	2.12	2.39	2.34	2.71	2.63
T ₂ – 15 th October	0.61	0.60	1.67	1.65	2.19	2.17	2.42	2.39	2.74	2.67
T ₃ – 1 st November	0.60	0.60	1.63	1.57	2.13	2.10	2.37	2.32	2.69	2.59
T ₄ – 15 th November	0.59	0.58	1.52	1.48	1.94	1.92	2.23	2.19	2.53	2.45
F test	NS	NS	Sig.							
SE (m) ±	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04
C.D. at 5 %	--	--	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.11
Pinching (P)										
P ₀ – No pinching	0.59	0.59	1.53	1.49	2.05	2.01	2.30	2.25	2.54	2.46
P ₁ – 30 DAT	0.60	0.59	1.61	1.58	2.12	2.09	2.38	2.34	2.71	2.64
P ₂ – 45 DAT	0.61	0.60	1.60	1.56	2.08	2.06	2.33	2.29	2.69	2.62
P ₃ – 30 & 45 DAT	0.60	0.60	1.66	1.62	2.06	2.03	2.31	2.27	2.63	2.56
F test	NS	NS	Sig.							
SE (m) ±	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04
C.D. at 5 %	--	--	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.10
Interaction (TxP)										
F test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	0.02	0.02	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.08
C.D. at 5 %	--	--	--	--	--	--	--	--	--	--

DAT was recorded (1.53 and 1.49, 2.05 and 2.01, 2.30 and 2.25, 2.54 and 2.46 cm) in control treatment i.e. no pinching, during the year 2010-11 and 2011-12 respectively. This was due to the fact that, an early pinching reduced the plant height with corresponding increase in branches per plant tending to more plant spread and automatically accumulated the carbohydrates in branches resulted into thicker stem. Similar results were reported by Pawar (2001) [11] who noticed increased basal diameter of main stem by pinching four weeks after transplanting in chrysanthemum and Shivankar (2010) [14] observed maximum diameter of main stem in annual chrysanthemum in single pinching at 30 DAT.

Effect of planting time and pinching on spread of plant at 50% flowering:

The data presented in the Table 4 showed that, the spread of plant at 50% flowering was significantly influenced by different planting time and pinching.

Effect of planting time: During both the years of the experimentation, maximum spread of the plant was noticed in 15th October planting (39.98 and 34.72 cm) whereas, minimum spread of the plant was observed in 15th September planting (34.67 and 30.52 cm), during the year 2010-11 and 2011-12 respectively. Unlike other treatments, the plants of 15th October transplanting established in the field and enter the state of vegetative growth. The plant is capable of exponential increase in size. The increment in size of plant is correlated with the favourable environmental condition since it experienced to hot and humid condition available to the plant. These results are in close agreement with the findings of Jane *et al.* (2001) [8] who found maximum spread of plant with 5th October planting in chrysanthemum. Better spread of plant was observed in larkspur when planted on 20th October by Dhatt and Kumar (2010) [4] and Pakhale *et al.* (2012) [9] noticed maximum plant spread when the transplanting was done in first week of October in African marigold.

Effect of pinching: During both the years of investigation, maximum spread of the plant was observed (39.77 and 35.83

cm) in single pinching at 30 days after transplanting. Whereas, minimum spread of the plant was recorded (32.59 and 28.17 cm) in control treatment i.e. no pinching during 2010-11 and 2011-12 respectively. From the above results it was noticed that, pinching increased spread of the plant. However, spread of the plant was increased as pinching performed at 30 days after transplanting. Minimum spread of the plant was recorded in control where no pinching was performed. Increase in the spread of the plant was due to pinching and removal of the apical growth from plant which arrested the vertical growth and auxiliary buds below pinched portion given rise to primary branches of plant. Therefore, there was enhanced spread. As the number of pinching increased the spread of plant was reduced. Results are in line with findings of Bhatti and Chikara (1987) [3] in marigold, Yassin and Pappiah (1990) [16] in chrysanthemum and Shivankar (2010) [14] in annual chrysanthemum, they reported more spread of plant when pinching was done 30 days after transplanting.

Effect of planting time and pinching on biomass of plant (fresh) at 50% flowering

It is seen from the data presented in the Table 4 that, biomass of plant (fresh) at 50% flowering was significantly influenced by the different planting time and pinching during both the years of investigation.

Effect of planting time: During both the years of experimentation, maximum biomass of plant (fresh) at 50% flowering was noticed in 15th October planting (726.00 and 650.58 g). Whereas, minimum biomass of the plant (fresh) was noticed in 15th September planting (653.59 and 607.61 g) during 2010-11 and 2011-12 respectively. Normally, plants increase in fresh weight with increase in age, less of their growth is apportioned to leaves as indicated by the decline in photosynthetic and non photosynthetic organ. As plant increase in weight, they maintain a fixed ratio. At lower light intensity some species showed decline in ratio and other still showed the constant ratios. Similar situation (i.e. lower light intensities being in winter) is also noticed during the course of

this investigation. However 627.00 g biomass was produced by annual chrysanthemum planted on 15th October which surpasses the other treatments. These results are in relation with the findings of Jane *et al.* (2001) [8] in chrysanthemum, Dhatt and Kumar (2010) [4] in larkspur and Pakhale *et al.* (2012) [9] in African marigold, who observed more spread of plant transplanted on first fortnight of October.

Effect of pinching: During both the years of experimentation, single pinching at 30 days after transplanting recorded maximum biomass of plant (fresh) at 50% flowering (742.13 and 689.09 g). Whereas, minimum biomass of plant (fresh) at 50% flowering was noticed in control treatment i.e. no pinching (622.89 and 542.20 g) during 2010-11 and 2011-12 respectively.

From the above results, it was noticed that, pinching increased fresh weight of the plant. However, fresh weight of the plant was increased as pinching was performed at 30 days after transplanting. Minimum fresh weight of the plant was recorded in control where no pinching was performed.

Plant fresh weight partitioned among organs such as roots, stem, leaves, flowers and concentration of specific chemical constituents along with water. i.e. nucleic acids, soluble nitrogen, protein nitrogen, lipids, carbohydrates in tissues and organs of leaves.

The simple reason for increasing the fresh weight of the plant was due to pinching i.e. removal of the apical growth or topmost shoots from plants which produced more vegetative growth resulting in increased spread with number of branches. Therefore, there was enhancement in fresh weight of plant.

Table 4: Effect of planting time and pinching on Spread of Plant at 50% flowering, biomass of Plant (fresh) at 50 % flowering & biomass of Plant (fresh) at 50 % flowering

Treatment	Spread of Plant at 50% flowering (cm)		Biomass of Plant (fresh) at 50 % flowering (g)		Biomass of Plant (fresh) at 50 % flowering (g)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Planting time (T)						
T ₀ – 15 th September	34.67	30.52	653.59	607.61	181.74	170.63
T ₁ – 1 st October	38.05	33.97	710.37	637.06	197.20	180.38
T ₂ – 15 th October	39.98	34.72	726.00	650.58	200.85	186.98
T ₃ – 1 st November	37.33	32.80	682.13	626.94	189.88	172.53
T ₄ – 15 th November	35.52	31.16	658.47	612.56	185.76	174.24
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.20	0.80	12.05	9.44	3.11	3.12
C.D. at 5 %	3.43	2.30	34.48	27.03	8.91	8.92
Pinching (P)						
P ₀ – No pinching	32.59	28.17	622.89	542.20	174.43	152.96
P ₁ – 30 DAT	39.77	35.83	742.13	689.09	206.71	195.90
P ₂ – 45 DAT	38.22	33.59	695.73	642.00	193.12	180.87
P ₃ – 30 & 45 DAT	37.86	32.94	683.69	634.52	190.08	178.08
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.07	0.72	10.78	8.45	2.78	2.79
C.D. at 5 %	3.07	2.06	30.84	24.18	7.97	7.98
Interaction (TxP)						
F test	NS	NS	NS	NS	NS	NS
SE (m) ±	2.40	1.61	24.09	18.89	6.23	6.23
C.D. at 5 %	--	--	--	--	--	--

These results are in close agreement with the findings of Pawar (2001) [11] Beniwal *et al.* (2005) [2] in chrysanthemum and in confirmation with the findings of Shivankar (2010) [14] in annual chrysanthemum who noticed maximum fresh weight of plant when pinching was done at 30 DAT.

Effect of planting time and pinching on biomass of plant (dry) at 50% flowering

The data presented in the Table 4 revealed that, biomass of plant (dry) at 50% flowering was significantly influenced by the different planting time and pinching.

Effect of planting time: It could be seen from the Table 4 that, during both the years of experimentation significantly maximum biomass of plant (dry) was recorded in 15th October planting (200.85 and 186.98 g) whereas, significantly minimum biomass of the plant (dry) was noticed in 15th September planting (181.74 and 170.63 g) during 2010-11 and 2011-12 respectively. The mean values after drying the fresh biomass was estimated and presented in Table 4. It is seen from the data that average biomass (dry) content at 50% flowering was significant but it is interesting to note that the biomass (dry) computed on five planting times was around 27

to 28% to that of fresh biomass indicating thereby that the plant was not only hardy but content adequate food material also. Fact of the matter is that physiological sink and source activities was in progress, resulting thereby the storage of photosynthate and non evaporative biochemicals in the various organs of annual chrysanthemum grown under a set of agro climatic conditions. Maximum biomass of plant (dry) (200.85 g) was noticed at 50% flowering in 15th October planting. These results are in relation with the findings of Jane *et al.* (2001) [8] in chrysanthemum, Dhatt and Kumar (2010) [4] in larkspur and Pakhale *et al.* (2012) [9] in African marigold, who observed more spread of plant transplanted on first fortnight of October.

Effect of pinching: During both the years of experimentation, single pinching at 30 days after transplanting recorded maximum biomass of plant (dry) at 50% flowering (206.71 and 195.90 g). Whereas, significantly minimum biomass of plant (dry) at 50% flowering was noticed in control treatment i.e. no pinching (174.43 and 152.96 g) during 2010-11 and 2011-12 respectively.

From above results it was noticed that, dry matter of plant was increased in pinched plants due to fresh weight of plant,

number of branches and spread of plant, which was more in pinching and hence biomass of plant (dry) was more in pinched plants.

Dry weight of plant is mainly depends on the green (fresh) weight of plant and the growth parameter which increased due to the single pinching at 30 DAT.

These results are in close agreement with the findings of Pawar (2001) ^[11], Beniwal *et al.* (2005) ^[2] in chrysanthemum and in confirmation with the findings of Shivankar (2010) ^[14] in annual chrysanthemum who noticed maximum dry weight of plant when pinching was done at 30 days after transplanting.

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