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Effect of plant Bio-Regulatores on Growth, Flowering and Seed yield in China Aster (*Callistephus chinensis* L. Nees) CV. Kamini

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ABSTRACT

A field experiment was conducted to study the effect of plant bio regulators on growth, flowering and seed yield in China aster cv. Kamini at College of Horticulture, Rajendranagar, Hyderabad during rabi, 2013-14. The experiment was laid in randomized block design and replicated twice. Plant growth regulators *viz.*, GA_3 salicylic acid, maleic hydrazide, alar and paclobutrazol were used in the experiment. The treatments were imposed as foliar sprays twice at 20 and 35 days after transplanting. The observations on growth parameters were recorded at three stages of plant growth *viz.*, 30, 60 and 90 DAT. GA_3 200 mg/l spray recorded significantly higher plant height (60.10 cm), number of primary branches per plant (24.60) and number of secondary branches per plant (61.45) at 90 DAT, number of flower's per plant (84.96), flower yield per plant (109.66 g), flower yield per hectare (16.58 t), seed yield per plant (9.98 g), seed yield per ha (1509.31 kg) and 1000 seed weight (2.01 g). GA_3 200 mg/l foliar spray was found to be at par with SA 200 mg/l in respect of number of primary branches (23.86), flower yield per hectare (15.90 t), seed yield per plant (9.85 g) and seed yield per hectare (1489.65 kg). SA 200 mg/l foliar spray could be recommended for increased growth, flower and seed yield in China aster cv. Kamini as it is more cheaper than GA_3.

Key words : Flower yield, GA_3, SA, Seed yield

INTRODUCTION

China aster (*Callistephus chinensis* L. Nees) belongs to the family Asteraceae and is one of the most popular flowering annuals. It is a hardy and free blooming annual grown all over the world on account of its ease of cultivation, greater diversity in forms and colours and their long vase life has made them popular as cut flower among the growers. The growing popularity of China aster in most of the major cities in India has led to its cultivation as annual commercial crop for cut flower. Increase in flower production both qualitatively and quantitatively and reduction in the plant form the important objectives to be reckoned in commercial flower cultivation as tall plant lodge easily resulting in reduced flower size and yield per plant. Although environment and genetic factors greatly affect the yield and quality, exogenous application of growth regulators plays a major role on growth i.e., plant height and number of branches, yield and quality parameters of China aster (Bose *et al.*, 1998). Exogenous application of plant growth regulators infact has revolutionized agriculture, more particularly horticulture in industrially developed countries. Growth regulators application have been an essential part of floriculture and utilization of growth substances constituted one of the most important advances in agro-technology for improving the yield and quality parameters of flowers. The plant growth regulators have been used in floriculture to manipulate plant growth in a desired direction (Sharma *et al.*, 2001). However, not much work has been done in Andhra Pradesh under Hyderabad conditions to exploit the potential benefits of plant growth regulators over growth and flowering traits of China aster. Keeping these points in view the present work has been proposed to study the response of various plant growth regulators on growth and yield of China aster cv. Kamini.

MATERIALS AND METHODS

The experiment was conducted at the College of Horticulture, Rajendranagar, Hyderabad, Andhra Pradesh during the year 2013-14. The experiment was laid out in randomized block design with 16 treatments (GA_3 at 100 mg/l, 150 mg/l and 200 mg/l, salicylic acid (SA) at 100 mg/l, 150 mg/l and 200 mg/l, maleic hydrazide (MH) at 900 mg/l, 1000 mg/l and 1100 mg/l, alar at 1000 mg/l, 1250 mg/l and 1500 mg/l, paclobutrazol at 25 mg/l, 50 mg/l and 75 mg/l and control) and replicated twice. The treatments were imposed as foliar sprays at 20 and 35 days after transplanting.

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Seedlings of China aster cv. Kamini were raised on well prepared nursery bed and transplanted to main field at 35 DAS. Well decomposed FYM @ 20 t ha $^{-1}$ was incorporated during the last ploughing. Phosphorous and potassium @ 80 and 120 kg ha $^{-1}$ were applied in the form of single super phosphate and muriate of potash, respectively as basal dose. Nitrogen @ 120 kg $^{-1}$ was applied in the form of urea in two splits, once at the time of transplanting and second one month after transplanting. Standard cultural practices were followed during the entire crop period. The observations on growth (at 30,60 and 90 DAT), flower and seed parameters were recorded and analysed statistically as per the procedure described by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Vegetative parameters: The data recorded on plant height at 30, 60 and 90 DAT as influenced by different concentrations of plant growth regulators is presented in Table 1. The maximum plant height was recorded with gibbrellic acid at 200 mg/l (36.38 cm) and was at par with salicylic acid at 200 mg/l (35.90 cm) and salicylic acid at 150 mg/l (34.76 cm). On the other hand, minimum plant height (15.47 cm) was recorded with maleic hydrazide at 1100 mg/l which was at par with alar at 1500 mg/l (15.75 cm), paclobutrazol at 75 mg/l (15.91cm), maleic hydrazide at 1000 mg/l (16.63cm) and alar at 1250 mg/l (17.70 cm). The plant height recorded at 60 DAT ranged from 21.13 cm to 48.68 cm. Maximum plant height (48.68 cm) was recorded with gibberellic acid at 200 mg/l which was at par with salicylic acid at 200 mg/l and 150 mg/l (46.52 and 45.10 cm, respectively). Maleic hydrazide at 1100 mg/l recorded minimum plant height (21.13cm) and was at par with alar at 1500 mg/l (21.56 cm). At 90 DAT, the maximum plant height (60.10 cm) was recorded with gibbrellic acid at 200 mg/l followed by salicylic acid at 200 mg/l (55.73 cm) and gibbrellic acid at 150 mg/l (54.80 cm). Increase in the concentration of GA_3 and salicylic acid increased the plant height as evident from the data recorded at various stages of plant growth.

This may be attributed to the capacity of GA_3 to induce mRNA synthesis pertaining to hydrolytic enzymes and to increase cell enlargement eventually leading to increased length of internodes. SA was stated to have a direct involvement in plant growth by promoting ion uptake (Hayat *et al.*, 2007). Similar results of increased plant height were recorded due to GA_3 in China aster by Prabhat Kumar *et al*. (2003), Nandre *et al*. (2009) and Padmini *et al*. (2013). Maleic hydrazide at all the concentrations under study markedly reduced the plant height. The growth suppression by MH may be due to its action as an anti-auxin with dwarfing effect on plant growth and nullification of apical dominance and also it could be due to disturbed carbohydrate and mineral metabolism. The results are in conformity with the findings of Joshi *et al.* (2006) in China aster.

TABLE 1: Effect of plant growth regulators on plant height (cm) at 30, 60 and 90 days after transplanting (DAT) in China aster cv. Kamini

Treatment (T)	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
(T_1) Gibberellic acid 100 mg/l	29.95	40.90	52.50
(T_2) Gibberellic acid 150 mg/l	33.43	43.46	54.80
(T_3) Gibberellic acid 200 mg/l	36.38	48.68	60.10
(T_4) Salicylic acid 100 mg/l	32.13	44.30	51.40
(T_5) Salicylic acid 150 mg/l	34.76	45.10	53.60
(T_6) Salicylic acid 200 mg/l	35.90	46.52	55.73
(T_7) Maleic hydrazide 900 mg/l	18.90	26.20	35.20
(T_8) Maleic hydrazide 1000 mg/l	16.63	24.36	32.80
(T_9) Maleic hydrazide 1100 mg/l	15.47	21.13	28.00
(T_{10}) Alar 1000 mg/l	19.95	25.80	32.80
(T_{11}) Alar 1250 mg/l	17.70	23.23	31.23
(T_{12}) Alar 1500 mg/l	15.75	21.56	30.80
(T_{13}) Paclobutrazol 25 mg/l	20.67	32.22	37.20
(T_{14}) Paclobutrazol 50 mg/l	18.86	28.20	32.20
(T_{15}) Paclobutrazol 75 mg/l	15.91	25.10	30.10
(T_{16}) Control (water spray)	18.55	25.75	29.75
S.Em.±	0.87	1.28	1.25
C.D. at 5%	2.63	3.90	3.82

The data recorded on number of primary and secondary branches at 30, 60 and 90 DAT is presented in Table 2. The maximum number of primary branches per plant was recorded with gibbrellic acid at 200 mg/l (11.56) and was at par with SA 200 mg/l (9.55). However control (water spray) recorded minimum number of primary branches (4.10). The data on number of primary branches per plant at 60 DAT shows that significantly, maximum number of primary branches per plant (21.73) was recorded with gibberellic acid at 200 mg/l was at par with salicylic acid at 200 mg/l (19.52). Whereas control recorded least number of primary branches (7.60). At 90 DAT, maximum number of primary branches (24.60) was recorded with gibberellic acid at 200 mg/l and was at par with salicylic acid at 200 mg/l (23.86). Minimum number of primary branches were recorded with control (8.90). The data revealed that the number of branches per plant at 30, 60 and at 90 DAT were significantly increased due to chemicals as compared to control. The increase in number of branches might be due to the promotion of horizontal growth (branching) apart from vertical growth. Similar results were noticed by Khandelwal *et al.* (2003) in China aster with GA_3 spray.

Maximum number of secondary branches per plant was recorded with gibberellic acid at 200 mg/l (26.45) and was at par with salicylic acid at 200 mg/l (26.10). Minimum number of secondary branches per plant was noticed in control (6.70) which was found at par with paclobutrazol at 25 mg/l, 50 mg/l and 75 mg/l (20.67, 18.86 and 15.91 respectively). The data on number of secondary branches per plant at

60 DAT shows that maximum number of secondary branches per plant i.e., 50.45 was observed with gibberellic acid at 200 mg/l followed by salicylic acid at 200 mg/l (42.65). Control plants recorded least number of branches (8.20) and was at par with paclobutrazol at 75 mg/l (10.23). The data recorded on number of secondary branches per plant at 90 DAT exhibited significant difference among the treatments. Maximum number of branches (61.45) was recorded with gibberellic acid at 200 mg/l and was followed by salicylic acid at 200 mg/l (56.46). The least number of branches were recorded with control (11.45). Maximum number of secondary branches per plant was observed with gibberellic acid at 200 mg/l at all stages of growth. There was progressive and significant increase in number of secondary branches per plant with increase in the concentrations gibberellic acid. GA_3 was known to influence translocation and transcription mechanism of protein biosynthesis, thus, resulting in increased plant height with more number of productive branches. The increase in vegetative growth due to GA_3 might also be due to stimulation of cell division and cell elongation while increasing plasticity of cell wall and formation of energy rich phosphates. Similar results were reported by Shivakumar (2000) in China aster.

Flower parameters: The data recorded on number of days to first flowering was not significantly influenced by growth regulators. Likewise, non significant differences were recorded among the treatments for number of days to 50% flowering and flower diameter (Table 3).

The data recorded on number of flowers per plant is presented in Table 4. The plants sprayed with gibberellic acid at 200 mg/l produced significantly more number of flowers per plant (84.96) followed by salicylic acid at 200 mg/l (75.10). The absolute control (water spray) treatment had the lowest number of flowers per plant (29.83). This increase in number of flowers per plant due to GA_3 200 mg/l could be attributed to the increase in the number of branches per plant. The above results are in conformity with the findings of Lal and Mishra (1986) in China aster and Sunitha *et al.* (2007) in marigold.

The flower yield per plant and per hectare varied significantly due to different growth regulator sprays (Table 4). Foliar spray of gibberellic acid 200 mg/l recorded significantly more flowers per plant (109.66 g) and was followed by salicylic acid at 200 mg/l (105.15 g). While the control (water spray) plants produced significantly lowest flower yield per plant (48.94 g). GA_3 at 200 mg/l spray resulted significant increase in flower yield as compared to other concentrations. This may be attributed to the availability of higher photosynthetes towards the sink *i.e.* flowers due to increased photo synthetic surface area and photosynthetic activity in leaves. The results are in agreement with Anil (2004) in French marigold. Gibberellic acid at 200 mg/l (16.58 t/ha) followed by salicylic acid at 200 mg/l (15.90 t/ha) produced significantly higher flower yield per hectare. This was due to high flower yield per plant with these treatments. Absolute control (water spray) treatment produced significantly lowest flower yield per hectare (7.40 t/ha).

TABLE 2: Effect of plant growth regulators on number of primary and secondary branches at 30, 60 and 90 days after transplanting (DAT) in China aster cv. Kamini

Treatment (T)	Number of primary branches			Number of secondary branches		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
(T_1) Gibberellic acid 100 mg/l	7.93	14.82	16.60	19.40	38.20	52.21
(T_2) Gibberellic acid 150 mg/l	8.87	17.48	19.90	22.30	47.60	55.20
(T_3) Gibberellic acid 200 mg/l	11.56	21.73	24.60	26.45	50.45	61.45
(T_4) Salicylic acid 100 mg/l	7.62	14.91	17.30	17.75	25.25	32.83
(T_5) Salicylic acid 150 mg/l	8.31	17.37	18.33	21.40	38.80	45.27
(T_6) Salicylic acid 200 mg/l	9.55	19.52	23.80	26.10	42.65	56.46
(T_7) Maleic hydrazide 900 mg/l	7.51	12.80	16.23	12.00	15.25	18.72
(T_8) Maleic hydrazide 1000 mg/l	7.74	14.50	17.35	15.46	18.74	23.15
(T_9) Maleic hydrazide 1100 mg/l	8.15	16.10	19.64	17.95	20.80	27.17
(T_{10}) Alar 1000 mg/l	6.92	12.60	15.10	10.15	14.75	17.85
(T_{11}) Alar 1250 mg/l	7.23	13.70	16.22	11.52	15.05	19.42
(T_{12}) Alar 1500 mg/l	7.86	14.20	18.23	13.55	16.20	21.78
(T_{13}) Paclobutrazol 25 mg/l	7.06	12.13	14.30	9.45	12.45	16.26
(T_{14}) Paclobutrazol 50 mg/l	6.57	11.83	13.58	8.72	11.65	14.73
(T_{15}) Paclobutrazol 75 mg/l	6.35	8.70	11.56	7.65	10.23	13.82
(T_{16}) Control (water spray)	4.10	7.60	8.90	6.70	8.20	11.45
S.Em.±	0.82	0.93	0.77	1.06	0.78	0.68
C.D. at 5%	2.50	2.82	2.34	3.23	2.38	2.09

TABLE 3: Effect of plant growth regulators on days to first flowering, days to 50% flowering and flower diameter (cm) in China aster cv. Kamini

Treatment (T)	Days to first flowering	Days to 50%flowering	Flower diameter (cm)
(T_1) Gibberellic acid 100 mg/l	57.31	86.00	6.52
(T_2) Gibberellic acid 150 mg/l	55.93	85.50	6.63
(T_3) Gibberellic acid 200 mg/l	52.67	83.00	6.93
(T_4) Salicylic acid 100 mg/l	58.24	84.50	6.65
(T_5) Salicylic acid 150 mg/l	56.78	84.50	6.79
(T_6) Salicylic acid 200 mg/l	54.56	85.00	6.87
(T_7) Maleic hydrazide 900 mg/l	70.46	84.50	6.49
(T_8) Maleic hydrazide 1000 mg/l	72.92	87.50	6.37
(T_9) Maleic hydrazide 1100 mg/l	74.23	89.00	6.01
(T_{10}) Alar 1000 mg/l	71.60	84.00	6.51
(T_{11}) Alar 1250 mg/l	73.40	89.50	6.39
(T_{12}) Alar 1500 mg/l	75.65	91.00	6.26
(T_{13}) Paclobutrazol 25 mg/l	69.28	88.00	6.34
(T_{14}) Paclobutrazol 50 mg/l	71.53	87.00	6.27
(T_{15}) Paclobutrazol 75 mg/l	73.78	87.50	6.02
(T_{16}) Control (water spray)	75.100	89.00	6.19
S.Em.±	1.848	1.814	0.26
C.D. at 5%	NS	NS	NS

TABLE 4: Effect of plant growth regulators on number of flowers per plant and flower yield in China aster cv. Kamini

Treatment (T)	Number of flowers per plant	Flower yield per plant (g)	Flower yield per hectare (t)
(T_1) Gibberellic acid 100 mg/l	54.63	98.37	14.87
(T_2) Gibberellic acid 150 mg/l	72.70	102.84	15.52
(T_3) Gibberellic acid 200 mg/l	84.96	109.66	16.58
(T_4) Salicylic acid 100 mg/l	48.40	92.09	13.92
(T_5) Salicylic acid 150 mg/l	67.51	97.61	14.76
(T_6) Salicylic acid 200 mg/l	75.10	105.15	15.90
(T_7) Maleic hydrazide 900 mg/l	67.41	93.74	14.17
(T_8) Maleic hydrazide 1000 mg/l	71.72	95.85	14.49
(T_9) Maleic hydrazide 1100 mg/l	74.90	98.62	14.91
(T_{10}) Alar 1000 mg/l	60.16	80.02	12.10
(T_{11}) Alar 1250 mg/l	63.94	82.60	12.49
(T_{12}) Alar 1500 mg/l	68.90	87.35	13.21
(T_{13}) Paclobutrazol 25 mg/l	47.32	62.45	09.44
(T_{14}) Paclobutrazol 50 mg/l	38.78	58.27	08.81
(T_{15}) Paclobutrazol 75 mg/l	33.15	50.16	07.58
(T_{16}) Control (water spray)	29.83	48.94	7.40
S.Em.±	0.80	0.86	0.07
C.D. at 5%	2.46	2.63	1.10

Seed yield parameters: The seed yield per plant and per hectare varied significantly due to growth regulators (Table 5). Foliar spray of gibberellic acid 200 mg/l recorded significantly more seed yield per plant (9.98 g) and was at par with gibberellic acid at 150 mg/l (9.41 g) and salicylic acid at 200 mg/l and 150 mg/l (9.85 g and 9.20 g respectively). While the control (water spray) plants recorded significantly lowest flower yield per plant (0.86 g). Increase in seed yield per plant could be attributed to increase in number of branches per plant, number of flowers per plant and thousand seed weight. The results are in line with the reports of Shivaprasad Shetty (1995) in China aster. Seed yield per hectare was greatly influenced by growth regulators. Gibberellic acid at 200 mg/l produced significantly higher seed yield per hectare (1509.31 kg) followed by salicylic acid at 200 mg/l (1489.65 kg). Significantly lowest seed yield per hectare (757.68 kg) was recorded with control (water spray) plants. The increase in seed yield per plant and per hectare due to gibberellic acid 200 mg/l could be attributed to increase in yield attributes such as number of flowers and thousand seed weight and increase in growth parameters like number of branches per plant. The above results are in conformity with the findings of Swaroop *et al.* (2007) in African marigold and Sunitha *et al.* (2007) in marigold with GA_3 spray. Thousand seed weight (Table 5) varied significantly due to different growth regulators. Gibberellic acid at 200 mg/l recorded significantly high thousand seed weight (2.01 g) and was at par with salicylic acid at 200 mg/l (1.94), gibberellic acid at 150 mg/l (1.89 g) and salicylic acid at 150 mg/l (1.86 g). Absolute control (water spray) treatment recorded significantly lowest thousand seed weight (1.21g). Increase in thousand seed weight might be due to increase in individual seed weight due to GA_3 and SA foliar sprays. Similar findings on increase in thousand seed weight due to GA_3 spray were reported by Sunitha *et al.* (2007) in marigold.

TABLE 5: Effect of plant growth regulators on seed yield and thousand seed weight (g) in China aster cv. Kamini

Treatment (T)	Seed yield per plant (g)	Seed yield per hectare (kg)	Thousand seed weight (g)
(T_1) Gibberellic acid 100 mg/l	8.92	1349.01	1.82
(T_2) Gibberellic acid 150 mg/l	9.41	1423.11	1.89
(T_3) Gibberellic acid 200 mg/l	9.98	1509.31	2.01
(T_4) Salicylic acid 100 mg/l	8.87	1341.44	1.80
(T_5) Salicylic acid 150 mg/l	9.20	1391.35	1.86
(T_6) Salicylic acid 200 mg/l	9.85	1489.65	1.94
(T_7) Maleic hydrazide 900 mg/l	8.78	1327.83	1.69
(T_8) Maleic hydrazide 1000 mg/l	9.17	1386.81	1.78
(T_9) Maleic hydrazide 1100 mg/l	9.32	1409.50	1.82
(T_{10}) Alar 1000 mg/l	8.13	1229.53	1.71
(T_{11}) Alar 1250 mg/l	8.46	1279.44	1.72
(T_{12}) Alar 1500 mg/l	8.62	1303.63	1.78
(T_{13}) Paclobutrazol 25 mg/l	7.84	1185.67	1.73
(T_{14}) Paclobutrazol 50 mg/l	7.56	1143.32	1.68
(T_{15}) Paclobutrazol 75 mg/l	7.45	1126.69	1.65
(T_{16}) Control (water spray)	5.01	0757.68	1.21
S.Em.±	0.28	28.91	0.05
C.D. at 5%	0.86	78.05	0.15

On the basis of present research findings in China aster, it could be concluded that for obtaining higher flower and seed yield per hectare SA 200 mg/l foliar spray at 20 and 35 DAT could be recommended for increased growth, flower and seed yield in China aster cv. Kamini as it is cheaper than GA_3.

REFERENCES

Anil, K. S. (2004). Influence of plant bio regulators on growth and seed yield in French marigold (*Tagetes patula* Linn.). *J.Orn. Hort*. **7** (2): 193-195.

Bose, T. K. and Yadav, L. P. (1998). Commercial flowers. Naya Prokash Publishers. Calcutta. India.

Hayat, S., Ali, B. and Ahmad, A. (2007). Salicylic Acid: A Plant Hormone In: *Salicylic Acid: Biosynthesis, Metabolism and Physiological Role in Plants*, Springer Netherlands. pp.1-14.

Joshi, V., Reddy, S. A. and Reddy, K. M. (2006). Effect of Maleic hydrazide on growth and flowering in China aster. *J. Res.,* ANGRAU. **34** (4): 94-97.

Khandelwal, S. K., Jain, N. K. and Singh, P. (2003). Effect of growth retardants and pinching on growth and yield of African marigold (*Tagetes erecta* L.). *J.Orn. Hort*. **6** (3): 271– 273.

Lal, H. and Mishra, S. P. (1986). Effect of gibberellic acid and maleic hydrazide on growth and flowering of marigold and China aster. *Prog. Hort*. **18** (1-2): 151-152.

Nandre, D. R.., Navandar, U. O. and Archana, D. W. (2009). Effect of growth regulators on growth, flowering and yield of China aster. *Asian J. Hort.* **4** (1): 50-51.

Padmini, K., Janakiram and Naik L. B. (2013). Effect of nutrients and growth regulators on seed yield in China aster *(Callistephus chinensis)* cv. Poornima. *Indian J. Agric. Sci.* **83** (3): 349-351.

Panse, V. G and Sukhatme, P. V. (1978). Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Prabhat Kumar, Raghava, S. P. S., Mishra, R. L. and Krisna P. Singh (2003). Effect of GA_3 on growth and yield of China aster. *J.Orn. Hort*. **6** (2): 110-112.

Sharma, C. P., Maurya, A. N., Srivastava, O. P. and Mishra, A. (2001). Role of GA_3, MH and ethrel in modifying vegetative and floral characters of *Chrysanthemum morifolium Ram. The Orissa J. Hort*. **29** (2): 35-38.

Shivakumar, C. M. (2000). Effect of mother plant nutrition, plant density and seed maturity on seed yield and quality in marigold (*Tagetes erecta* L.) *M.Sc. (Agri.) Thesis*, University of Agriculture Sciences. Dharwad, Karnataka.

Shivaprasad Shetty (1995). Effect of GA_3 and cycocel on maturity, seed yield and quality of China aster (*Callistephus chinensis* L. Nees.) *M. Sc. (Agri.) Thesis*, University of Agriculture Sciences. Bangalore, Karnataka.

Sunitha, H. M., Ravi Hunje, Vyakaranahal, B. S. and Bablad, H. B. (2007). Effect of plant spacing and integrated nutrient management on yield and quality of seed and vegetative growth parameters in African marigold (*Tagetes erecta* Linn.). *J.Orn. Hort*. **10** (4): 245-249.

Swaroop, K., Kanwar, P., Singh, P. and Raju, D. V. S. (2007). Vegetative growth, flowering and seed characters of African marigold *(Tagetes erecta* L.) as influenced by different growth substances during mild off seasons. *J.Orn. Hort.* **10** (4): 268-270.