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EFFECT OF BIOSTIMULANTS AND PGRS ON FLOWERING CHARACTERS AND YIELD OF GAILLARDIA (*Gaillardia pulchella*) CV. LOCAL

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ABSTRACT

The field trial was undertaken at Horticulture Polytechnic, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, India during the Summer, 2023 undertaken to assess on the "Effect of biostimulants and PGRs on flowering characters and yield of gaillardia (*Gaillardia pulchella*) cv. Local". The experiment was laid out in Randomized Block Design (RBD) with three replications with of eleven treatments of biostimulants and PGRs *viz*; Novel Organic Liquid Nutrients 0.5 %, Novel Organic Liquid Nutrients 1 %, Cow urine 1%, Cow urine 2%, *Vermiwash* 1 %, *Vermiwash* 2 %, BA 50 ppm, BA 100 ppm, GA_3 50 ppm, GA_3 100 ppm and control (water spray). The treatments were applied as foliar spray to the plants at 30 and 45 days after transplanting. The results demonstrated that the flowering traits varied depending on different treatments at 60 and 90 DAT. Regarding flowering parameters, the foliar application of GA_3 @ 100 ppm resulted in the highest flowering duration (60.13 days) and the earliest bud emergence (38.33 days). Other floral characteristics, such as bloom longevity (12.23 days) and flower diameter (8.46 cm) were determined to be at their highest with treatment BA @ 100 ppm. While, the maximum shelf life (9.80 hours) found with Novel Organic Liquid Nutrients 1% and average weight of flowers (6.30 g) were found maximum with the Cow urine 1 %. In terms of yield parameters, such as number of flowers per plant (83.40), yield per plot (2896.77 g) and yield per hectare (20116 kg) found better with application of GA_3 @ 100 ppm.

Keywords **:** Gaillardia, Biostimulants, PGRs and flowering parameter

Introduction

Gaillardia belongs to asteraceae family, native of North America and Mexico. It is popularly known as "Blanket Flower". The common name may refer to the resemblance of inflorescence to the brightly patterned blankets made by Native Americans or to the ability of wild taxa blanket the ground with colonies. There are more than 30 species of gaillardia, out of which *Gaillardia pulchella* and *Gaillardia aristata* are of horticultural importance (Bose and Yadav,1989). Gaillardia has religious value due to dominant yellow coloured flowers which are used for worship and also used for preparation of garlands, *veni* and for decoration during social functions. It is mainly grown for loose flowers but in some flower arrangements, it can be used as cut flowers. It's glamouring colours are best for vase arrangement. It is one of popular minor loose flower crop and a summer annual. Gaillardia can also be use in mixed border, edging and carpet bedding. The plant also has an anti-tumour activity. The genus gaillardia was named in honour of French botanist "Gaillard de Marentoneau". It is one of the most popular flowers in India because of its easy cultivation, wide adaptability to varying soils and climatic conditions with long duration of flowering and attractive flower colours. Among the flowers used for domestic market, gaillardia (*Gaillardia pulchella*) is one of the important commercial flowers.

Plant growth regulators (PGRs) are defined as organic compounds other than nutrients which can regulate, modify or enhance growth processes in plants at very low concentrations. PGRs interrupt physiological pathways of hormones and enzymes, which disrupts normal growth (Danielson, 2005) which ultimately affect the plant growth, yield and quality of flowers. These growth substances are certainly required for the complete growth and development of plant.

Gibberellic acid is known for increasing cell elongation, cell division, delayed senescence, break seed dormancy, root initiation, stimulate flowering, plant height, number of leaves, chlorophyll content, while gibberellic acid also reduce the juvenile period for flowering and improving quality and yield. Flowering is a complex process that occurs in response to environmental factors as photoperiod, temperature, light intensity and spectrum (Ben Tal, 2000). Gibberellins are able to replace some of these factors and induce flowering. Application of GA_3 on the majority of long-day and cold requiring plants to induce flowering.

Benzyl adenine has been used as one of the sources that maintain or increase the quality of various ornamental plants (Han, 2001). It has been demonstrated that applying benzyl adenine affects numerous other physiological and developmental processes, reduces leaf chlorosis, increases vase life and delays the senescence by blocking the production of ethylene (Cook *et al*., 1985), nutrient mobilization, apical dominance, formation and activity of shoot apical meristem, floral development, combating drought stress in plants (Waterland *et al*., 2010).

A biostimulant is defined as an organic material and micro-organism that is applied for enhance an organic nutrient uptake, stimulate growth, enhance stress tolerance or crop quality. Thus, the application of nutrients in small doses applied more frequently favours better growth and flower production (Sankari *et al.*, 2015). They are the materials other than the fertilizers that promote the plant growth when applied in minute quantities and are also referred as 'metabolic enhancers' (Hegde *et al*., 2018).

Novel Organic Liquid Nutrient is banana pseudostem based organic liquid nutrient used as agro inputs in all crops. It contains gibberellic acid (110.2–205.0 ppm), cytokinin (137.8 – 244.3 ppm), N (0.062 %), P (0.018 %), K (0.180 %), Ca (0.031 %), Mg (0.092 %), S (0.010 %), Fe (109.3 ppm), Mn (5.73 ppm), Zn (2.92 ppm) and Cu (0.40 ppm) (Desai *et al*., 2016).

Vermiwash, the extracted body fluid of earthworms is also nutrient rich with components promoting good plant growth (Gorakh Nath *et al*., 2009). The dead worm's tissue discharges nitrogen in form of nitrates 25 %, ammonia 45 %, organic soluble compound 3 % and other material 27 % (Satchell, 1967).

Cow urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. It contains 95% water, 2.5 % urea and remaining 2.5 % contains mineral salts, hormones and enzymes (Pradhan *et al*., 2018). It also contains growth promoting chemical (auxin) and nutrients. Cow urine has antibacterial, antifungal, antiviral properties; hence it is most effective secretion of animal origin with multitudinous therapeutic values. which purifies and enhances soil fertility. However, cow urine has a good manurial value and can be utilized as a bio fertilizer (Ledgard *et al*., 1982).

Materials and Methods

The current investigation was undertaken out at Horticulture Polytechnic, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat during summer, 2023. The experiment consists of eleven treatments of biostimulants and PGRs *viz.*, Novel Organic Liquid Nutrients 0.5 %, Novel Organic Liquid Nutrients 1 %, Cow urine 1%, Cow urine 2%, *Vermiwash* 1 %, *Vermiwash* 2 %, BA 50 ppm, BA 100 ppm, GA_3 50 ppm, GA_3 100 ppm and control (water spray). The treatments were applied as foliar spray to the plants at 30 and 45 days after transplanting. In order to minimize sampling error, five randomly chosen plants from each treatment were taken for capturing information on several characters at the ideal period of plant growth. For statistical analysis, averages of the data from the sampled plants with regard to various attributes were employed.

Results and Discussions

Days to First Bud Appearance

The flowering attributes as influenced by the application of different doses of biostimulants and PGRs presented in Table 1.

The Minimum days for first flower bud appearance (38.33 days) was recorded in T_{11} - GA_3 @100 ppm which was statistically at par with T_{10} - GA_3 @ 50 ppm (40.00 days) and T_7 - *Vermiwash* 2 % (41.13 days). whereas, The maximum days were noted in T_1 - Control (50.33 days).

The balanced nutrition is of considerable importance in improving the yield and reducing the juvenile phase. Early flower bud appearance might be due to auxin. The higher production of auxin at early phase of growth would have contributed to early flowering. GA_3 can promote early bud initiation by activating genes involved in the transition from vegetative growth to reproductive growth. Specifically, GA_3 can induce the expression of genes involved in the synthesis of another plant hormone, florigen, which is a key regulator of flowering. Florigen is produced in the leaves in response to long-day conditions and is transported to the shoot apical meristem, where it triggers the transition to reproductive growth (Dabas *et al*., 2001). By promoting the synthesis and signaling of florigen, GA_3 can accelerate the transition from vegetative growth to reproductive growth, leading to early bud initiation. Similar results regarding early flower bud appearance were also reported by Mounika *et al*. (2019) in chrysanthemum.

Table 1: Effect of foliar application of biostimulants and PGRs on days to first bud appearance (days) in gaillardia

Treatments	Days to first bud appearance (days)
T_1: Control	50.33
T_2: Novel Organic Liquid Nutrients 0.5 %	49.93
T_3: Novel Organic Liquid Nutrients 1%	46.13
T_4: Cow urine 1%	46.53
T_5: Cow urine 2%	49.47
T_6: *Vermiwash* 1 %	47.53
T_7: *Vermiwash* 2 %	41.13
50 ppm	45.13
T_9: BA 100 ppm	46.13
T_{10}: GA_3 50 ppm	40.00
T_{11}: GA_3 100 ppm	38.33
S.Em. ±	2.39
C.D. @ 5%	7.07
C.V. %	9.12

Flower Diameter (cm)

The flower diameter (cm) was affected through application of different biostimulants and PGRs in gaillardia furnished in Table 2. Maximum diameter of flower (8.46 cm) was recorded by the application of (T_9) BA @100 ppm which was statistically at par with (T_7) *Vermiwash* 2 % (8.03 cm). whereas, T_1 - Control was recorded least in flower diameter (5.60 cm).

Flower size in terms of flower diameter is the important parameter which decide the quality of flower. Significant difference was observed among different biostimulants and PGRs. *Benzyl adenine* at 100 ppm found best for large sized flower development. The role of BA in promoting protein synthesis, increasing cell division, cell enlargement and chlorophyll synthesis (Cheema and Sharma, 1982), Which lead to an increase in flower diameter. These results are comparable with those obtained by Taranjit and Madhu (2020) in chrysanthemum.

Table 2: Effect of foliar application of biostimulants and PGRs on flower diameter (cm) in gaillardia

Treatments	Flower diameter (cm)
T_1: Control	5.60
T_2: Novel Organic Liquid Nutrients 0.5 %	6.00
T_3: Novel Organic Liquid Nutrients 1%	6.48
T_4: Cow urine 1%	6.54
T_5: Cow urine 2%	6.60
T_6: *Vermiwash* 1 %	7.25
T_7: *Vermiwash* 2 %	8.03
T_8: BA 50 ppm	7.17
T_9: BA 100 ppm	8.46
T_{10}: GA_3 50 ppm	6.25
T_{11}: GA_3 100 ppm	6.35
S.Em. ±	0.34
C.D. @ 5%	1.01
C.V. %	8.73

Flowering Duration (days)

The flower duration (days) was affected through application of different biostimulants and PGRs in gaillardia furnished in Table 3.

The longest flowering duration (60.13 days) was recorded by the application of GA_3 @ 100 ppm (T_{11}) which was statistically at par with application of GA_3 @ 50 ppm (T_{10}) having period of flowering duration (57.13 days) followed by *Vermiwash* 2 % (55.00 days). The shortest flowering duration (42.62 days) was observed in the treatment T_1 - Control.

Gibberellic acid spray recorded a significant longest flowering duration due to advanced bud formation and early flowering in GA_3 treated plants. Enhanced flowering duration was also recorded by Patel *et al.* (2018) in limonium. Prolonged flowering duration owing to GA_3 was also documented by Kumar *et al*. (2020) in marigold.

Table 3: Effect of foliar application of biostimulants PGRs on flowering duration (days) in gaillardia

Treatments	Flower duration (days)
T_1: Control	42.67
T_2: Novel Organic Liquid Nutrients 0.5 %	48.93
T_3: Novel Organic Liquid Nutrients 1%	49.13
T_4: Cow urine 1%	44.60
T_5: Cow urine 2%	47.80
T_6: *Vermiwash* 1 %	51.80
T_7: *Vermiwash* 2 %	55.00
50 ppm	50.93
T_9: BA 100 ppm	50.73
T_{10}: GA_3 50 ppm	57.13
T_{11}: GA_3 100 ppm	60.13
S.Em. ±	2.69
C.D. @ 5%	7.95
C.V. %	9.2

Longevity of flower (days)

The longevity of flower (days) was affected through application of different biostimulants and PGRs in gaillardia furnished in Table 4. The maximum flower longevity (12.23 days) was recorded by the application of BA @ 100 ppm (T_9) which was statistically at par with application of BA @ 50 ppm (T_8) having period of flowering longevity (11.60 days). The shortest flower longevity (5.63 days) was observed in the treatment T_1 - Control.

The increased flower longevity of BA-treated inflorescence may be due to decreased ethylene synthesis processes in the tissue of flowers (Bosse and Van Staden, 1989) and decreasing of protein hydrolytic enzymes activity lipoxygenase (Leshem *et al*., 1979). Also, it may attributed to its role in decreasing the respiration rate of kinetin treated flowers (MacLean and Dedolph, 1962). These results are comparable with those obtained by Ramy *et al*. (2019) in gaillardia.

Table 4: Effect of foliar application of biostimulants and PGRs on longevity of flower (days) in gaillardia

Treatments	Longevity of flowers (days)
T_1: Control	5.63
T_2: Novel Organic Liquid Nutrients 0.5 %	7.93
T_3: Novel Organic Liquid Nutrients 1%	8.13
T_4: Cow urine 1%	7.80
T_5: Cow urine 2%	7.90
T_6: *Vermiwash* 1 %	9.33
T_7: *Vermiwash* 2 %	10.16
T_8: BA 50 ppm	11.60
T_9: BA 100 ppm	12.23
T_{10}: GA_3 50 ppm	8.33
T_{11}: GA_3 100 ppm	8.73
S.Em. ±	0.45
C.D. @ 5%	1.34
C.V. %	8.83

Shelf Life (hours)

Shelf life of flowers as affected by application of different biostimulants and PGRs result depicted in Table 5.

The shelf life (days) was significantly influenced by various treatments at 75 % withering of flowers. Maximum shelf life (9.80 hours) was recorded by the application of Novel Organic Liquid Nutrients 1% (T_3) which was statistically at par with T_2 - Novel Organic Liquid Nutrients 0.5 % (9.23 hours). While, minimum shelf life (5.33 hours) was recorded with T_1 (Control).

This might be due to presence of micro and macro nutrients as well as gibberellins with other hormones in Novel Organic Liquid Nutrients which is quite effective in reducing the juvenile period of the plants (Patil *et al*., 2016). GA can help maintain their freshness and prolong their shelf life by promoting the uptake and utilization of essential nutrients, enhancing the antioxidant activity of flowers and regulating stomatal opening and closing, which helps flowers to maintain water balance and reduce water loss. The similar results were recorded by Sathyanarayana *et al.* (2017) in gladiolus, Desai *et al.* (2018) in tuberose, Patel *et al*. (2020) in African marigold.

Table 5: Effect of foliar application of biostimulants and PGRs on shelf life (hours) of flowers in gaillardia

Treatments	Shelf life (hours)
T_1: Control	5.33
T_2: Novel Organic Liquid Nutrients 0.5 %	9.23
T_3: Novel Organic Liquid Nutrients 1%	9.80
T_4: Cow urine 1%	6.60
T_5: Cow urine 2%	7.93
T_6: *Vermiwash* 1 %	8.07
T_7: *Vermiwash* 2 %	8.57
T_8: BA 50 ppm	7.70
T_9: BA 100 ppm	7.50
T_{10}: GA_3 50 ppm	8.47
T_{11}: GA_3 100 ppm	9.07
S.Em. ±	0.24
C.D. @ 5%	0.69
C.V. %	5.08

Number of Flowers per Plant

The data recorded on number of flowers per plant have been presented in Table 6.

The significantly maximum number of flowers per plant (83.40) were observed in the treatment T_{11} (GA_3 @ 100 ppm) which was significantly superior over rest of the treatments. Minimum number of flowers (15.80) was recorded in treatment (T_1) Control.

Higher number of flowers per plant was attributed to the production of large number of branches at the early stage, which had sufficient time to accumulate reserve carbohydrates for proper bud differentiation. The same effect of GA_3 on number of flowers per plant was observed by Patel *et al*. (2010) in chrysanthemum, Montessori *et al.* (2013) in gladiolus, Parveen *et al.* (2020) in marigold.

Table 6: Effect of foliar application of biostimulants and PGRs on number of flowers per plant in gaillardia

Treatments	Number of flowers per plant
T_1: Control	15.80
T_2: Novel Organic Liquid Nutrients 0.5 %	24.53
T_3: Novel Organic Liquid Nutrients 1%	21.20
T_4: Cow urine 1%	23.53
T_5: Cow urine 2%	35.93
T_6: *Vermiwash* 1 %	31.67
T_7: *Vermiwash* 2 %	46.27

T_8: BA 50 ppm	28.97
T_9: BA 100 ppm	22.17
T_{10}: GA_3 50 ppm	63.93
T_{11}: GA_3 100 ppm	83.40
S.Em. ±	1.85
C.D. @ 5%	5.45
C.V. %	8.86

Average weight of flowers per plant

The average weight of five flowers (g) as affected by the application of various treatments of biostimulants and PGRs in gaillardia flowers is furnished in Table 7.

Maximum average weight of five flowers (6.30 g) was recorded through the application of Cow urine 1 % (T_4) which was statistically at par with T_5 - Cow urine 2% (5.87 g) and T_9 - BA @100 ppm (5.73 g). Minimum weight of five flowers (1.80 g) was noted in T_1 - Control.

Cow urine contains a variety of elements that can potentially contribute to increasing the weight of flowers. Cow urine contains nutrients such as nitrogen, phosphorus, manganese, potassium, other minerals, hormones and enzymes that can improve plant growth and health. When used as a fertilizer or biostimulant, cow urine can enhance the plant's ability to absorb nutrients, increase chlorophyll content and promote photosynthesis. These factors can collectively lead to better plant growth and potentially an increase in flower weight (Rathore *et al*., 2016).

Table 7: Effect of foliar application of biostimulants and PGRs on average weight (g) of flowers in gaillardia

Treatments	Average weight of five flowers (g)
T_1: Control	1.80
T_2: Novel Organic Liquid Nutrients 0.5 %	4.33
T_3: Novel Organic Liquid Nutrients 1%	3.80
T_4: Cow urine 1%	6.30
T_5: Cow urine 2%	5.87
T_6: *Vermiwash* 1 %	4.40
T_7: *Vermiwash* 2 %	3.33
T_8: BA 50 ppm	5.33
T_9: BA 100 ppm	5.73
T_{10}: GA_3 50 ppm	3.40
T_{11}: GA_3 100 ppm	3.80
S.Em. ±	0.25
C.D. @ 5%	0.75
C.V. %	10.03

Flower Yield per Plot (g) and Hectare (kg)

The data on flower yield per plot is presented in Table 8

The maximum flower yield per plot (2896.77g) was recorded in the treatment T_{11} GA_3 @ 100 ppm and it was at par with the treatment T_{10} (GA_3 @ 50 ppm) (2730.63 gm). The lowest flower yield per plot (1982.47 g) was observed in the treatment (T_1) Control.

Moreover, maximum flower production per hectare (20116 kg) was also recorded in T_{11} - GA_3 @ 100 ppm which was statistically at par with T_{10} - GA_3 @ 50 ppm (18962.61 kg). Minimum flower production per hectare (13767 kg) was obtained in T_1 - Control.

The most impressive yield of flowers per plant, plot and hectare was recorded with treatment GA_3 at 100 ppm. This is attributed to the production of large number of laterals at an early stage of growth, which leads sufficient time to accumulate reserve carbohydrates for proper flower bud differentiation (Dutta *et al*, 1993). Increased number of flowers per plant was observed because of the production of large number of branches and more plant spread due to GA_3 application. After successful vegetative phase only, the plant could step into reproductive phase with better yield. This result finds support from the findings of (Poshiya *et al*, 1995) in gaillardia.

Similar results were found by Patel *et al*. (2010) in chrysanthemum, Singh *et al*. (2018) in marigold, Kumar *et al*. (2020) in marigold.

Table 8: Effect of foliar application of biostimulants and PGRs on flower yield per plot (g) and per hectare (kg) in gaillardia

Treatments	Yield of flowers	
	Per plot (g)	Per ha (kg)
T_1: Control	1982.47	13767
T_2: Novel Organic Liquid Nutrients 0.5 %	2107.43	14635
T_3: Novel Organic Liquid Nutrients 1%	2161.47	15010
T_4: Cow urine 1%	2392.27	16613
T_5: Cow urine 2%	2464.93	17117
T_6: *Vermiwash* 1 %	2523.70	17525
T_7: *Vermiwash* 2 %	2623.50	18219
0 ppm	2050.37	14238
T_9: BA 100 ppm	2154.57	14962
T_{10}: GA_3 50 ppm	2730.63	18963
T_{11}: GA_3 100 ppm	2896.77	20116
S.Em. ±	118.14	820.41
C.D. @ 5%	348.51	2420.2
C.V. %	8.63	8.63

Conclusions

According to the results collected, it is possible to conclude that foliar application of GA_3 @ 100 ppm at 30 and 45 days after transplanting gave early flower bud appearance, flowering duration, number of flowers per plant and flower yield. Other floral characteristics, such as bloom longevity and flower diameter were determined to be at their highest with BA @ 100 ppm.

While, the maximum shelf life hours found with Novel Organic Liquid Nutrients 1% and average weight of flowers were found maximum with the Cow urine 1 %.

References

Ben Tal, Y. (2000). Are gibberellins capable of replacing the environmental flowering signal. *Israel J. Pl. Sci.*, **48**(3), 205- 215.

Bose, T. K. and Yadav, L. P. (Eds) (1989). Commercial flowers. Naya prakash, Calcutta, pp. 605-607.

Bosse, C. A. and Van Staden, J. (1989). Cytokinins in cut carnation flowers. V. Effects of cytokinin type, concentration and mode of application on flower longevity. *J. Pl. Physiol.*, **135**(2), 155-159.

Cook, D., Rasche, M. and Eisinger, W. (1985). Regulation of ethylene biosynthesis and action in cut carnation flower senescence by cytokinins. *J. American Soc. Hort. Sci*., **110**(1), 24-27.

Dabas, H. K., Mitra, L. and Dabas, S. (2001). Effect of different concentrations of GA_3, MH and NAA on primary branches of marigold (*Tagetes erecta* L.). *Indian Agric*., **45**(3-4), 265-267.

Danielson, H. E. (2005). Production and performance of gaillardia cultivars and ecotypes. *M.Sc. thesis* submitted to University of Florida, Florida, USA.

Desai, C. S., Patel, J. M., Pawar, S. L., Usadadia, V. P., Naik,V. R. and Savani, N. G. (2016). "Value Added Products from Banana Pseudostem". Research Scientist, Soil and Water Management Research Unit, Navsari Agricultural University, Navsari. pp. 55-56.

Desai, S.A., Patel, B.B., Pooja, R. N. and Patel, V. (2018). Effect of plant growth enhancers on growth and flowering of tuberose cv. Prajwal. *Int. J. Chem. Stud*., **6**(6), 1076-1079.

Dutta, J. P., Ramdas, S. and Khader. A. M. D. (1993). Regulation of flowering by growth regulators in chrysanthemum (*Chrysanthemum indicum* L.) cv. CO-1. *South Indian Hort*., **41**, 293-299.

Gorakh, N., Keshav, S. and Singh, D. K. (2009). Chemical analysis of vermicompost/*vermiwash* of different combination of animal, agro and kitchen wastes. *Australia J. Bas. Appl. Sci.*, **3**(4),3672-3676.

Han, S. S. (2001). Benzyl adenine and gibberellins improve postharvest quality of cut Asiatic and Oriental lilies. *Hort. Sci*., **36**(4),741-775.

Hegde, P. P., Shivaprasad, M., Ganapathi, M. and Chandrashekar, S. Y. (2018). Influence of biostimulants on growth and physiology of chrysanthemum (*Dendranthema grandiflora* Tzvelev.) var. Kolar Local under protected cultivation, *Int. J. Pure App. Biosci.*, **6**(2), 1259-1264.

Kumar, P., Singh, A., Laishram, N., Pandey, R., Dogra, S., Jeelani, M. I., and Sinha, B. (2020). Effects of plant growth regulators on quality flower and seed production of marigold (*Tagetes erecta* L.). *Bangladesh J. Bot*., **49**(3), 567-577.

Ledgard, S. F., Sheath, G. W. and Gillingham, A. G. (1982). Influence of some soil and pasture components on the growth of hill country pastures L. winter and spring production. *New Zealand J. Exp. Agric*., **10**(3), 239-244.

Maclean, D. C and Dedolph, R. R. (1962). Effects of N'-benzyl aminopurine on postharvest respiration of *Chrysanthemum morifolium* and *Dianthus caryophyllus*. *Bot. Gaz.*, **124**, 20-21.

Montessori, N., Bhanishana, R. K., Hemochandra, L., Sharma, R. and Das, R. (2013). Effect of application of plant growth regulators in sustainable improvement of gladiolus production in Manipur. *Int. J. Plant Sci*., **8**(1),103-106.

Mounika, C. H., Suseela, T., Subbaramamma, P., Sujatha, R. V. and Dorajeerao, A. V. (2019). Effect of pinching and growth regulators on vegetative and floral parameters chrysanthemum cv. Pusa Kesari. *J. Pharmacog. Phytochem*., **8**(5), 1035-1041.

Patel, M. G., Patel, R. B., Chawla, S. L., Patil, S. and Patel, D. K. (2018). Effect of plant growth regulators on growth and yield of limonium var. Misty White. *Int. J. Chemical Studies*, **6**(1), 1578-1580.

Patel, S. M., Aklade, S. A., Chawla, S. L. and Tandel, B. M. (2020). Effect of different stimulants on growth, flowering and yield of african marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Indian. J. Pure App. Biosci.*, **8**(5), 451-455.

Patel, S. R., Parekh, N. S., Parmar, A. B. and Patel, H. C. (2010). Effect of growth regulators on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. "IIHR-6". *Int. J. Agric. Sci.*,**6**(1), 243-245.

Patil, D., Chopde, N., Lokhande, S. and Bhande, M. H. (2016). Studies of response of african marigold to plant growth regulators for seed production. *Pl. Arch.*, **16**(1), 423-425.

Poshiya, V. K., Katariya, G. K. and Chovatia, V. P. (1995). Effect of growth substances on growth and yield in gaillardia. *J. App. Hort*., **1**, 99-100.

Pradhan, S. S., Verma, S., Kumari, S. and Singh, Y. (2018). Bio-efficacy of cow urine on crop production, A review. *Int. J. Chemical Studies*, **6**(3), 298-301.

Ramy, G. E. K., Atef, M. K. and Ahmed, A. A. (2019). The role of benzyl amino purine and kinetin in enhancing the growth and flowering of three gaillardia varieties. *Alex. J. Agric. Res.*, **64**(5), 277-288.

Rathore, J. S., Gupta, V. K. and Kuhad, R. C. (2016). "Comparative evaluation of antifungal activity of cow urine and its nutritional effect on *Trigonella foenum-graecum* and *Abelmoschus esculentus*," *J. Appl. Natural Sci*., **8**(2), 419-425.

Sankari, A., Anand, M. and Arulmozhiyan, R. (2015). Effect of biostimulants on yield and post harvest quality of gladiolus cv. White Prosperity. *Asian J. Hort.*, **10**(1), 86-94.

Satchell J.E. Lumbricidae In, Soil Biology. (A. Burges and F. Raw, Eds). Academic Press. London. 1967, 259- 322.

Sathyanarayana, E., Patil. S., Bahubali, M. and Chawla, S. L. (2017). Effect of integrated nutrient management on growth and flowering of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty under Navsari and Tansa conditions. *Int. J. Chem. Stud*., **5**(5), 317-319.

Singh, R., Sisodia, A., Singh, A. K. and Pal, A. K. (2018). Effect of pinching, gibberellic acid and kinetin on growth, flowering and seed yield in marigold. *J. Pharma. Phytochem*., **7**(3), 3318-3320.

Waterland, N. L., Finer, J.J. and Jones, M. L. (2010). Benzyl adenine and gibberellic acid application prevents abscisic acid-induced leaf chlorosis in pansy. *Hort. Sci*., **45**(6), 925-933.