EFFECT OF VARIOUS SUCKER SIZES AND PLANTING TIMES ON GROWTH AND FLOWER YIELD OF CHRYSANTHEMUM

Aamir Nawaz*, Shahena Gul, Muhammad Akbar Anjum and Farrukh Naveed
Department. of Horticulture, Univ. College of Agriculture, Bahauddin Zakariya University, Multan
*Corresponding author: Aamir Nawaz aamir khan_74@hotmail.com

Small and large sized suckers of *Chrysanthemum morifolium* were planted on four different dates, i.e. 18th February, 18th April, 17th June and 16th August to find out their effect on growth and flower yield. Plants resulting from small sized suckers produced significantly higher number of primary and secondary branches and leaves plant^{-1}. However, plant height, leaf area, number of suckers produced, biomass (fresh plant weight) and flower yield plant^{-1} were not affected by the sucker sizes. As the planting was delayed, plant growth and flower yield was reduced. Early plantings resulted in increased plant height, more number of branches and leaves plant^{-1}, greater biomass, and higher flower yields but reduced leaf area as compared to late plantings.
Keywrds: Biomass; juvenile period; *Chrysanthemum morifolium*; flower yield; suckers; vegetative growth

INTRODUCTION

Chrysanthemum (*Chrysanthemum morifolium*) is one of the oldest cultivated flowers grown on large scale as a cut flower. Flowers are showy with outstanding aesthetic beauty. They are among the best keeping flowers for home use and are most adaptable to design work like 'Ikebana'. As a landscape plant, the chrysanthemum makes a beautiful fall display for home gardens. However, their popularity is due to their potential as cut flower for export to many countries of the world (Erler and Seigmund, 1986). In Pakistan, there is range of cut flowers but very few are available in autumn. Chrysanthemum is among those flowers, which bloom during autumn and can fulfil the demand of cut flower market. The need has been particularly felt with an increase in demand of cut flowers in our country particularly in autumn, as growers have to supply flowers to retailers throughout the year. Ornamental cut flowers, potted flowering plants and foliage plants are showing great trade potential for export to Gulf countries and European markets. Rose, carnation, tuberose and chrysanthemum are the most important flowers in international market. Many flower growing countries are earning handsome amounts from export of flowers. Among them, Netherlands is playing a leading role in the production and marketing of flowers. We are fortune to have a subtropical climate in Pakistan and can produce and export cut flowers. Pakistan can also establish its floriculture industry by providing necessary facilities and can surely fetch millions of dollars as foreign exchange.

Unfortunately, chrysanthemum is subjected to various problems like poor growth, insect-pests and diseases, unreliable flower setting etc., which ultimately result in low yields with poor quality flowers. No complete information on production technology including propagation method and time of planting is available in Pakistan for farming community to produce healthy plants with good quality flowers. Hence, there is a dire need to evaluate proper planting time and size of suckers to be used for propagation 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), Chrysanthemum (Anjum *et al*., 2007). 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 (Kiyatkin, 1976; Barman *et al*., 1993; Deotale *et al*., 1994 & 1995; Shin *et al*., 1996; 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. Therefore, the present study was envisaged to evaluate the effect of two sucker sizes and four different planting times on the growth and flower yield of chrysanthemum.

MATERIALS AND METHODS

Small and large sized suckers of *Chrysanthemum morifolium* were planted on four different dates, i.e. 18th February, 18th April, 17th June and 16th August. The difference in height between small and large sized suckers was at least 5 cm, though actual heights of suckers varied depending upon the time of planting.

The experiment was laid out in a Randomized Complete Block Design with factorial arrangement. There were 8 treatment combinations (two sucker sizes and four planting times) which were repeated thrice, resulting in 24 experimental units.

Clay pots (22 cm in diameter) were filled with potting mixture, prepared by mixing two parts of leaf manure and one part of silt (by volume). Only one sucker was planted in each pot and there were 10 pots in each treatment combination per replication. Plants were watered regularly through a sprinkler depending upon the season and weather conditions. To keep the weeds under control, manual hoeing was practiced at early stages of plant growth. 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 (30 cm in diameter) with fresh potting mixture. The data were recorded on the following parameters during the course of study; plant height (cm), number of branches plant^{-1}, number of leaves plant^{-1}, leaf area (cm^2), number of suckers produced plant^{-1}, fresh weight plant^{-1} (g) and fresh flower yield plant^{-1} (g). 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 (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Plant height (cm)

Height of the plants was significantly affected by the planting times and their interaction with sucker sizes. However, sucker sizes alone have no significant effect on the height of resulting plants (Table 1). Maximum plant height was attained when suckers were planted on 18th February. Minimum plant height was recorded when suckers were planted on 16th August followed by 17th June and 18th April plantings. These three planting dates also stood at par with each other. It is evident from the data that the plant height decreased as planting was delayed. The difference in plant height may be attributed to duration of growing period. As growing period was prolonged, plant height was increased. Meher *et al*. (1999) found that early planting produced the tallest plants of chrysanthemum. Similarly, Poonam *et al*. (2002) reported that early planting produced the maximum plant height in zinnia. Regarding the interaction between sucker sizes and planting times, tallest plants were obtained when large sized suckers were planted on the earliest date, followed by small sized suckers also planted on the same date. These also behaved statistically alike. The minimum plant height was recorded when large sized suckers were planted on the latest date i.e. 16th August. These differences in treatment combinations were probably due to the dominating effect of early planting.

Number of primary branches plant^{-1}

Data revealed significant differences in number of primary branches due to variation/differences in sucker sizes and planting times, while interaction between these two factors was found non-significant (Table 1). Small sized suckers resulted in more number of primary branches as compared to large sized suckers (Fig. 1a). In case of planting times, the earliest planting (18th February) differed significantly from all other plantings resulting in the highest number of primary branches. Although all other plantings were statistically at par, the minimum number of primary branches was recorded when the suckers were planted on the latest date (16th August). These results indicate that early planting resulted in more number of branches possibly due to increased plant height. Present results are also supported by the findings of Poonam *et al*. (2002) that early planting produced the maximum number of branches in zinnia.

Number of secondary branches plant^{-1}

Sucker sizes, planting times and their interaction had significant effect on number of secondary branches plant^{-1} (Table 1). Small sized suckers resulted in significantly higher number of secondary branches plant^{-1} as compared to large sized suckers (Fig. 1b). In case of planting time, maximum number of secondary branches was produced when suckers were planted on earlier dates i.e. 18th February and 18th April, These treatments were also statistically at par. Minimum number of secondary branches was produced when suckers were planted on later dates i.e. 17th June and 16th August, which also behaved statistically alike. Regarding the interaction, maximum number of secondary branches was obtained when small sized suckers were planted on the earliest date (18th February), which significantly differed from all other treatment combinations. The minimum number of secondary branches was recorded in case of large sized suckers planted on the latest date (16th August), followed by the large sized suckers planted on 17th June. These treatment combinations also stood statistically at par with each other. Possible reason behind the results is that in case of late planting, shorter growing period was available for vegetative growth of the plants.

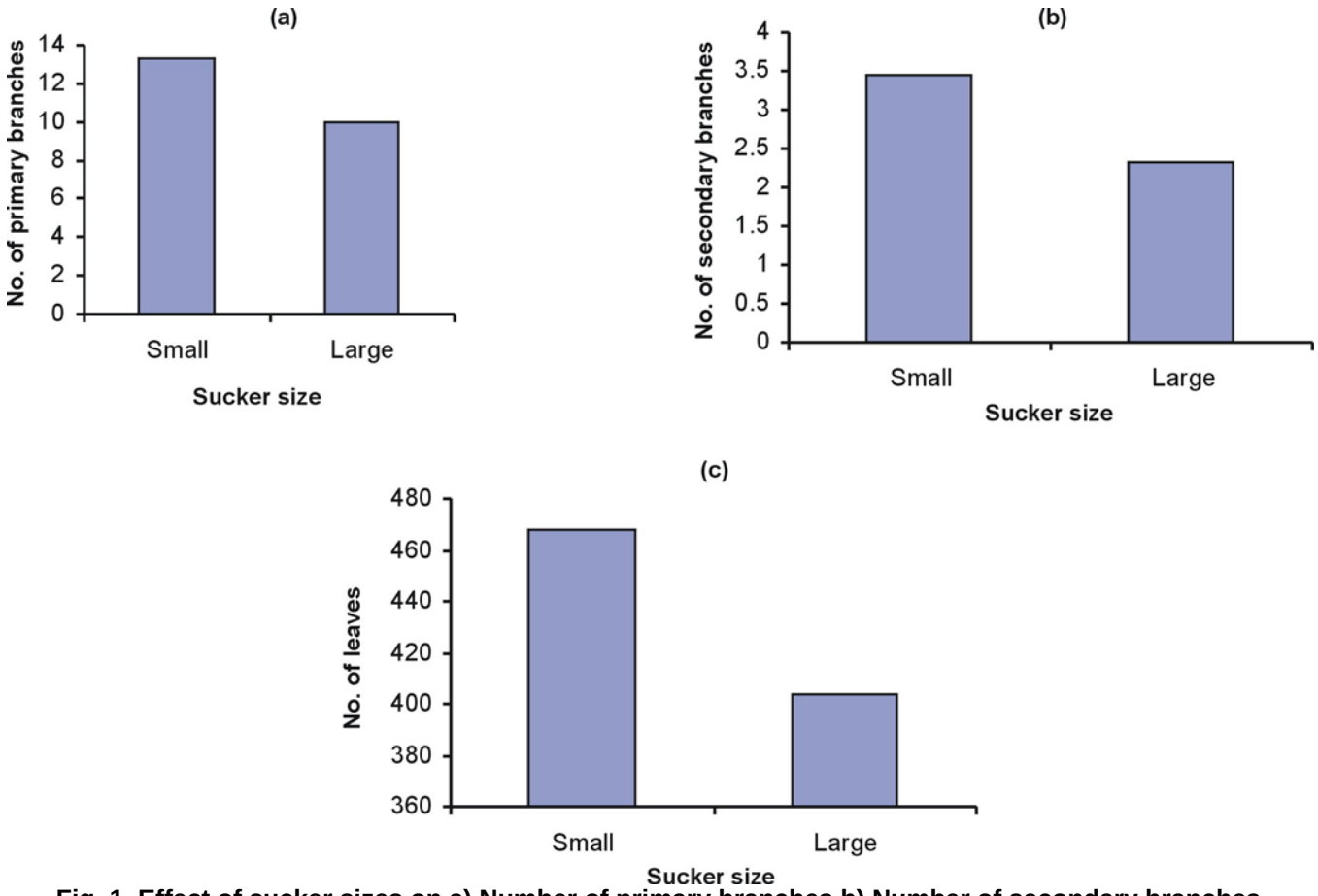

Fig. 1. Effect of sucker sizes on a) Number of primary branches b) Number of secondary branches c) Number of leaves per plant

Number of leaves plant^{-1}

Information procured on leaf number indicated that the parameter was significantly affected by the sucker sizes and planting times, while it was not influenced by their interaction (Table 1). Plants resulting from small sized suckers had more number of leaves as compared to those resulting from large sized suckers (Fig. 1c), possibly due to more number of primary and secondary branches plant^{-1}. As for as planting times are concerned, earliest planting (18th February) resulted in significantly more leaves plant^{-1}. As planting time was delayed, the leaf number plant^{-1} decreased being minimum in last two plantings. These two planting times were also statistically at par. In fact, more number of leaves was produced in those treatments which also resulted in greater plant height and more number of branches plant^{-1}. From this, it can be concluded that the leaf number has a direct relationship with plant height and number of branches. Kiyatkin (1976) recorded reduced number of leaves in chrysanthemum by late planting. Barman *et al*. (1997) counted maximum number of leaves in early planting of chrysanthemum. Therefore, the results of present study are in conformity with the findings of previous workers.

Leaf area

Planting times had a significant effect on leaf area, while the parameter was not affected by the sucker sizes and their interaction with planting times (Table 1). Maximum leaf area (35.33 cm^2) was attained when suckers were planted on the latest date of 16th August, which significantly differed from all other planting times. The minimum leaf area was recorded in the earliest planting of 18th February, followed by that of 18th April. These two planting times also behaved statistically alike. Although, the early plantings have larger growing periods, the leaf was less probably due to more number of leaves. These results also support the findings of Deotale *et al*. (1995), who found that in chrysanthemum the leaf area was greatest with late planting.

Table 1. Effect of various sucker sizes and planting times on growth and flower yield of chrysanthemum

Planting Time	Sucker size	Plant height (cm)	No. of primary branches	No. of secondary branches	Number of leaves plant^{-1}	Leaf area (cm^2)	No. of suckers plant $^{-1}$	Fresh weight plant^{-1}(g)	Fresh flower yield plant^{-1}(g)
18th February	Small	101.30 ab	18.00 a*	5.94 a*	626.33 a*	12.20 a*	32.33 a*	48.53 a*	277.10 a*
	Large	106.33 a	15.40 a	2.92 c	593.00 a	12.40 a	36.33 a	475.30 a	290.04 a
	Mean	103.82 a	16.70 a	4.43 a	609.67 a	12.30 c	34.33 a	461.91 a	283.57 a
18th April	Small	96.30 b	13.60 a	4.33 b	587.00 a	14.80 a	25.67 a	341.00 a	258.28 b
	Large	96.00 b	9.50 a	4.47 b	513.33 a	15.66 a	35.33 a	305.05 a	217.51 cd
	Mean	96.15 b	11.55 b	4.40 a	550.16 b	15.23 c	30.50 ab	323.03 b	237.90 b
17th June	Small	98.41 b	13.60 a	1.73 cd	337.93 a	29.86 a	26.40 a	280.59 a	199.38 d
	Large	91.00 b	9.06 a	1.40 de	261.26 a	30.33 a	24.87 a	266.20 a	213.12 cd
	Mean	94.70 b	11.33 b	1.57 b	299.60 c	30.10 b	25.63 b	273.39 c	206.25 c
16th August	Small	97.80 b	7.93 a	2.00 cd	320.53 a	31.66 a	13.86 a	203.13 a	217.45 c
	Large	87.01 c	6.00 a	0.16 e	248.77 a	39.00 a	16.33 a	186.00 a	207.47 cd
	Mean	92.40 b	7.96 c	1.80 b	284.65 c	35.33 a	15.10 c	194.56 d	217.45 c

Planting Time	Sucker size	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of leaves per plant	Leaf area (cm^2)	No. of suckers plant $^{-1}$	Fresh weight plant^{-1} (g)	Juvenile period (days)	Fresh flower yield plant^{-1} (g)
18th February	Small	101.30 ab	18.00 a*	5.94 a*	626.33 a*	12.20 a*	32.33 a*	48.53 a*	252.00 *	277.10 a*
	Large	106.33 a	15.40 a	2.92 c	593.00 a	12.40 a	36.33 a	475.30 a	262.00 a	290.04 a
	Mean	103.82 a	16.70 a	4.43 a	609.67 a	12.30 c	34.33 a	461.91 a	257.00 a	283.57 a
18th April	Small	96.30 b	13.60 a	4.33 b	587.00 a	14.80 a	25.67 a	341.00 a	199.30 a	258.28 b
	Large	96.00 b	9.50 a	4.47 b	513.33 a	15.66 a	35.33 a	305.05 a	204.00 a	217.51 cd
	Mean	96.15 b	11.55 b	4.40 a	550.16 b	15.23 c	30.50 ab	323.03 b	201.65 b	237.90 b
17th June	Small	98.41 b	13.60 a	1.73 cd	337.93 a	29.86 a	26.40 a	280.59 a	147.00 a	199.38 d
	Large	91.00 b	9.06 a	1.40 de	261.26 a	30.33 a	24.87 a	266.20 a	150.00 a	213.12 cd
	Mean	94.70 b	11.33 b	1.57 b	299.60 c	30.10 b	25.63 b	273.39 c	148.50 c	206.25 c
16th August	Small	97.80 b	7.93 a	2.00 cd	320.53 a	31.66 a	13.86 a	203.13 a	91.00 a	217.45 c
	Large	87.01 c	6.00 a	0.16 e	248.77 a	39.00 a	16.33 a	186.00 a	94.00 a	207.47 cd
	Mean	92.40 b	7.96 c	1.80 b	284.65 c	35.33 a	15.10 c	194.56 d	92.50 d	217.45 c

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

Number of suckers plant^{-1}

Data revealed that planting times had a significant effect on number of suckers produced plant^{-1}. However, the effect of sucker sizes and their interaction with planting times was found non-significant (Table 1). The maximum number of suckers was produced in case of earliest planting (18th February), followed by 18th April planting. These two planting times were statistically similar for the parameter under study. Minimum number of suckers was recorded in case of 16th August planting. This indicated that the number of suckers decreased as planting time was delayed, probably due to shorter growing seasons during which photosynthetic activity was not efficient to promote underground lateral stems.

Fresh weight plant^{-1}

Statistical analysis of the data pertaining to fresh weight plant^{-1} showed non-significant results for sucker sizes and their interaction with planting times, but showed significant results for planting times (Table 1). Maximum fresh weight was recorded when suckers were planted on the earliest date (18th February), which differed significantly from all other planting dates. As the planting was delayed, there was a progressive decrease in fresh weight of plants. Minimum fresh weight of plants was obtained when suckers were planted on 16th August. The heigher fresh weight in early plantings may be attributed to increased plant height, number of primary and secondary branches and leaf number. In early plantings, growing period was long with more photosynthetic activity resulting in more biomass of plants.

Fresh flower yield plant^{-1}

Flower yield was significantly affected by the planting times and their interaction with sucker sizes. However, effect of sucker sizes alone on the parameter was non-significant (Table 1). Maximum yield (283.57 g) of fresh flowers was harvested from the earliest planting (18th February), followed by the next planting date (18th April). However, both of these planting times were statistically different. Minimum yield was obtained when suckers were planted either on 17th June or 16th August. These two planting times were statistically at par. This indicates that the flower yields were higher in early plantings than later ones. Armitage and Laushman (1990) also reported that late planting in Acidanthera, Anemone, Allium, Bridiaea and Crocosmia resulted in lower yield than early planting. The interaction between sucker sizes and planting times showed that higher flower yields were obtained when large sized suckers were planted on the earliest date (18th February), followed by small sized suckers planted on the same date. These two treatment combinations were also statistically similar. Small sized suckers when planted on 18th April or 16th August were in middle. Rest of the treatment combinations stood statistically at par with each other with lower yields. Higher flower yields in former treatment combinations were probably due to dominating effect of early planting having prolonged period of photosynthetic activity.

CONCLUSION

It can be concluded from the results of the present study that chrysanthemum suckers should be planted earlier in the spring as these have large growing period and result in more vegetative growth with high flower yield.

REFERENCES

Ambad, S.N. and U.S. Kadam. 1998. Effect of different planting dates on the pyrethrum flower. *J. Maharashtra Agric. Univ.* 23: 66-67.

Anjum, M.A., A. Nawaz, S. Gul and F. Naveed. 2007. Effect of various sucker sizes and planting times on flowering and vase life of chrysanthemum. Pak. J. Agric. Sci. 44(3): 475-480.

Armitage, A.M. and J.M. Laushman. 1990. Planting date, in-ground time affect cut flowers of *Acidanthera, Anemone, Allium, Bridiaea* and *Crocosmia*. Hort. Sci. 25: 1236-1238.

Barman, D., S. Ghosh and P. Pal. 1993. Effect of planting date and pinching height on flowering of chrysanthemum. Hort. J. 6: 121-124.

Barman, D., P. Pal and R.C. Upadhaya. 1997. Effect of planting date and pinching height on growth and flowering of chrysanthemum. Internat. J. Trop. Agric. 15: 65-73.

Deotale, A.B., P.V. Belorkar, S.R. Patil, V.N. Zode and M.B. Keche. 1994. Effect of date of planting and foliar spray of GA_3 on flowering and yield of chrysanthemum. J. Soils & Crops 4: 148-151.

Deotale, A.B., P.V. Belorkar, M.H. Dahale, S.R. Patil and N.N. Zode. 1995. Effect of date of planting and foliar application of GA_3 on growth of chrysanthemum. J. Soils & Crops 5: 83-86.

Dod, V.N., K.T. Saawarte, L.W. Kulwal and S.W. Vaidya. 1989. Effect of different dates of planting and size of corms on growth and flower yield of gladiolus. PKV Res. J. 13: 164-165.

Erler, R. and I. Seigmund. 1986. Yearbook of the International Horticultural Statistics, USA, p.44.

Garibaldi, E.A. 1986. Trials to increase corm size of anemones grown in country. Colture Protette 15: 31-33 [Hort. Abst. 58(3): 1594; 1988].

Gilbertz, D.A. and A.J. Lewis. 1990. Effect of planting date and application method on ancymidol response of hybrid lilies. Sci. Hort. 45: 159-165.

Han, J.S., S.K. Kim, N.Y. Uin, J.Y. Ko and K.K. Lee. 1994. Effect of planting times and shading on the flowering and cut flower yield of *Lilium spp*. Enchantment in alpine areas. RDA J. Agric. Sci. 36: 452-456.

Kalasareddi, P.T., B.S. Reddy, S.R. Patil, P.R. Patil and B.S. Kulkarni. 1997. Effect of planting time on flowering, flower quality and vase and field life of gladiolus. Adv. Agric, Res. India 8: 45-51.

Khobragade, R.I., M.M. Damke, B.J. Jadhao and C.V. Hedau. 1997. Effect of planting time and spacing on growth, flowering and bulb production of tuberose cv. 'Single'. PKV Res. J. 21: 44-47.

Kim, D.K., J.M. Kim, K.K. Lee, Y.K. Shin, H.J. Kim, J.S. Choi and B.J. Jung. 1996. Effect of planting date of corm on summer season cut flowers production of freesia (*Freesia hybrida* Hort.) in sub-alpine area. RDA J. Agric. Sci. 38: 508-511.

Kim, J.H., J.S. Lee, T.J. Kim, H.H. Kim, H.D. Lee, C.H. Lee and T. Yun. 2000. Effect of shading and mulching on growth and flower quality of chrysanthemums. J. Korean Soc. Hort. Sci. 41: 631-635.

Kiyatkin, A.K. 1976. Chrysanthemum. Referativnyi Z. 7: 951-955.

Ko, J.Y., S.K. Kim, N.Y. Uin, J.S. Han and K.K. Lee. 1994. Planting times and corms grades of *Gladiolus gandavensis* in highland. RDA J. Agric. Sci. 36: 430-434.

Laskar, M.A. and B.K. Jana. 1994. Effect of planting time and size of corms on plant growth, flowering and corm production of gladiolus. Indian Agric. 38: 89-97.

Maitra, S. and C.N. Roy. 1999. Effect of time and depth of planting on growth, development, flowering, corm and cormlet production of gladiolus. Hort. J. 12: 83-90.

Meher, S.P., D.J. Jiotode, A.B. Turkhede, S.O. Darange, C.S. Dhawad and K.A.W. Thorat. 1999. Effect of planting time and growth regulator treatments on growth of chrysanthemum. Crop Res. (Hisar) 18: 486-489.

Mishra, H.P. 1999. Effect of planting time on plant growth, flower and spike production of tuberose (*Polianthes tuberosa* L.). J. App. Hort. 1: 145-148.

Misra, R.L. 1996. Effect of staggered plantings on the flowering and propagation coefficient of gladiolus var. Christian Jane. Prog. Hort. 25: 168-172.

Misra, R.L. 1997. Residual effect of previous planting season on growth and flowering of gladiolus in following growing season. Ann. Agric. Res. 18: 222-224.

Poonam, R. Kumar and R.K. Dubey. 2002. Effect of planting time and spacing on zinnia. J. Ornamental Hort., New Series 5: 49-50.

Shin, H.K., J.K. Choi and S.T. Choi. 1996. Effect of planting time and pinching on aspects of axillary bud abortion in branchless chrysanthemum. J. Korean Soc. Hort. Sci. 37: 442-446.

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics. A Biometric Approach. 3rd ed. McGraw Hill Book Co. Inc., New York.

Talia, M.C., I. Ferrari and Vendola. 1987. The effect of the growing environment and planting time on the flowering of narcissus. Colture Protette 16: 55-60 [Hort. Abst. 58(10): 6814; 1988].

Young, J.B., J.S. Kuehny and P.C. Branch. 2003. Scheduling of Gladiolus, Celosia, Helianthus and Zinnia. Acta Hort. 624: 373-378.

Zizzo, G.V., G. Fascella and S. Agnello. 1999. Effect of planting date and bulb size on flowering of tuberose. Ital. Hort. 7: 17-25.