EFFECT OF VARIOUS SUCKER SIZES AND PLANTING TIMES ON FLOWERING AND VASE-LIFE OF CHRYSANTHEMUM

Muhammad Akbar Anjum, Aamir Nawaz, Shaheena Gul and Farrukh Naveed
Department of Horticulture, University College of Agriculture,
Bahauddin Zakariya University, Multan

Small and large sized suckers (with a difference of at least 5 cm in height) of chrysanthemum were planted on four different planting dates i.e. 18th February, 18th April, 17th June and 16th August to study their effect on blooming and flower quality. Small sized suckers resulted in longer blooming period and more number of flowers per plant. The earliest planting (18th February) took more time to initiate flowers with prolonged blooming period, greater number of flowers with extended vase-life. On the other hand, the late planting (16th August) gave the flowers with increased diameter and maximum fresh and dry weights per flower.
Keywords: Blooming period, *Chrysanthemum morifolium*, flower quality, flower size, post-harvest life

INTRODUCTION

Chrysanthemum (*Chrysanthemum morifolium*), family Asteraceae, is one of the oldest cultivated flowers. Despite many species of this genus, only one group, *Chrysanthemum morifolium* is grown on large scale. This majestic flowering plant is extremely popular all over the world. It starts to bloom during autumn season. In Pakistan, its peak blooming period is month of December. Flowers are showy and their popularity has increased not only due to their outstanding aesthetic beauty but also due to their good potential of export as cut flowers to many countries of world (Erler and Seigmund, 1986). The flowers are among the best keeping ones for home use and are most adaptable to design work like "Ikebana". Chrysanthemum is grown both as potted plants and as cut flowers in most of the countries of the world including Pakistan. Many flower growing countries are earning handsome amounts from flowers export. Among them, Holland is a leading country in the production and marketing of flowers in the world with a share of 60 percent in floral trade (Bhattacharjee and De, 2003). In European countries, winter is the season when snow and frost hazards appear. Europe imports cut flowers as flower cultivation in greenhouse costs more in winter. International trade in flowers and plants is far more extensive than most people imagine, cut flowers account for largest share and chrysanthemum is most popular florist flower, with hundreds of millions of stems being sold every year in North America and Europe alone (Bhattacharjee and De, 2003). Pakistan can also set up its floriculture industry and can fetch million of dollars by the export of cut flowers.

It is unfortunate that chrysanthemum is subjected to various problems like poor growth, unreliable flower setting, insect-pests and diseases etc., which ultimately result in low yields with poor quality flowers. Unfortunately, no complete data is available in Pakistan in relation to time of planting and size of suckers for farming community to be benefited maximum through the adoption of such information. So, there appears a dire need for searching out proper planting time and propagation method of chrysanthemum. Experiments have been conducted to find out proper planting times for various cut flowers including tuberose (Khobragade *et al.*, 1997; Mishra, 1999; Zizzo *et al.*, 1999), gladiolus (Misra, 1997; Kalasareddi *et al.*, 1997; Maitra and Roy, 1999; Young *et al.*, 2003), anemone (Garibaldi, 1986; Armitage and Laushman, 1990), lily (Gilbertz and Lewis, 1990; Han *et al.*, 1994), narcissus (Talia *et al.*, 1987), freesia (Kim *et al.*, 1996), zinnia (Poonam *et al.*, 2002; Young *et al.*, 2003), celosia and sunflower (Young *et al.*, 2003). Similarly, effect of corm size has also been studied by various workers in gladiolus (Dod *et al.*, 1989; Ko *et al.*, 1994; Laskar and Jana, 1994; Misra, 1996) and freesia (Kim *et al.*, 1996). In chrysanthemum, attempts have been made to study the effect of planting time on growth and flowering (Barman *et al.*, 1993; Deotale *et al.*, 1994 & 1995; Barman *et al.*, 1997; Ambad and Kadam, 1998; Meher *et al.*, 1999; Kim *et al.*, 2000) but the results reported are contradictory. However, no attempts have been made to study the effects of sucker size. Hence, the objective of the present study was to determine optimum planting time and sucker size for propagation of *Chrysanthemum morifolium* to get maximum number of good quality flowers.

MATERIALS AND METHODS

The present study was conducted to find out the effect of various planting times on the flowering, yield, quality and vase-life of Chrysanthemum flowers. The suckers were also divided in small and large ones. The difference between small and large sized suckers was at least 5 cm, although actual height of suckers varied depending upon the time of planting. The suckers were planted on four times with 60 days interval i.e. 18th February, 18th April, 17th June and 16th August. The experiment was arranged in a Randomized Complete Block Design with factorial arrangement with three replications.
Clay pots (Ø 22 cm) were filled with leaf manure and silt (2:1 by volume). Only one sucker was planted in each pot and there were 10 pots in each treatment per replication. Plants were irrigated regularly depending upon the season and weather conditions. Hoeing was done at early stages of plant growth to keep the weeds under control. Fertilizers were applied fortnightly, as Ammonium sulphate @ 1.50 g, Monoammonium phosphate @ 0.40 g and Potassium sulphate @ 1.25 g per litre of water. All the cultural practices were uniform for all the treatments. During the month of September, all the plants were re-potted in larger clay pots (Ø 30 cm). The data were recorded on the following parameters during the course of study; days taken to flowering (1st and 50%), blooming period (days), number of flowers per plant, flower diameter (cm), average weight (fresh and dry) per flower (g) and vase-life of flowers (days). The data collected were subjected to analysis of variance technique and treatment means were compared by using least significant difference (LSD) test at 5% probability level (Petersen, 1994).

RESULTS AND DISCUSSION

Days taken to 1st flowering

Data on time taken to initiate flowering revealed that the emergence of first flower was significantly affected by the planting times. However, the parameter was not affected by the sucker sizes and their interaction with planting times (Table 1). The late planting (16th August) took the minimum days to initiate flowering, while the earliest planting (18th February) resulted in prolonged juvenile period and hence took maximum time to initiate flowering. As the planting time was delayed, time to initiate flowering was decreased. In fact, flowering in plants is regulated by photoperiod. Delay in planting does not necessarily result in delayed flowering. As the days to first flowering were counted from date of planting, the plants in early plantings took more days to initiate flowering. Deotale *et al.* (1994) already reported that in chrysanthemum time to flowering was reduced in late plantings.

Table 1. Days taken to 1st flowering as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	252.00 a*	199.30 a	147.00 a	91.00 a	172.33 a
Large	262.00 a	204.00 a	150.00 a	94.00 a	177.58 a
Mean	257.00 a	201.65 b	148.50 c	92.50 d	

Days taken to 50% flowering

The data procured showed that the parameter under study was significantly affected by the planting times. However, effect of the sucker sizes and their interaction with planting times was found non-significant (Table 2). The longest period required to complete 50% flowering was recorded in the earliest planting (18th February). As the planting time was delayed, the time to complete 50% flowering was reduced, being the minimum in the latest planting (16th August). In another experiment with chrysanthemum, Meher *et al.* (1999) had already stated that number of days to flowering was least when planted in July.

Poonam *et al.* (2002) also found that in zinnia, late planting resulted in the lowest number of days required for initial flowering.

Blooming period

Blooming period of the plants was significantly affected by the sucker sizes, planting times and their interaction (Table 3). Days from flower opening to wilting were significantly more in case of small sized suckers as compared to large sized suckers. The longest blooming period was recorded in 18th February planting, which differed significantly from all other plantings. This was followed by 16th August and 18th April plantings and both these plantings behaved statistically alike. The shortest blooming period was observed in case of 17th June planting. In other words, flower life on plant was more in case of February planting and less in case of June planting. This indicates that the temperature at the time of planting plays a significant role in flower life on plant. The findings of Barman *et al.* (1997) also revealed that the chrysanthemum planted on early dates had the longest flowering season. Mean values of interaction revealed that the maximum blooming period was recorded in case of small sized suckers when planted on 18th February, which differed significantly from all other treatments. Minimum flower life on plant was observed in case of large sized suckers when planted either on 17th June or 18th April. The trend was probably due to the dominating effect of sucker size and planting time on the blooming period.

Table 2. Days taken to 50% flowering as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	275.00 a*	208.70 a	154.00 a	95.00 a	183.17 a
Large	278.00 a	210.00 a	157.00 a	102.00 a	186.75 a
Mean	276.50 a	209.35 b	155.50 c	98.50 d	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

Table 3. Blooming period (days) as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	71.00 a*	47.70 c	45.66 cd	48.33 c	53.17 a
Large	58.00 b	43.00 de	40.00 e	46.30 c	46.83 b
Mean	64.50 a	45.35 b	42.83 c	47.32 b	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

Number of flowers per plant

Flower number was significantly affected by the sucker sizes, planting times and their interaction (Table 4). Small sized suckers resulted in significantly more number of flowers as compared to large sized suckers indicating that the small sized suckers had more potential to give higher number of flowers. Regarding planting times, maximum number of flowers was recorded in the earliest planting (18th February), followed by the next planting (18th April). However, these two plantings differed significantly for

Table 4. Number of flowers per plant as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	83.80 b*	95.66 a	38.67 d	54.67 c	68.20 a
Large	96.40 a	49.50 c	35.13 d	29.60 d	52.65 b
Mean	90.10 a	72.58 b	36.90 c	42.13 c	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

the parameter under study. Minimum number of flowers was counted in 17th June planting, followed by

that of 16th August and both of these plantings were statistically alike. The results of the present study are in accordance with the findings of Park *et al.* (1989) who observed that in *Liatris spicata*, the number of flowers decreased as planting was delayed. The interaction between sucker sizes and planting times revealed that the maximum number of flowers was produced when large sized suckers were planted on 18th February or small sized suckers planted on 18th April and both the treatments behaved statistically alike. Minimum number of flowers were recorded when large sized suckers were planted either on 16th August or 17th June, followed by the small sized suckers planted on 17th June. All these three treatment stood at par with each other. The difference in treatment combinations for flower number was probably due to the dominating effect of planting times as early plantings resulted in more number of flowers due to prolonged period of photosynthetic activity.

Flower diameter

Table 5. Flower diameter (cm) as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	6.44 a*	6.29 a	7.46 a	8.44 a	7.15 a
Large	6.48 a	8.21 a	7.33 a	9.07 a	7.77 a
Mean	6.46 c	7.25 c	7.39 b	8.75 a	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

Figures related to the diameter of flowers depicted significant results for the planting times and non-significant for sucker sizes and their interaction with planting times (Table 5). Planting of 16th August resulted in maximum flower diameter followed by 17th June and 18th April plantings, while minimum diameter was recorded in case of 18th February planting. The later two planting time also stood statistically at par. This indicates that the late planting showed significant supremacy over early plantings. Barman *et al.* (1997) found that there was gradual increase in flower diameter of chrysanthemum as planting was delayed and in their experiment largest flower diameter was obtained from planting on September 30th. In the present study, early plantings resulted in more number of flowers but with reduced flower size (diameter), possibly due to distribution of the food reserve to more number of terminal buds. On the other hand, late planting gave less number of flowers but with large sized flowers.

Average fresh weight per flower

Planting times had significant effect on the fresh weight of flowers, while the parameter was not affected by the sucker sizes and their interaction with planting times (Table 6). Fresh weight of flowers was significantly higher in case of the last planting i.e. 16th August and the minimum was in the earliest planting (18th February) followed by those of 18th April and 17th June. The latter three planting also stood statistically at par with each other. This revealed that the earliest planting gave more number of flowers

Table 6. Average fresh weight per flower (g) as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	2.71 a*	2.70 a	2.57 a	4.16 a	3.03 a
Large	2.49 a	2.98 a	3.22 a	5.32 a	3.50 a
Mean	2.60 b	2.84 b	2.89 b	4.74 a	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

Table 7. Average dry weight per flower (g) as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	0.41 a*	0.53 a	0.61 a	0.95 a	0.62 a
Large	0.40 a	0.60 a	0.64 a	0.93 a	0.64 a
Mean	0.41 c	0.57 bc	0.62 b	0.94 a	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

of flowers possibly due to availability of more nutrients. As the flower number was less in case of late planting, the flower size in terms of diameter and fresh weight was more. These results are in contrary to the findings of Deotale *et al.* (1995) that planting out on 24th June produced the heaviest (2.15 g) and largest (6.42 cm diameter) flowers, possibly due to differential climate at the sites of experiments.

Average dry weight per flower

Dry weight of flowers was significantly affected by the planting times. However, the effect of sucker sizes and their interaction with planting times was found non-significant (Table 7). Maximum dry weight was attained in case of the last planting i.e. 16th August and the minimum in the earliest planting i.e. 18th February. The other two plantings were in the middle. Average dry weight of flowers normally depends on their average fresh weight and diameter. Early planting with increased number of flowers but with less flower diameter and lower fresh weight resulted in reduced dry weight. In another experiment Ambad and Kadam (1998) had already reported that in pyrethrum flowers, dry flower yield was highest when planted on 5th September. These results are in line with the present findings that the maximum dry weight of flowers was recorded in the latest planting (16th August).

Vase-life of flowers

Planting times had significant effect on vase-life of flowers when kept in distilled water. However, sucker sizes and their interaction with planting times had no significant effect on the parameter (Table 8). The longest vase-life was recorded in the flowers resulting from the earliest planting (18th February) and the shortest in case of 17th June planting. Other two planting times were in the middle. However, all the four planting times differed significantly from each other. These results are almost in line with those procured in case of blooming period indicating that the flower life on plant has at least some correlation with its post-harvest life.

Table 8. Vase-life of flowers (days) as affected by various sucker sizes and planting times

Sucker Size	Planting time				Mean
	18th February	18th April	17th June	16th August	
Small	19.66 a*	8.33 a	8.00 a	14.33 a	12.58 a
Large	21.00 a	10.33 a	7.00 a	13.00 a	12.83 a
Mean	20.38 a	9.333 c	7.50 d	13.66 b	

*Means sharing similar letter(s) in a group are statistically non-significant at P = 0.05 (LSD test).

CONCLUSIONS

Small sized suckers gave more number of flowers per plant with longer blooming period than the large sized suckers. The earliest planting (18th February) resulted in prolonged blooming period, greater number of flowers with extended vase-life. The late planting (16th August) took minimum time to initiate flowering and gave large sized and heavier flowers.

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