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# Effect of planting dates on growth, flowering and seed production of garland chrysanthemum (*Chrysanthemum coronarium*)

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ABSTRACT

A field experiment carried out to study the effect of planting dates on growth, flowering and seed production of garland chrysanthemum (*Chrysanthemum coronarium* L.) under mid-hills of Himachal Pradesh during 2010-11 and 2011-12 exhibited significant influence on growth, flowering and seed production. Planting was done at an interval of 15 days starting from 17 September in both the years with planting dates as; 17 September, 2 October, 17 October, 1 November, 16 November and 1 December. The maximum plant height (120.29 cm), number of side stems/plant (16.23), early flowering (95.08 days), duration of flowering (41.43 days), number of flowers/stem (21.98), number of heads/plant (308), number of seeds/head (243.95), seed yield/plant (77.40 g) and 1 000 seed weight (1.67 g) were recorded when planting was done on 17 September. However head formation was earliest (158.53 days) in 1 December planting.

**Key words**: *Chrysanthemum coronarium,* Flowering, Garland chrysanthemum, Planting dates, Seed yield

*Chrysanthemum coronarium* L., commonly called as garland chrysanthemum, annual chrysanthemum and crown daisy, belongs to family Asteraceae and is usually grown as bedding plant for landscape purposes and for loose flower production. It is a native of the Mediterranean region distributed throughout Europe, northern Africa and Asia. It is among commercial crops grown for loose flowers in India. It grows very well under mild or slightly cold climates, but will go quickly into premature flowering in warm summer conditions. It produces large sized attractive blooms for making garlands and for decoration during religious functions. The species is possibly a good companion plant, protecting neighbouring plants from caterpillars etc. There is a report that secretion from the roots is effective in controlling nematodes in the soil (Mishra *et al.* 2002). It is stated as a possible agroforestry species. Thus, garland chrysanthemum is believed to be a potential commercial flower crop and a species for multi-disciplinary research, on account of its diverse qualities. Seed production of flowers is now gaining popularity in India as it is having great export potential. The climatic conditions prevailing in North India are favourable for cultivation of winter annuals. In Himachal Pradesh the availability of congenial climatic conditions favour the entrepreneur of flower seed production.

Farmers have already entered into flower seed production and have reported 2.5 to 3 times more profit than traditionally grown wheat crop in Punjab (Singh *et al*. 2009). Seed production of flowers is relatively remunerative enterprise as compared to other traditional seasonal crops grown by farmers in Himachal Pradesh. Planting time influence the seed yields of acceptable quality in annuals to great extent (Gupta *et al*. 1995). Effective pollination leading to higher seed set depends on environmental factors, particularly temperature and relative humidity (Hall 2001) high temperature coupled with the drying effects of low relative humidity affect female floral structures causing reduction in the duration of stigma receptivity, pollen germination on the stigmatic surface, and initial pollen tube growth (Prasad *et al*. 2001). Planting dates depend upon the environmental conditions and the geographical location of the area. Hence, it can not be standardised on national scale because of difference in the natural environmental conditions with variation in planting zone which influence the plant growth and flowering date. Therefore, keeping in view the importance of plant scheduling, attempts were made to examine an applied possibility of plant scheduling of garland/annual chrysanthemum by planting it at different

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dates to find out the optimum time of planting for flower and seed production.

## MATERIALS AND METHODS

The experiment was conducted at the experimental farm of the Department of Floriculture and Landscaping of Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during 2010-11 and 2011-12 (altitude of 1270 m amsl and latitude of $32^0$51'0" North and longitude of $77^0$11'30" East). The climate is sub-temperate with annual rainfall ranges between 800-1300 mm. Experiment was conducted on seedlings obtained from open pollinated seeds of garland chrysanthemum procured from the experimental farm of the Department of Floriculture and Landscaping. Nursery raising was done 1 to 1½ months before transplanting depending upon the planting date. Seedlings having four leaves on an average were planted after basal application of farmyard manure 5 kg/$m^2$ and fertilizers, i.e. half dose (15 g/$m^2$) of nitrogen and full doses (30 g/$m^2$) each of phosphorus and potassium. Nitrogen was applied as urea, phosphorus as single super phosphate and potassium as muriate of potash. Remaining half dose of nitrogen was applied after 30 days of transplanting. The transplanting of uniform sized seedlings was done at a spacing of 30 cm × 30 cm from plant to plant and row to row accommodating nine plants per square meter area. Transplanting was done on six different dates from 17 September to 1 December at an interval of 15 days during 2010 and 2011, six, viz. 17 September, 2 October, 17 October, 1 November, 16 November and 1 December. Pinching was done at 4 node stage by removing the apical growing portion of the plant in order to produce multi-stemmed plants. The experiment was laid out in randomized block design with six planting dates as treatments and four replications. The observations recorded on various growth and flowering parameters were subjected to analysis of variance (ANOVA) using randomized block design (Gomez and Gomez 1984). Plant growth parameters were recorded at the time of full flowering.

## RESULTS AND DISCUSSION

Planting dates significantly influenced the vegetative growth, flowering and seed yield of annual chrysanthemum (Table 1, 2 and 3). The maximum plant height (120.29 cm), plant spread (55.50 cm) and number of side stems/plant (16.23) were obtained with 17 September planting followed by 2 October planting (Table 1). As the weather conditions prevailing during the earlier planting were mild and it might have proved to be favourable for the growth of garland chrysanthemum. Warmer weather conditions prevailing during the vegetative growth of garland chrysanthemum might have resulted in more number of nodes before flowering which resulted in more number of stems/plant and finally increased plant spread as compared to other planting dates. Plant height, plant spread and number of side stems/plant decreased gradually with extending date of planting. With delay in planting date there was decrease in temperature which could be the reason for decrease in vegetative growth parameters. Jane *et al.* (2001) have also observed tallest plants of annual chrysanthemum with maximum spread with early planting (5 October). Best results obtained with early planting also get the support from Singh *et al*. (2011), who recorded maximum plant height, number of shoots/plant, percentage of flowering plants and number of flowers/plant in pyrethrum (*Tanacetum cinerariifolium*) when planting was commenced on 3 November, whereas with delay in planting (i.e. on 23 November and 13 December) a corresponding decline in all the parameters was observed. As temperature decreased, node number at flowering in African marigold, angelonia, blue salvia, browallia, cosmos, dahlia, dianthus, moss rose, petunia, snapdragon, verbena and zinnia decreased linearly (Blanchard and Runkle 2011).

Earliest bud formation (60.08 days) and flowering (95.08 days) was noticed in 17 September planting followed by 2 October planting (Table 2). September 17 planted crop might have flowered earlier due to congenial environmental conditions prevailing during the growth period, as temperature was comparatively mild, with increased humidity and sunshine hours during both the years. Delay in flowering of different bedding plants with decrease in mean daily temperature has also been reported by Blanchard and Runkle (2011). They reported that as temperature decreased from 20 to 15° C, the time to flower increased by

Table 1 Effect of planting dates on vegetative growth of garland chrysanthemum (*Chrysanthemum coronarium*)

| Planting date | Plant height (cm) | | | Plant spread (cm) | | | Number of side stems/plant | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | Pooled Mean | 2010 | 2011 | Pooled Mean | 2010 | 2011 | Pooled Mean |
| 17 September | 119.83 | 120.75 | 120.29 | 56.45 | 54.55 | 55.50 | 16.25 | 16.20 | 16.23 |
| 2 October | 116.55 | 117.50 | 117.03 | 53.95 | 52.78 | 53.36 | 16.00 | 15.90 | 15.95 |
| 17 October | 115.45 | 115.65 | 115.55 | 52.63 | 51.85 | 52.24 | 15.80 | 15.75 | 15.78 |
| 1 November | 108.25 | 106.50 | 107.38 | 47.60 | 46.33 | 46.96 | 15.70 | 15.58 | 15.64 |
| 16 November | 96.95 | 101.20 | 99.08 | 42.60 | 44.13 | 43.36 | 14.95 | 15.45 | 15.20 |
| 1 December | 90.23 | 97.45 | 93.84 | 41.65 | 42.10 | 41.88 | 14.00 | 14.75 | 14.38 |
| Mean | 107.88 | 109.84 | | 49.15 | 48.62 | | 15.45 | 15.60 | |
| CD (P=0.05) for | 6.10 | 5.81 | 3.89 | 2.24 | 3.75 | 2.07 | 0.75 | 0.83 | 0.52 |
| Year (Y) | | | NS | | | NS | | | NS |
| Year × planting date (Y×D) | | | NS | | | NS | | | NS |

Table 2 Effect of planting dates on flowering of garland chrysanthemum (*Chrysanthemum coronarium*)

| Planting date | Days taken for visible bud formation | | | Days taken for flowering | | | Duration of flowering (days) | | | Number of flowers/ stem | | | Flower size (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean |
| 17 September | 62.65 | 57.50 | 60.08 | 97.85 | 92.30 | 95.08 | 40.70 | 42.15 | 41.43 | 22.73 | 21.23 | 21.98 | 5.78 | 5.54 | 5.66 |
| 2 October | 69.30 | 58.40 | 63.85 | 105.85 | 98.70 | 102.28 | 39.85 | 39.70 | 39.78 | 21.28 | 19.64 | 20.46 | 4.67 | 5.34 | 5.00 |
| 17 October | 72.50 | 64.70 | 68.60 | 114.70 | 103.90 | 109.30 | 38.90 | 38.15 | 38.53 | 20.57 | 19.01 | 19.79 | 4.37 | 4.67 | 4.52 |
| 1 November | 71.85 | 75.25 | 73.55 | 113.95 | 112.50 | 113.23 | 38.60 | 37.75 | 38.18 | 16.10 | 18.51 | 17.30 | 3.43 | 4.39 | 3.91 |
| 16 November | 70.15 | 72.50 | 71.33 | 113.25 | 115.10 | 112.18 | 37.15 | 37.35 | 37.25 | 16.04 | 17.53 | 16.78 | 3.43 | 3.91 | 3.67 |
| 1 December | 68.80 | 71.50 | 70.15 | 104.45 | 106.00 | 105.23 | 36.30 | 35.00 | 35.65 | 15.89 | 16.50 | 16.19 | 3.35 | 3.46 | 3.41 |
| Mean | 69.21 | 66.64 | | 108.34 | 104.75 | | 38.58 | 38.35 | | 18.77 | 18.73 | | 4.17 | 4.55 | |
| CD (P=0.05) for | 3.09 | 5.18 | 2.86 | 3.42 | 3.94 | 2.63 | 1.31 | 1.98 | 1.23 | 2.90 | 1.66 | 1.55 | 0.26 | 0.45 | 0.26 |
| Year (Y) | | | 1.65 | | | 1.52 | | | NS | | | NS | | | 0.14 |
| Year × planting date (Y×D) | | | 4.05 | | | 3.71 | | | NS | | | 2.19 | | | 0.35 |

Table 3 Effect of planting dates on seed characters of garland chrysanthemum (*Chrysanthemum coronarium*)

| Planting date | Days taken for head formation | | | Number of heads/ plant | | | Number of seeds/ head | | | Seed yield/plant (g) | | | 1 000 seed weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean | 2010 | 2011 | Pooled mean |
| 17 September | 174.80 | 172.05 | 173.43 | 315.70 | 300.30 | 308.00 | 241.60 | 246.30 | 243.95 | 80.82 | 73.98 | 77.40 | 1.64 | 1.70 | 1.67 |
| 2 October | 172.40 | 171.80 | 172.10 | 301.70 | 285.70 | 293.70 | 239.65 | 240.35 | 240.00 | 74.20 | 67.54 | 70.87 | 1.53 | 1.69 | 1.61 |
| 17 October | 170.40 | 164.50 | 167.45 | 282.25 | 274.45 | 278.35 | 236.80 | 238.45 | 237.63 | 65.92 | 55.39 | 60.66 | 1.51 | 1.68 | 1.60 |
| 1 November | 161.95 | 164.50 | 163.23 | 267.76 | 260.55 | 264.16 | 230.14 | 235.78 | 232.96 | 51.51 | 49.31 | 50.41 | 1.54 | 1.67 | 1.60 |
| 16 November | 161.40 | 164.10 | 162.75 | 237.10 | 240.65 | 238.88 | 227.20 | 231.35 | 229.28 | 49.96 | 47.23 | 48.59 | 1.44 | 1.64 | 1.54 |
| 1 December | 157.10 | 159.95 | 158.53 | 223.30 | 227.70 | 225.50 | 213.08 | 220.10 | 216.59 | 44.74 | 43.25 | 44.00 | 1.34 | 1.58 | 1.46 |
| Mean | 166.34 | 166.15 | | 271.30 | 264.89 | | 231.41 | 235.39 | | 61.19 | 56.12 | | 1.50 | 1.66 | |
| CD (P=0.05) for | 2.13 | 1.98 | 1.40 | 10.53 | 16.10 | 9.07 | 7.49 | 6.40 | 4.62 | 9.23 | 6.83 | 5.31 | 0.09 | 0.07 | 0.06 |
| Year (Y) | | | NS | | | 5.24 | | | 2.66 | | | 3.06 | | | 0.04 |
| Year × planting date (Y×D) | | | 1.98 | | | NS | | | NS | | | NS | | | NS |

4-8 days in French marigold, dahlia, petunia, snapdragon, and viola; 11-18 days in African marigold, cosmos, dianthus, gazania, moss rose, petunia, verbena, and zinnia; and 20-38 days in angelonia, blue salvia, browallia, and pentas. Maximum duration of flowering (41.43 days), number of flowers per stem (21.98) and biggest flowers (5.66 cm in diameter) were also recorded in 17 September planted crop. Extended flowering may be ascribed to optimum temperature conditions at the time of flowering. These results are in conformity with Dhatt and Kumar (2010) who also reported maximum duration of flowering with early planting (20 October) of larkspur. More number of flowers/stem may be attributed to abundant growth in terms of more plant height, plant spread and number of stems/plant which in return increased photosynthetic area and ultimately increased photosynthetic assimilates. Increased flower yield with earlier plantings have also been reported by Sreekanth *et al.* (2008) in African marigold. Similarly an increase in flower size was observed which may be attributed to the fact that 17 September planted crop was exposed to most favourable climatic conditions for longer duration which might have resulted in translocation of more photosynthates to the sink, i.e. flower and which in turn helped in increased flower size.

Though, earliest head formation was noticed in 1 December (158.53 days) planted crop, quality and quantity of seed was comparatively low as in case of the other earlier plantings (Table 3). Early head formation in 1 December planted crop may be attributed to warmer temperature and low humidity prevailing at the time of head formation which also resulted in faster maturation of heads. The time from pollination initiation to seed maturity in sugarbeat was affected by temperature and time for seed maturity was found to be 71 days (61-90 days) at 19°C and 57 days (44-69 days) at 24°C (Snyder and Hogaboam 1963). September 17 planting resulted in maximum number of heads/plant (308.00), seeds/head (243.95), seed yield/plant (77.40 g) and 1 000 seed weight (1.67 g). More number of heads/plant could be attributed to abundant vegetative growth (plant height, plant spread and number of side stems/plant) and more number of flowers/stem in 17 September planted crop which ultimately resulted in more number of heads/plant. Similar results of increased number of capsules/plant in earlier plantings have also been reported by Sharma (2012) in pansy.

September 17 planted crop also resulted in maximum number of seeds/head, might be due to increased flower size which finally resulted in larger sized heads having more number of seeds. It further could be attributed to optimum temperature during active growth period with longer reproductive phase and better flower pollination due to increased activity of pollinators which in return produced heads with more number of seeds. In addition, effective sunshine hours decreased towards later date of planting during vegetative growth phase which lead to significant reduction in the floral and other phenological characters that lowered the seed yield. Similar results of increased seed production have been reported by Dubey *et al.* (2002) in cosmos and Sharma (2012) in pansy. More seed yield/plant with seeds having higher weight was also observed in 17 September planting. More seed yield in 17 September planted crop might have been resulted due to increased number of heads/plant along with more number of seeds/head. These findings are in line with findings of increased seed yield with earlier planting by Kumar and Kaur (2000) in phlox and Dhatt and Kumar (2007) in coreopsis. As regards 1 000 seed weight, it was also recorded maximum in 17 September planting which could be attributed to favourable temperature (comparatively cooler) conditions prevailing at the time of flowering and at the time of seed maturity which resulted in better seed filling. Considering that seed filling period prolongs under cool conditions, the plants produce more and larger seeds which are effective in increasing the yield (Wood *et al*. 1982). On the other hand seed yield decreased with extending planting time as effective sunshine hours increased during seed filling period affecting the yield negatively. These results are in line with findings of increased seed yield with early planting by Dhatt and Kumar (2010) in larkspur.

From the present findings it is evident that planting garland chrysanthemum on 17 September resulted in more luxuriant vegetative growth which ultimately resulted in improved flowering and seed production. Thus, it may be concluded that to get maximum flower and seed yields in garland chrysanthemum mid September is optimum planting time.

## REFERENCES

Arora J S. 1990. *Introductory Ornamental Horticulture*, p 203. Kalyani Publishers, New Delhi.

Blanchard Mathew G and Runkle Erik S. 2011. Quantifying the thermal flowering rates of eighteen species of annual bedding plants. *Scientia Horticulturae* **128**: 30–7.

Dhatt K K and Kumar Ramesh. 2007. Effect of planting time and spacing on growth, flowering and seed yield in *Coreopsis lanceolata* and *Coreopsis tinctoria. Journal of Ornamental Horticulture* **10**(2): 105–9.

Dhatt K K and Kumar Ramesh. 2010. Effect of planting time and growth regulators on growth and seed quality parameters of larkspur (*Delphinium ajacis* L.). *Journal of Ornamental Horticulture* **13**(1): 50–4.

Dubey R K, Kumar, Ramesh and Poonam. 2002. Effect of planting time and spacing on cosmos. *Journal of Ornamental Horticulture* **5**(2): 46–7.

Gomez L A and Gomez A A. 1984. *Statistical Procedures for Agricultural Research*, 3rd edn, p 680. John Wiley and Sons, Singapore.

Gupta P R D, Ghosh S K and Foning M S. 1995. Flower seed and bulb industry in India. (*In*) *Prospects of Floriculture in India*, pp 139–52. Kaul G L and Dadlani N K (Eds). Ministry of Agriculture, Government of India.

Hall A E. 2001. *Crop Responses to Environment*, p 228. CRC Press LLC, Boca Raton, Florida.

Jane R N, Kawarkhe V J and Jadhoo B J. 2001. Effect of different dates of planting on the flower yield of annual chrysanthemum (*Chrysanthemum coronarium*). *Orissa Journal of Horticulture*

**29**(2): 19–22.

Kumar, Ramesh and Kaur, Kiranjeet. 2000. Effect of planting time and cultivars on growth, flowering and seed yield in phlox (*Phlox drumondii*). *Seed Research* **28**(1): 23–6.

Meshram N, Badg S, Bhongle S A and Khiratkaz S D. 2008. Effect of bio-inoculants with graded doses of NPK on flowering, yield attributes and economics of annual chrysanthemum. *Journal of Soil and Crops* **18**(1): 217–20.

Mishra R L, Mishra S D and Mishra S. 2002. Annual chrysanthemum - A good host of root knot nematode (*Meloidogyne* spp). *Journal of Ornamental Horticulture* **5**(2): 65.

Prasad P V, Crauffurd P Q, Kakani V G, Wheeler T R and Boote K J. 2001. Influence of high temperature during pre and post-anthesis stages of floral development on fruit-set and pollen germination in peanut. *Australian Journal of Plant* Physiology **28**: 233–40.

Sharma, Rishu. 2012. 'Effect of seed priming and planting dates on growth and flowering of Pansy (*Viola* × *wittrockiana* Gams.).' M Sc thesis, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh.

Singh R, Dhaliwal H S and Joshi A S. 2009. Contract farming of floriculture in Punjab-problems and prospects. *Floriculture Today* **13**(11): 32–7.

Singh S, Singh M, Singh A K, and Verma R K. 2011. Effects of calliterpenone and $GA_3$ on the growth, yield, and pyrethrin contents of pyrethrum [*Tanacetum cinerariifolium* (Trevir.) Sch. Bip.] planted on different dates. *Journal of Horticultural Science and Biotechnology* **6**(1): 19–24.

Snyder F W and Hogaboam G J. 1963. Effect of temperature during anthesis and seed maturation on yield and germinability of sugar beet. *Journal of American Society of Sugar Beet Technologist* **12**(7): 545–63.

Sreekanth P, Padma M, Chandrasekhar R and Madhulety T Y. 2008. Effect of planting time, spacing and nitrogen levels on growth of African marigold (*Tagetes erecta*) cv. Sierra Orange. *Orissa Journal of Horticulture* **36**(1): 69–74.

Wood D W, Scott R K and Longded P C. 1982. Effects of seed crop ripening temperatures on bolting in the sugar beet root crop. *45th Winter Congress,* IIRB, Bruscelles; pp 15–24.