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Efficacy of plant bio-regulators on vegetative and flowering of Asiatic Lilium hybrid cv. Tresor

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Abstract
A field experiment was conducted to study the efficacy of plant bio-regulators on flowering and bulb production of Asiatic Lilium hybrid cv. Tresor during the year 2017-18. The trial was conducted in a randomized block design with ten treatments in four replications. The treatments comprised of foliar application of GA_3 at 50ppm alone and in combination with BA at 50 ppm, GA_3 at 75ppm with BA at 75 ppm, Chlormequat chloride alone at 75ppm, 100ppm, 125 ppm concentration and in combination with GA_3 at 50ppm and a control (water spray). The result revealed that application of 50 ppm GA_3 significantly increased the plant height (72.32 cm), number of leaves per plant (81.58) & leaf length (11.57 cm), advanced the days to bud appearance (19.37 days), bud break (45.75 days) & first flowering (46.12 days) whereas basal stem diameter (2.1 cm) was significantly higher with application of 125 ppm Chlormequat chloride. Application of 125 ppm Chlormequat chloride & 50 ppm GA_3 significantly enhanced the number of flowers per plant (3.66), bloom life of individual flower (7.66 days), bloom life of whole spike (15.24 days) and vase life (14.57 days).

Keywords: Benzyl adenine, chlormequat chloride, flowering, gibberellic acid and Lilium

Introduction
Lilium is an important ornamental bulbous plant. They are produced both as potted plants, cut flowers and are used in landscaping (Dole & Wilkins 1999) [9]. It is a species of great economic importance in production and commercialization of cut flower in the international market (Jimenez *et al.* 2012) [13]. Due to its size, beauty and longevity lilium is one of the ten most superior cut flowers in the world (Thakur *et al.* 2005) [28]. In recent years lilium plant cultivation has been increasing due to the rise in demand for the lilium flowers in domestic and global market. Asiatic hybrids lilium were the first commercially successful group of hybrid lilies derived from species that are native to China, Japan, Korea and Europe. One of the important factor affecting the market values of flowers is the precision and uniformity with which the flowers become ready for sale (Attiya *et al.* 2015) [3]. For crop regulation plant bio-regulators play a major role. Bio-regulators are widely been used in horticultural and floricultural crops to enhance vegetative growth, flowering, yield and post-harvest quality (Rademacher 2015) [21]. Plant bio-regulators include hormones or compound having hormonal like activities (Zulfiqar *et al*. 2019) [30] which modify the natural plant physiological process and have positive influence on flower quality and quantity. They are capable to enhance the plant growth & development, flowering as well as bulb production (Zulfiqar *et al.* 2019) [30]. They not only aid in better quality flowers but also extend the flowering duration.
Application of GA_3, BA and CCC showed tremendous potential in modulating growth and related processes in different flowering plants. Gibberellins are used to increase stem elongation and induce flower development. BA is cytokinin which has been found essential for growth and development of plant organs, retention of chlorophyll, translocation of nutrient (Pandey and Sinha, 1984) [20]. CCC (2-chloroethyl trimethyl ammonium chloride) also known as Chlormequat chloride is a growth retardant which reduces the growth of stem, promoted the flowering parameters, extended the shelf-life of flowers and increased bulb production. Therefore, a study was carried out to evaluate the efficacy of plant bio-regulators on flowering and bulb production of Asiatic Lilium hybrid cv. Tresor.

Materials and Methods
A field experiment was conducted in 2017-2018 under the poly shade net structure of RKVY project at Biotechnology and Tissue Culture Centre (BTCC), Baramunda, College of Agriculture, Orissa University of Agriculture and Technology Bhubaneswar, India using

Lilium Hybrid cv. Tresor from The Netherlands through Florance flora farm of Bangalore. Bulbs were treated with 0.2% Bavistin for 30min before planting to protect the bulbs from fungal infection.

A media mixture was prepared with Farm Yard Manure (FYM), Coco Peat and Garden soil in the ratio 1:1:1. Media was first sterilized with 0.1% Ridomil MZ (Mancozeb 64% and Metalaxyl 4%). In the poly shade-net structure, the whole site was cleaned and dug thoroughly and the entire field was then divided into 4 beds with each bed measuring 16m x 1m with spacing of 40cm in between of each bed for path. The media mixture was used in the beds for planting of lilium bulbs. The bulbs were planted at dept of 6cm depth with spacing of 25cm X 15cm and a light irrigation was given.

The experimental design used was Randomised Block Design (RBD) having 10 treatments and 4 replications. The experiment consisted of foliar application of three plant bio-regulators viz., Gibberellic acid (GA_3), Benzyl Adenine (BA), Chlormequat chloride(CCC). The treatments were as follows: 50 ppm GA_3, 75 ppm Chlormequat chloride, 100 ppm Chlormequat chloride, 125 ppm Chlormequat chloride, 50 ppm GA_3 + 50 ppm BA, 75 ppm GA_3 + 75 ppm BA, 75 ppm Chlormequat chloride + 50 ppm GA_3, 100 ppm Chlormequat chloride + 50 ppm GA_3, 125 ppm Chlormequat chloride + 50 ppm GA_3 and water spray as control. For preparation of solution, alcohol for GA_3 & BA and water for CCC was used for dissolving. The whole plants were sprayed at 30 days after planting. Fertilizer in the form of Urea, SSP and MOP were applied in each plot as basal dose of planting to ensure a healthy growth of plant and the recommended cultural practices were followed during the experimentation.

Plants were uprooted carefully and data on various vegetative, bud and flowering characteristics were recorded from randomly selected plants. Vegetative parameters like Plant height was recorded by measuring the length from the base (collar region) to the highest point of growth (i.e., tip of the bud development stage) of the plant and average was worked out and expressed in centimetres. The numbers of functional leaves produced after planting till the time of harvesting were counted. The length and width of the third leaf from the top of the plant before bud opening was taken and expressed in centimetres. Basal stem diameter was recorded by slide callipers at the collar region just touching the soil surface. Flower bud characteristics like days to bud appearance (emergence of first bud from date of planting), days to bud development(bud emergence and bud break) and days to bud break (days taken for splitting of bud) were recorded in days. The number of flower buds per plant, length and width of flower bud were recorded in centimetres at fully matured stage but before it opens. Flowering attributes like the date of opening of first flower and the duration of flowering from the date of planting were recorded. The length of flower stalk, number of full bloomed flowers in each plants, length and width of flower at fully opened stage, time taken from opening of the flower to shedding of the same flower, time taken from opening of the first flower to shedding of the last flower of the same spike and time taken from opening of the first flower to shedding of the last flower of the same spike were recorded. Data collected on various parameters were analysed by using OPSTAT statistical package, Hisar, India [25].

Result and discussion

Effect of Growth Regulators on Vegetative Parameters

The result showed that foliar application of 50 ppm GA_3 significantly increased the plant height (72.32cm). Increase in plant height with application of GA_3 may be due to its effect on cell elongation (Tonecki 1980) [29]. The present findings are in agreement with (Dicks *et al.* 1974) [8] in mid-century hybrid lily and (Das *et al.*, 1992) [7] in Day lily. Application of 125 ppm Chlormequat chloride significantly reduced plant height (54.76 cm) This may due to the Chlormequat chloride, a gibberellin biosynthesis inhibitor, decreases the concentration of gibberellins in plant and inhibits cell expansion by lowering the gibberellin dependant cell wall relaxation (Cosgrove and Sovonick Dunford 1989) [6]. (Ahmed *et al.* 2013) [2], reported Chlormequat chloride recorded significantly minimum plant height in Tulip (*Tulipa gesneriana* L.) which corroborated with the present findings.

Foliar application of 50 ppm GA_3 significantly increased the number of leaves per plant (81.58). (Bhalla and Kumar 2008) [4] reported that the increasing number of leaves per plant may be due to the positive effect of GA_3 on increasing the vegetative growth in gladiolus. Increased vegetative growth might have been due to increase in photosynthesis and respiration which ameliorated CO_2 fixation in the treated plant (Broughton *et al.* 1970) [5]. The present findings are in agreement with (Pal and Das 1990) [19] in Lilium *longiflorum*, (Dicks *et al.* 1974) [8] in mid-century hybrid lily and (Das *et al.* 1992) [7] in Day lily.

The revealed that application of 50 ppm GA_3 significantly increased leaf length 11.57cm. The effect of GA_3 on leaf length may due to its stimulatory effect on cell division and elongation (Tonecki 1980) [29]. Similar results were obtained by (Ismail, 1997) [12] on Narcissus. While application of 125 ppm Chlormequat chloride recorded significantly minimum leaf length (7.72 cm). The reduction in leaf length due to the retardation of the longitudinal growth of cells by (Lee and Lee 1991) [16] by Chlormequat chloride.

Foliar application of 50 ppm GA_3 and 50 ppm BA increased leaf width (2.15 cm).Similar findings were also reported by (Acharjee *et al.* 2018) [1] in Oriental Lilium hybrid cv. Sorbonne where foliar application of 50 ppm BA and 50 ppm GA_3 significantly enhanced vegetative growth.

The foliar application of 125 ppm Chlormequat chloride recorded maximum basal stem diameter (2.10 cm). This might be due to the reason that Cholrmequat chloride (cycocel) treatment reduced apical dominance and exhibited numerous changes in the growth and production characters (*Singh et al.* 2018) [26]. The present findings were in consonance with (Lijuaan *et al.* 2004) [17] on *S. baicalensis* and (Koriesh *et al.* 1989) [14] in chrysanthemum.

Effect of Growth Regulators on Bud Characteristics

The result revealed that the foliar application of 50 ppm GA_3 had significantly advanced days to bud appearance (19.37 days) and days to bud break (45.75 days). (Singh *et al.* 2018) [26] reported that GA_3 at all concentration showed positive effect on early flower bud appearance which may have been due to GA_3 causes flower initiation indirectly through the production of other flower promoting factor. Or this may also be due to increased photosynthesis and respiration along with enhanced fixation by GA_3 that led to flower bud initiation (Sen and Sen,1968) [23]. While 125 ppm Chlormequat chloride delayed bud appearance (24.25 days) and 100 ppm Chlormequat chloride delayed bud break (51.87 days). (Singh *et al.* 2018) [26], reported that CCC (Chlormequat chloride) showed reverse effect on first flower bud appearance and the formation of flower bud were delayed under the influence of

Chlormequat chloride treatment, possible due prolong vegetative growth. The present findings are in consonance with (Singh *et al.* 2018) [26] in chrysanthemum. The maximum no of buds per plant were recorded with application of 125 ppm Chlormequat chloride + 50 ppm GA_3. This also may be due to synergetic effect of both Chlormequat chloride + GA_3 reported by (Hamza and Helaly 1983) [11]. The present findings are in agreement with (Sarmah and Sarma 2009) [22] in Brassica campestris, CCC (Chlormequat chloride) along with GA_3 that recorded highest yield. The result revealed that maximum bud length of 8.56 cm and bud width of 2.43 cm was obtained in 75 ppm Chlormequat chloride+ 50 ppm GA_3. (Shanmugan *et al*. 1973) [24] reported that application of GA_3 increase auxin production in the leaves and bulbs which stimulate chemical changes in plant, PBRs are primordial, bud initiation, development of flower bud and opening of flowers. This also may be due to synergetic effect of both Chlormequat chloride + GA_3 reported by (Hamza and Helaly 1983) [11].

Effect of growth regulators on flowering parameters

The result revealed that foliar application of 50 ppm GA_3 significantly advanced the days to first flowering, requiring only 46.12 days for opening of the first flower. Early flowering by GA_3 might be due to their vital role in production and regulation of floral stimulus (Taha 2012) [27]. While Application of 125 ppm Chlormequat chloride took maximum days to first flowering (52.50 days). Delayed flowering due to growth retardants is apparently the result of growth inhibitor rather than direct effect on flowering stimulus (Ahmed *et al*. 2013) [2]. The present findings are in agreement with (Taha 2012) [27] in Iris, Mohamed (1992) [18] on gladiolus and Goma (2003) [10] on *Dahlia pinnata.*

The number of flowers per plants is another important parameter of plant growth. The result from the above findings pursued that Number of flowers per plant was significantly maximum (3.66) in treatment 125 ppm Chlormequat chloride + 50 ppm GA_3 and Number of flowers was lowered (2.33) in the control. This might be due to the stimulation of these growth parameters resulted in diverting the growth production balance towards increased number of flowers (Sarmah and Sarma 2009) [22].

The length of the flower (8.83 cm) was significantly increased with the application of 75 ppm Chlormequat chloride + 50 ppm GA_3. The increase in length of flower might be due to the additive effect of Chlormequat chloride and GA_3 (Hamza and Helaly,1983) [11]. The flower diameter was significantly higher (16.16 cm) with application of 125 ppm Chlormequat chloride. Smaller flower was produced by the Control. The present findings are in consonance with (Kottayam *et al*. 2014) [15] in Tulip.

The result showed that Foliar application of 125 ppm Chlormequat chloride + 50 ppm GA_3 significantly enhanced bloom life of individual flower (7.66 days), bloom life of whole spike (15.24 days) and vase life (14.57 days). Chlormequat chloride and GA_3 can have additive effect in hastening flowering (Hamza and Helaly 1983) [11] thus improving the blooming life as well as vase life.

Table 1: Effect of Plant Bio-Regulators on vegetative characteristics of Asiatic lilium hybrid cv. Tresor

Treatment	Plant height (cm)	No of leaves Per plant	Leaf length (cm)	Leaf width (cm)	Basal stem diameter (cm)
Control (water spray)	61.58	73.47	8.58	1.58	1.65
50ppm GA_3	72.32	81.58	11.57	1.81	1.69
75ppm Chlormequat chloride	56.21	68.16	7.94	1.77	2.06
100ppm Chlormequat chloride	55.48	67.25	7.86	1.76	2.09
125ppm Chlormequat chloride	54.76	66.33	7.72	1.86	2.10
50ppm GA_3 + 50ppm BA	65.49	77.75	10.73	2.15	1.56
75ppm GA_3 + 75 ppm BA	70.98	74.91	10.42	1.91	1.53
75ppm Chlormequat chloride + 50ppm GA_3	60.59	74.08	9.55	1.78	2.03
100ppm Chlormequat chloride + 50ppm GA_3	59.50	73.41	9.63	1.92	1.93
125ppm Chlormequat chloride + 50ppm GA_3	58.41	69.66	9.17	1.67	1.85
S.Em (±)	0.15	0.48	0.19	0.05	0.05
C.D. at 5%	0.44	1.40	0.56	0.15	0.16

Table 2: Impact of plant bio-regulators on bud characteristics of Asiatic lilium hybrid cv. Tresor

Treatment	Days to bud appearance (days)	Days to bud development (days)	Days to bud break (days)	No of buds Per plant	Bud length (cm)	Bud width (cm)
Control (water spray)	22.62	24.87	47.49	2.57	7.07	1.70
50ppm GA_3	19.37	26.37	45.75	3.08	8.05	1.97
75ppm Chlormequat chloride	23.12	26.50	50.25	3.16	7.40	2.05
100ppm Chlormequat chloride	23.62	28.25	51.87	3.24	7.26	2.21
125ppm Chlormequat chloride	24.25	23.12	47.75	3.33	7.11	2.31
50ppm GA_3 + 50ppm BA	19.50	29.12	48.62	2.91	8.25	2.07
75ppm GA_3 + 75 ppm BA	19.87	28.37	48.25	3.16	8.51	2.31
75ppm Chlormequat chloride + 50ppm GA_3	22.00	26.37	48.37	3.24	8.56	2.43
100ppm Chlormequat chloride + 50ppm GA_3	22.62	27.12	49.75	3.57	8.33	2.36
125ppm Chlormequat chloride + 50ppm GA_3	21.87	26.25	48.12	3.74	8.31	2.18
S.Em (±)	0.23	0.56	0.34	0.15	0.16	0.06
C.D at 5%	0.67	1.65	1.01	0.43	0.47	0.18

Table 3: Efficacy of Plant Bio-Regulators on Flower characteristics of Asiatic lilium hybrid cv. Tresor

Treatment	Days to first Flowering (days)	No. of Flowers per plant	Flower length (cm)	Flower diameter (cm)	Bloom life of individual flower (days)	Bloom life of whole spike (days)	Vase life(days)
Control (water spray)	47.62	2.33	7.21	13.87	5.58	12.16	11.83
50ppm GA_3	46.12	2.99	8.25	15.18	6.99	13.91	13.33
75ppm Chlormequat chloride	50.37	3.08	7.25	15.12	6.49	12.83	12.49
100ppm Chlormequat chloride	52.37	3.16	7.64	15.77	6.58	13.08	12.91
125ppm Chlormequat chloride	52.50	3.24	7.43	16.16	6.74	13.41	13.16
50ppm GA_3 + 50ppm BA	49.50	2.83	8.45	14.25	7.16	14.33	14.16
75ppm GA_3 + 75 ppm BA	49.00	3.08	8.75	15.31	6.82	13.74	13.33
75ppm Chlormequat chloride + 50ppm GA_3	48.37	3.16	8.83	15.02	6.41	12.83	12.57
100ppm Chlormequat chloride + 50ppm GA_3	48.75	3.41	8.61	15.12	6.49	12.99	12.66
125ppm Chlormequat chloride + 50ppm GA_3	50.12	3.66	8.63	15.57	7.66	15.24	14.57
SE(m+)	0.35	0.15	0.02	0.08	0.25	0.38	0.35
C.D at 5%	1.03	0.43	0.06	0.23	0.72	1.12	1.04

Conclusion

The current investigation showed that foliar application of 125ppm CCC in combination with 50ppm GA_3 enhanced the number of flowers, bloom life, vase life thus improving the flower yield and post harvest quality of Lilium Plants. Hence, this treatment may be preferred for quality flower production.

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Reference

1. Acharjee S, Beura S, Giri TK. Impact of Plant Bio-Regulators on vegetative and Bulb characteristic of Oriental Lilium hybrids cv Sorbonne. Proceeding of the National Symposium on "Recent Advances in Floriculture and Urban Horticulture in Global perspective BCKV-WB 2018, 130-131
2. Ahmed Z, Sheikh MQ, Siddique MAA, Jeelani MI, Singh A, Nazir G *et al*. Enhancing early blooming and flower quality of tulip (*Tulipa gesneriana Linn*.) through application of plant growth regulators. African Journal of Agricultural Research 2013;8(38):4780-4786
3. Attiya JH, Naji DA, Askar HM. Effect of Plant Growth Regulators (IBA, BA, and CCC) on Some Flowering Characters of Three Hybrid Lily Cultivars of (*Lilium spp. L*.). Iraqi Journal of Science 2015;56(4B):3107-3113.
4. Bhalla R, Kumar A. Response of plant bio-regulators on dormancy breaking in gladiolus, J. Ornament. Hortic 2008;11(1):1-8.
5. Broughton WJ, Hellmth EO, Young D. Role of glucose in development of the gibberellins response in peas. Biochem bophys Acta 1970;222:491-500.
6. Cosgrove DJ, Sovonick Dunford SA. Mechanism of gibberellin dependent stem elongation in peas. Plant Physiology 1989;89:184-191.
7. Das SN, Jana BK, Das BC. Effect of growth regulators on growth and flowering of *Hemerocallis aurantiaca* L. South Indian Hort. 1992;40(6):336-339.
8. Dicks JW, Gilford J McD, Rees AR. The influence of timing of application and GA on the effects of ancymidol on growth and flowering of Mid-century Hybrid lily cv. 'Enchantment'. Scientia Horticulturae 1974;1(2):153-163.
9. Dole JM, Wilkins HF. Floriculture: principles and species 1999, 285-287.
10. Goma AO. Effect of foliar spraying with gibberellic acid and calcium on growth and flowering of *Dahlia pinnata*. The 2 Conf. of Agric. and Biological Research division (Prospect of the Recent Agricultural Research 2003.
11. Hamza AM, Helaly MNM. Interaction Between Chlormequat (CCC) And Gibberellin (GA_3) On Growth, Flowering And Mineral Constituents Of Some Ornamental Plants. ISHS Acta Horticulturae 1983;137(21):197-210
12. Ismail HE. Effect of bulb soaking and foliar application of some growth regulators on growth, flowering, bulbs production and certain chemical contents in Narcissus Plants. Assiut J. Agric. 1997;28**:**36-57
13. Jimenez S, Plaza BM, Segura ML, Contreras JI, Lao TM. Peat substrate reuse in Lilium "Haveltia" crop. Commun. Soil Science and Plant Analysis 2012;43**:**243-250
14. Koriesh EM, Abou Dahab EWM Ali. Effects of CCC, gibberellic acid and nucleic acids on flowering and inflorescence characters. Asian Journal of Agricultural Sciences 1989;20(1):43-58.
15. Kottayam S, Sartaj A, Ansari H. Advancing flower quality of tulip (*Tulipa gesneriana Linn*.) through application of plant growth regulators. Journal of Horticulture And Floriculture 2014;2(2):4651
16. Lee PO, Lee JS. Effect of ancymidol and paclocutrazol on growth and flowering of potted gerbera. J. the Korean Soc. Fort. Hort. Sci. 1991;31:300-304.
17. Lijuaan X, Lei H, Yonghong L, Huikang X. Shortening effect of cycocel on potted Scutellaria baicalensis [Chinese]. Journal of Northeast Forestry University 2004;32(4):92-93.
18. Mohamed SM. Influence of some growth regulators on growth and flowering of white Godth and Oskar gladiolus cvs. Egypt Journal of Applied Science 1992;**7**:653-667
19. Pal AK, Das SN. Effect of growth regulators on growth and flowering of *Lilium longiflorum*. Orissa Journal of Horticulture 1990;18(1, 2):18-21.
20. Pandey SN, Sinha BK. Role of Auxin. Plant Physiol., Vikash Publishing House, New Delhi 1984, 432-436.
21. Rademacher W. Plant Growth Regulators: Backgrounds and Uses in Plant Production. Journal of Plant Growth Regulation 2015;34:845-872.
22. Sarmah KC, Sarma CM. Interaction between GA_3 and CCC on growth and yield of Brassica campestris L. (cv-M 27). International Journal of Plant Sciences 2009;4(2):429-43.

23. Sen PK, Sen SK. Effect of growth retarding and promoting chemicals on growth and flowering of some annuals, Indian Journal of Horticulture 1968;25:219-224.
24. Shanmugan A, Muthuswamy S, Rao VNM. A study on the effect of growth substance of chrysanthemum (*chrysanthemum indicum Linn*). Madras Agriculture Journal 1973;60:1-5.
25. Sheoran OP, Tonk DS, Kaushik LS, Hasija RC, Pannu RS. Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by Hooda DS & Hasija RC. Department of Mathematics Statistics, CCS HAU, Hisar 1998, 139-143
26. Singh J, Nigam R, Singh R, Kumar A, Kumar A. Effect of gibberellic acid and cycocel on growth, flowering and yield of chrysanthemum (*Dendranthema grandiflora ramat*) cv. birbal sahni. Journal Of Pharmacognosy And Phytochemistry 2018;SP1:2753-2758.
27. Taha AR. Effect of Some Growth Regulators on Growth, Flowering, Bulb Productivity and Chemical Composition of Iris Plants. Journal of Horticultural Science & Ornamental Plants 2012;4(2):215-220
28. Thakur R, Sood A, Nagar PK, Pandey S, Sobti RC, Ahuja PS. Regulation of growth of Lilium plantlets in liquid medium by application of paclobutrazol or ancymidol for its amenability in a bioreactor system: growth parameters. Plant Cell Rep. 2005;25**:**382-391
29. Tonecki J. Effect of growth regulators on shoot apex differentiation and changes in sugars and free amino acids in gladiolus. (gladiolus x hortorum cv. AccaLaurentia), Acta Horticulturae. 1980;109:347-356.
30. Zulfiqar F, Younis A, Abideen Z, Francini A, Ferrante A. Bioregulators Can Improve Biomass Production, Photosynthetic Efficiency, and Ornamental Quality of *Gazania rigens* L. Agronomy 2019;9:773-786.