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Effect of Planting Dates, Mulching and Application of GA_3 on growth and flower yield of Marigold (*Tagetes erecta* L.) cv. 'Pusa Narangi Gainda'

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A B S T R A C T

Marigold is an important commercial annual flower belonging to family Asteraceae. Besides its aesthetic value; it has medicinal values as well and roots used as trap crop for nematodes. Flower production seems one of the viable options to explore with the great export potential and North Indian climatic conditions are favorable. In marigold, the flower yield and quality is greatly influenced by the planting time and flower crops are generally weak competitor and suffer from heavy infestation of many annual weeds, so use of mulch is a way to prevent weeds, along with application of plant growth regulator (GA_3) which known to increase flower size and yield. Marigold flower production is relatively remunerative endeavour as compared to other traditional seasonal crops grown by farmers in HP. So keeping in view, a field experiment was conducted at experimental farm of SST, Dr YSP UHF, Nauni, Solan during 2015-17 to study the effect of different planting dates (1st week of July, 3rd week of July & 1st week of August, at 15 days interval), mulching (Control, Black plastic mulch, Silver-black plastic mulch & Crop residue mulch) and GA_3 (0, 50, 100 & 150ppm) application for plant growth and flower quality of African marigold cv.'Pusa Narangi Gandha'. 1st week of July along with application of silver-black mulch and GA_3 @150 ppm gave more plant height, number of flowers and size of flower also witnessed significant improvement under these factors.

Introduction

Marigolds belong to the genus *Tagetes*. The generic name *Tagetes* was derived from the Greek word "*Tages*", the name of Estrucsch God, a demigod, known for the beauty. Genus *Tagetes* belongs to subfamily Asteroideae (or Tubuliflorae) of family Asteraceae (Panero and Funk, 2002). It is native to Central and South America especially Mexico. In India these were introduced by Portuguese (Gavhane *et al.*, 2004). Marigold spreads quickly because its cultivation is easy, have longer blooming period and beautiful flowers with an excellent shelf life. In India, African marigold flowers are sold in the market as loose for making garland. Flowers are traditionally used for offering in churches, temple and used in festival for beautification of landscape. It is highly suitable for making

flower beds in herbaceous border and also found ideal for newly planted shrubberies to provide colour and fill the gap in landscape. Both leaves and flowers possess medicinal values. It is used for its nematocidal (trap crop), cosmetic and medicinal properties. The essential oil of the flower contains antioxidants (Hashemabadi *et al.,* 2012) and pronounced odours which act as repellant for house fly.

Growth and flowering in marigold is generally governed by the day length and temperature. To meet out the increasing demand of flowers throughout the year, its staggered planting is required. Flower crops are generally weak competitor and suffer from heavy infestation of many annual weeds so use of mulching is a way to prevent weeds. Black plastic mulch, silver mulch and other plastic mulches are most commonly used in agriculture as they reduce the deterioration of soil by way of preventing the runoff and soil loss, minimize the weed infestation, and reduce water evaporation and nutrient losses. Gibberellic acid has been found to be beneficial in enhancement of the plant growth, flower yield and seed yield in marigold. It determines important physiological changes such as cell division and expansion, and induces and enhances flowering (Kumar *et al.,* 2013). Therefore, this experiment was undertaken to evaluate the effect of planting dates, mulches and application of GA_3 on growth and flowering parameters of marigold.

Materials and Methods

The experiment was conducted in the field and laboratory of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) for two consecutive years 2015 to 2017. An experiment based on Split plot design with three planting dates (1st week of July, 3rd week of July & 1st week of August, at 15 days interval), four levels of mulching (Control, Black plastic mulch, Silver-black plastic mulch & Crop residue mulch) and four levels of GA_3 (0, 50, 100 & 150ppm after 45 days of transplanting) in African marigold cv.'Pusa Narangi Gandha'. The level of significance was tested for different variables at 5 percent level. The data was collected and analyzed for vegetative characteristics in both the years after pooling. The characteristics which are recorded were plant height, days taken to first flowering, number of flowers and flower size.

Results and Discussion

Plant height (cm)

The pooled data pertaining to the plant height have been depicted in the Table 1. A perusal of data clearly reveals that planting dates, mulches and GA_3 applications as well as their interactions have influenced plant height significantly. As regards planting dates (P), tallest plants (82.30 cm) were produced in P_1 i.e. when seedlings were transplanted in first week of July (1st July). The plants which were transplanted in first week of July (1st July) might have got sufficient time for putting up better vegetative growth as compared to later planting before the onset of autumn season after which growth of plants might have been reduced. The results are in close conformity with the findings of Rohith (2014) who reported maximum plant height in African marigold when planting was commenced in July.

The use of silver-black plastic mulch (M_4) has resulted in maximum plant height (80.49 cm) and found to be significantly highest over all other types of mulches. This may be ascribed to the fact that use of silver-black plastic mulch might have provided a favourable environment for the growth and development of plants. The results of the present investigation are also in close conformity with

the findings of Verma (2014) who has reported more plant height in bell pepper with the use of silver-black plastic mulch.

As regards the application GA_3, tallest plants (74.47 cm) were produced with the application of GA_3 @ 150 ppm and found to be significantly higher in comparison to all other applications of GA_3. This might be ascribed to the fact that applications of GA_3 particularly at higher concentrations might have enhanced the height of plants as a consequence of enlargement of cells, faster cell division and tissues as well. The results are in close conformity with the findings of Patil *et al.,* (2016) have observed maximum plant height in African marigold when GA_3 was applied @ 250 ppm.

The interaction of planting dates (P) and mulches (M) exhibited maximum plant height (88.71 cm) in the interaction, $P_1 \times M_4$ i.e. when seedlings were transplanted in the first week of July (1^{st} July) and mulched with silver-black plastic sheet and it was found to be significantly higher over all other interactions of planting dates and mulches. Similar results have been documented by Bajad (2017), who reported maximum plant height in China aster when the planting was commenced in the mid June and plants were mulched with silver black plastic sheet.

As regards the interaction of planting dates (P) and GA_3 applications (G), the plants of maximum height (85.19 cm) were produced in the interaction, $P_1 \times G_4$ i.e. when transplanting of seedlings was accomplished in the first week of July (first July) and plants sprayed with GA_3 @150 ppm after 45 days of transplanting and found to be significantly taller over all other interactions of planting dates and GA_3 doses.

The interaction of mulching (M) and GA_3 applications (G) reveals maximum plant height (83.61 cm) in the interaction, $M_4 \times G_4$ i.e. mulching of plants with silver-black plastic sheet spray and spraying of plants with GA_3 @ 150 ppm after 45 days of transplanting and found to be significantly superior in comparison to all other interactions of mulching and GA_3 doses. However, minimum height of plants (58.94 cm) was observed in the interaction, $M_1 \times G_1$ i.e. when no applications of mulches and GA_3 were practiced.

The interaction of planting dates (P) × mulching (M) × GA_3 applications (G) reveals maximum height of plants (90.63 cm) in the interaction, $P_1 \times M_4 \times G_4$ i.e. when seedlings were transplanted in the first week of July (1^{st} July) and mulched with silver- black plastic sheet coupled with the spraying of GA_3 @ 150 ppm after 45 days of transplanting. The interactions might have proved to be a beneficial for plant height which could be ascribed to the fact that the transplanting of marigold seedlings commenced during the earliest date i.e. first July might have established comparatively much earlier and could put up better growth vegetative due to more congenial weather conditions during that period and application of mulches in general and particularly with the use of silver-black plastic mulch might have contributed significantly for the further improvement of micro climate surrounding the plants and soil. Consequently, the plant growth was improved. The application of GA_3 particularly at higher concentrations have given the further encourage to growth and development of plants. Hence, the taller plants were produced in the said interaction.

Days taken to first flowering (days)

The pooled data on days taken to first flowering have been presented in Table 2 and clearly reveal that planting dates, mulches and GA_3 applications as well as the interaction

between planting dates (P) and mulching (M) have influenced number of days taken to first flowering significantly. However, all other interactions were found to be non- significant.

As regards the effects of planting dates (P), minimum time taken to first flowering (60.19 days) was recorded, when the transplanting of seedlings was accomplished in the first week of July (1st July) and found to be significantly lowest in comparison to other planting dates. These results are in conformity with the findings of Kaushal *et al.,* (2014) in China aster who observed minimum days taken for flowering (91.67) in China aster when the seedling was planted earlier (9th April).

The use of silver-black plastic mulch (M_4) has resulted in minimum days to flowering (52.41 days) and found to be significantly the lowest as compared to all other types of mulches. Similar results have also been reported by Dickerson (2012) who observed earliest flowering and production of marketable fruits in bell paper using silver-reflective mulch

The application effects of GA_3 @ 150 ppm resulted in the minimum days to first flowering (60.54 days) and found to be significantly lowest over all other applications of GA_3. Increased photosynthesis and respiration in GA_3 treated plants could also be the reasons for early flowering. Similar results were also reported by Patil *et al.,* (2016) in African marigold who, observed earliness in first flower bud initiation and 50% flowering when treated with highest dose of GA_3 (@ 300 ppm).

The interaction of planting dates (P) and mulches (M) recorded minimum days to flowering (51.19 days) in the interaction, $P_1 \times M_4$ i.e. when seedlings were transplanted in the first week of July (1st July) and mulched with silver-black plastic sheet and found to be significantly lower over all other interactions of planting dates and mulches. This could be attributed to the fact that said interaction of planting dates and mulching might had created suitable conditions for the growth and flowering of marigold plants. Also, it is a well established fact that coloured polythene mulch possess more capacity to regulate soil temperature and soil moisture content as well as other physiochemical and biological properties so much so, silver black plastic mulch reflects the sun's heat.

Number of flowers per plant

The pooled data on production of flowers per plant have been contained in Table 3 and closely depicts that planting dates, mulches and GA_3 applications as well as their interactions have influenced production of number of flowers per plant significantly.

As regards the effects of planting dates (P), maximum number of flowers per plant (48.77) was recorded, when the transplanting of seedlings was accomplished in first week of July (1st July) and found to be significantly higher in comparison to other planting dates. The results are in conformity with the findings of Lakshmi *et al.,* (2014) who observed maximum number of flowers per plant in October planting under Jammu conditions (J&K) in African marigold.

The use of silver-black plastic mulch (M_4) resulted in the production of maximum number of flowers per plant (46.99) and found to be significantly highest over all other types of mulches. The results are in agreement with the report of Bajad (2017) who observed maximum number of flowers per plant (47.89) using silver plastic mulch in China aster.

The foliar application of GA_3 @ 150 ppm recorded maximum number of flowers per plant (42.94) and they were found to be significantly highest over all other doses of

GA_3 this might be due to increased production of branches at early stage of growth and this in turn resulted in the accumulation of maximum amount of carbohydrates which was utilized for proper flower bud differentiation. The results are in conformity with the findings of Sunitha *et al.,* (2007) who recorded maximum number of flowers per plant when plants were sprayed with higher dose of GA_3 i.e. @ 200 ppm in African marigold under Karnataka conditions.

The interaction effects of planting dates (P) and mulches (M) indicated that the highest number of flowers per plant (55.36) was recorded in the interaction, $P_1 \times M_4$ i.e. planting of seedlings in the first week of July (1^{st} July) and mulching with silver-black plastic sheet, and they were found to be significantly higher over all other interactions of planting dates and mulches. This could be attributed to the fact that said interaction of planting dates and mulching might have created congenial conditions during the period of crop growth. The conditions like availability of more nutrients, sunlight and soil moisture retention etc. have also contributed for increasing the flower yield per plant. The results of present study are in conformity with the work of Bajad (2017) who reported maximum number of flowers per plant in China aster planted in mid of June and mulching with silver black plastic sheet.

As regards the interaction effects of planting dates (P) and GA_3 applications (G), maximum number of flowers per plant (50.15) was produced in the interaction, $P_1 \times G_4$ i.e. when the seedlings were transplanted in the first week of July (1^{st} July) and spraying of plants with GA_3 @150 ppm after 45 days of transplanting and observed to be significantly higher as compared to all other interactions of planting dates and GA_3 doses. This could be because of the fact that during the first fortnight of July the weather conditions might be very congenial for the growth and development of plants. Whereas, the application of GA_3 @ 150 ppm gave further impetus to growth of plants by enhancing the cell division, cell elongation and production of more number of branches per plant, which later on become reproductive. Hence, more number of flowers per plant.

The interaction effects of mulching (M) and GA_3 applications (G) revealed maximum number of flowers per plant (48.99) in the interaction, $M_2 \times G_2$ i.e. mulching with crop residue mulch and spraying of plants with GA_3 @ 50 ppm after 45 days of transplanting and found to be significantly highest in comparison to all other interactions of mulching and GA_3 applications. This might be due to enhanced growth and production of more branches with higher number of flower buds, vigorous growth of plants due to less competition with weeds and availability of maximum nutrients under silver black plastic sheet and spraying of plants with higher concentrations of GA_3 (@ 150 ppm).

The interaction of planting dates (P), mulching (M) and GA_3 applications (G) exhibited maximum number of flowers per plant (56.67) in the interaction, $P_1 \times M_4 \times G_4$ i.e. when seedlings were transplanted in first week of July and mulched with silver- black plastic sheet along with the spraying of GA_3 @ 150 ppm after 45 days of transplanting. This was found to be significantly superior in comparison to all other interactions. This could be ascribed to the fact that the transplanting of marigold seedling commenced during the earliest date (1^{st} July) might have established comparatively much earlier and could put up better vegetative growth. The application of mulches in general and particularly, the use of silver black plastic mulch might have contributed for the further improvement of growth and flowering of plants through micro climate surrounding the plants and soil.

Table.1 Effect of planting dates, mulching and GA_3 application on plant height (cm) of marigold

Planting dates / GA_3 doses	P_1					P_2					P_3					Mulching				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
G_1	72.68	75.38	82.57	87.15	**79.44**	53.27	57.44	72.09	75.94	**64.69**	50.87	54.82	64.86	70.09	**60.16**	58.94	62.55	73.18	77.73	**68.10**
G_2	75.09	78.30	84.98	88.40	**81.69**	54.15	61.76	74.88	78.90	**67.42**	51.75	60.64	65.85	72.32	**62.64**	60.33	66.90	75.24	79.87	**70.59**
G_3	76.81	80.17	85.82	88.65	**82.86**	56.12	63.45	75.98	80.30	**68.96**	53.37	61.63	67.95	73.34	**64.07**	62.10	68.42	76.58	80.77	**71.97**
G_4	79.68	82.77	87.67	90.63	**85.19**	56.65	71.21	79.20	85.39	**73.11**	54.12	61.80	69.78	74.82	**65.13**	63.48	71.93	78.88	83.61	**74.47**
Mean	**76.06**	**79.16**	**85.26**	**88.71**	**82.30**	**55.05**	**63.47**	**75.54**	**80.13**	**68.55**	**52.53**	**59.72**	**67.11**	**72.64**	**63.00**	**61.21**	**67.45**	**75.97**	**80.49**	

C.D. at 5% for:

Planting dates:0.86
Mulching:0.56
GA_3:0.56
Planting dates × Mulching:0.98
Planting dates × GA_3:0.98
Mulching × GA_3 :1.13
Planting dates × Mulching × GA_3:1.19

Treatment details :
Planting dates : 3
P_1: first week of July (first July)
P_2: 3rd week of July (16th July)
P_3: first week of August (first August)
Mulches : 4
M_1: No mulch (control)
M_2: Crop residue mulch
M_3: Black plastic mulch
M_4:Silver- black plastic mulch

GA_3 applications:4
G_1: Control (i.e. only water spray)
G_2: GA_3 @ 50 ppm
G_3: GA_3 @ 100 ppm
G_4: GA_3 @ 150 ppm

Table.2 Effect of planting dates, mulching and GA_3 application on days taken for first flowering (days) of marigold

Planting dates / GA_3 doses	P_1					P_2					P_3					Mulching				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
G_1	69.84	67.76	61.62	52.34	**62.89**	75.13	73.43	68.50	55.20	**68.07**	77.08	76.32	70.57	54.59	**69.64**	74.02	72.50	66.90	54.04	**66.86**
G_2	68.22	65.78	59.37	51.50	**61.22**	72.72	71.34	62.76	54.58	**65.35**	73.42	72.21	66.64	53.65	**66.48**	71.45	69.78	62.92	53.24	**64.35**
G_3	66.80	63.70	57.30	50.93	**59.68**	70.85	69.91	60.29	52.45	**63.37**	69.83	68.42	63.24	52.11	**63.40**	69.16	67.34	60.27	51.83	**62.15**
G_4	64.84	60.57	52.56	50.01	**56.99**	72.44	66.50	56.06	51.59	**61.65**	66.78	70.46	64.65	49.98	**62.97**	68.02	65.84	57.75	50.53	**60.54**
Mean	**67.42**	**64.45**	**57.71**	**51.19**	**60.19**	**72.79**	**70.30**	**61.90**	**53.45**	**64.61**	**71.78**	**71.85**	**66.27**	**52.58**	**65.62**	**70.66**	**68.87**	**61.96**	**52.41**	

C.D. at 5% for:

Planting dates: 1.77
Mulching: 1.03
GA_3: 1.03
Planting dates × Mulching: 1.79
Planting dates × GA_3: NS
Mulching × GA_3: NS
Planting dates × Mulching × GA_3: NS

Treatment details :
Planting dates : 3
P_1: first week of July (first July)
P_2: 3rd week of July (16th July)
P_3: first week of August (first August)
Mulches : 4
M_1: No mulch (control)
M_2: Crop residue mulch
M_3: Black plastic mulch
M_4:Silver- black plastic mulch

GA_3 applications:4
G_1: Control (i.e. only water spray)
G_2: GA_3 @ 50 ppm
G_3: GA_3 @ 100 ppm
G_4: GA_3 @ 150 ppm

Table.3 Effect of planting dates, mulching and GA_3 application on number of flowers per plant of marigold

Planting dates / GA_3 doses	P_1					P_2					P_3					Mulching				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
G_1	41.85	44.99	48.84	52.83	**47.13**	31.72	33.55	34.37	42.57	**35.55**	30.41	32.82	40.35	44.20	**36.95**	34.66	37.12	41.19	46.53	**39.87**
G_2	42.93	45.15	50.01	55.44	**48.38**	32.72	34.32	35.41	44.77	**36.80**	31.08	33.99	42.18	46.77	**38.51**	35.58	37.82	42.53	48.99	**41.23**
G_3	43.45	47.13	50.64	56.51	**49.43**	33.29	35.14	39.52	45.72	**38.42**	31.17	34.14	42.07	34.60	**35.49**	35.97	38.80	44.08	45.61	**41.11**
G_4	44.39	48.11	51.43	56.67	**50.15**	36.93	40.07	41.91	46.37	**41.32**	32.33	36.05	43.57	37.47	**37.36**	37.89	41.41	45.64	46.84	**42.94**
Mean	**43.15**	**46.35**	**50.23**	**55.36**	**48.77**	**33.66**	**35.77**	**37.80**	**44.86**	**38.02**	**31.25**	**34.25**	**42.04**	**40.76**	**37.08**	**36.02**	**38.79**	**43.36**	**46.99**	

C.D. at 5% for:

Planting dates	:	1.42
Mulching	:	0.96
GA_3	:	0.96
Planting dates × Mulching	:	0.67
Planting dates × GA_3	:	0.67
Mulching × GA_3	:	1.93
Planting dates × Mulching × GA_3	:	3.34

Treatment details :
Planting dates : 3
P_1: first week of July (first July)
P_2: 3rd week of July (16th July)
P_3: first week of August (first August)
Mulches : 4
M_1: No mulch (control)
M_2: Crop residue mulch
M_3: Black plastic mulch
M_4:Silver- black plastic mulch

GA_3 applications:4
G_1: Control (i.e. only water spray)
G_2: GA_3 @ 50 ppm
G_3: GA_3 @ 100 ppm
G_4: GA_3 @ 150 ppm

Table.4 Effect of planting dates, mulching and GA_3 application on size of flowers (cm) of marigold

Planting dates / GA_3 doses	P_1					P_2					P_3					Mulching				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
G_1	5.04	5.36	5.47	6.22	**5.52**	4.12	4.54	5.27	5.50	**4.86**	3.96	4.63	4.50	4.81	**4.47**	4.37	4.84	5.08	5.51	**4.95**
G_2	5.16	5.60	5.79	6.62	**5.79**	4.23	4.58	5.33	5.50	**4.91**	4.58	4.44	4.69	4.86	**4.64**	4.66	4.87	5.27	5.66	**5.11**
G_3	5.35	5.63	5.94	6.85	**5.94**	4.27	4.67	5.36	5.66	**4.99**	4.50	4.54	4.77	5.03	**4.71**	4.71	4.94	5.36	5.85	**5.21**
G_4	5.60	5.94	6.46	7.63	**6.41**	4.41	4.69	5.38	6.12	**5.15**	4.56	4.51	4.92	5.43	**4.85**	4.85	5.04	5.59	6.39	**5.47**
Mean	**5.29**	**5.63**	**5.92**	**6.83**	**5.91**	**4.26**	**4.62**	**5.33**	**5.69**	**4.98**	**4.40**	**4.53**	**4.72**	**5.03**	**4.67**	**4.65**	**4.93**	**5.32**	**5.85**	

C.D. at 5% for:

Planting dates:1.29
Mulching:0.10
GA_3 :0.10
Planting dates × Mulching:0.17
Planting dates × GA_3:0.17
Mulching × GA_3:1.99
Planting dates × Mulching × GA_3: NS

Treatment details :
Planting dates : 3
P_1: first week of July (first July)
P_2: 3rd week of July (16th July)
P_3: first week of August (first August)
Mulches : 4
M_1: No mulch (control)
M_2: Crop residue mulch
M_3: Black plastic mulch
M_4:Silver- black plastic mulch

GA_3 applications:4
G_1: Control (i.e. only water spray)
G_2: GA_3 @ 50 ppm
G_3: GA_3 @ 100 ppm
G_4: GA_3 @ 150 ppm

In addition, application of GA_3 particularly at higher concentrations increased the overall vegetative growth of plants by facilitating more photosynthetic and metabolic activities resulting in more transport and utilization of photosynthetic products which ultimately resulted in maximum number of flower per plant.

Size of flowers (cm)

A cursory glance of pooled data in Table 4 indicated that planting dates, mulches and GA_3 applications as well as their two way interactions have influenced size of flowers significantly.

As regards the effect of plant dates (P), maximum flower size (5.91 cm) was recorded when seedlings were transplanted in first week of July (1st July) and found to be significantly higher in comparison to other planting dates. This might be due to the reason that prevailing climatic conditions during said period must be quite favourable and thus, resulted in increased photosynthesis as well as and translocation of photosynthates to the sink (flowers) there by leading to increased flower size. Larger size flowers in African marigold have been reported by Lakshmi *et al.*, (2014) with early planting under Jammu conditions (J & K).

The use of silver-black plastic mulch (M_4) resulted in bigger size flowers (5.85cm) and found to be significantly larger over all other types of mulches used. This could be due to the fact that aluminum colour polythene sheet has more capacity to regulate soil temperature and least weed infestation was seen under polythene mulch treatment, besides creating a more favourable micro-climate for the growth and flowering of plants in comparison to other mulches. Similar results were reported by Bajad (2017) in China aster with the use of silver-black mulch.

As regards the effects of GA_3, maximum flower size (5.47 cm) was recorded with the foliar application of GA_3 @ 150 ppm and found to be significantly higher over all other doses of GA_3. The application of GA_3 particularly at higher doses seems to affect the flower size by forming a sink at a position where it accumulates and draws all the available photosynthates towards this site which might have resulted in production of large size flowers. The results of present study are in line with the findings of Sharma and Joshi (2015) who observed maximum size of flowers in China aster when plants were sprayed with highest dose of GA_3 @ 250 ppm.

Among the interactions of planting dates (P) and mulch (M), the largest flower size (6.83 cm) was recorded in the treatment combination, $P_1 \times M_4$ i.e. transplanting in the first week of July and mulching of plants with silver-black plastic sheet, which was found to be significantly higher over all other interactions of planting dates and mulches. This could be attributed to the fact that said interaction of planting dates and mulching might have created favourable conditions like moderate temperature, better retention of soil moisture and availability of proper nutrients during the period of crop growth and flowering. Hence, ultimately encouraging for the production of bigger sized flowers.

As regards the interaction effects of planting dates (P) and GA_3 applications (G), the maximum flower size (6.41 cm) was recorded in the interaction, $P_1 \times G_4$ i.e. when transplanting of seedlings was accomplished in the first week of July (1st July) and spraying of plants with GA_3 @ 150 ppm after 45 days of transplanting. This could be attributed to the fact that during first week of July, the prevailing weather conditions must be congenial for the better vegetative and reproductive growth of plants. Whereas,

application of GA_3 @ 150 ppm at juvenile phase might lead to increased cell division and shorter cell cycle, allowed the plants to grow more vigorously and profused flowering.

The interaction effects of mulching (M) and GA_3 applications (G) revealed maximum flower size (6.39 cm) in the interaction, $M_4 \times G_4$ i.e. mulching with silver-black plastic sheet and spraying of plants with GA_3 @150 ppm after 45 days of transplanting and it was found to be significantly highest in comparison to all other interactions of mulching and GA_3 applications. This might be due to the fact that silver-black colour polythene sheet has more capacity to regulate soil temperature than other mulch materials. In addition to this, less weed infestation was seen under silver-black polythene mulch treatment, besides creating a more favourable microclimate for the growth and flowering of plants in comparison to other mulches and when plants sprayed with higher concentration of GA_3. Thus, plants grew better and flowering was improved considerably especially the size of flower increased notably. Srikanth (2011) also, reported maximum flower size in China aster cv. 'Kamini' when plants mulched with black polythene sheet (40 µ) and sprayed with GA_3 @ 150 ppm.

In conclusion, the observations recorded from the present investigation revealed that marigold seedlings be transplanted in the first week of July (1st July) and mulched with silver- black plastic sheet and also sprayed with GA_3 @ 150 ppm after 45 days of transplanting to obtain best growth, flowering and flower yield.

References

Bajad AA. 2017. Studies on the effect of mulching materials on china aster planted during different times of the year. Ph.D. Thesis submitted to Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan.

Dickerson GW. 2012. Commercial vegetable production with plastic mulches. *Cooperative Extension Service* New Mexico State University 245:1-4.

Gavhane P B, Kore V N, Dixit A J and Gondhali B V. 2004. Effect of graded doses of fertilizers and polythene mulches on growth, flower quality and yield of marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *The Orissa Journal of Horiculture* 32(1): 35-37.

Hashemabad DM, Zaredost F, Zayabari M B, Zarchini M, Kaviani B, Solimandarabi M J, Torkashyand M and zarchini S. 2012. Influence of phosphate bio-fertilizer on quantity and quality features of marigold (*Tagetest erecta* L.). *Australian Journal of Crop Sciences* 6(6): 1101-1109.

Kaushal S, Dilta BS, Chaudhary SVS, Sharma BP and Gupta YC. 2014. Effect of planting dates on growth and flowering of china aster (*Callistephus chinensis* (L) Nees. *International Journal of Farm Sciences* 4(1):60-71.

Kumar R, Ahmed N, Singh D B, Sharma OM, Shiv Lal and Salmani MM. 2013. Enhancing blooming period and propogation coefficient of tulip (*Tulipa gesneriana* L.) using growth regulators. *African journal of Biotechnology*. 12 (2):168-174.

Lakshmi, Pandey RK, Dogra S, Laishram N, Bhat D, Singh A and Jamwal S. 2014. Studies on effects of planting dates and spacing in African marigold (*Tagetes erecta* L.). *Progressive Horticulture* 46(1):149-152.

Panero J L and Funk V A. 2002. Toward a phylogenetic subfamilial classification for the Compositae (Asteraceae). *Proceedings of the Biological Society of*

Washington 115(4): 909- 922.

Patil D, Chopde N, Lokhande S and Bhande MH. 2016. Studies on response of African marigold to plant growth regulators for seed production. *Plant Archives*, 16(1): 423-425

Rohith C. 2014. Impact of planting dates, micronutrients and GA_3 on flower and seed production in African marigold (*Tagetes erecta* L.). M.Sc. Thesis submitted to Horticultural College and Research Institute, Venkataramanna gudem, and West Godavari. Dr. Y.S.R. Horticultural University.

Sunitha HM, Hunje BSR, Vyakaranahal and Bablad HB. 2007. Effect of pinching and plant growth regulators on plant growth, flowering and seed yield in African marigold (*Tagetes erecta* L.). *Journal of Ornamental Horticulture.* 10(2): 91-95.

Srikanth LG. 2011. Influence of growth regulators on growth, flowering and yield of China aster. M.Sc. Thesis submitted to Department of Horticulture, University of Agricultural Sciences, Dharwad, Banglore.

Sharma MK and Joshi KI. 2015. Effect of foliar spray of GA_3 and NAA on growth flowering and yield of china aster (*Callistephus chinensis*) cultivars. *International Journal of Agriculture Science and Research* 5(4) : 105-110.

Verma R. 2014. Effect of mulching and planting geometry on seed production in bell pepper (*Capsicum annuum* L.). M.Sc. Thesis, submitted to Dr Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan (HP).

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