Analysis of bio- stimulant effectiveness for improved phenotypic attributes and post - harvest life of Asiatic lily cv. Indian Summerset

ABSTRACT

The study was conducted at the Research Farm at Department of Horticulture, Sam Higginbottom University of Agriculture, Technology, and Sciences in Prayagraj during the years 2021-22 and 2022-23. The experiment involved thirteen treatments namely triacontanol at concentrations of 10ppm, 15ppm, 20ppm, and 25ppm, brassinolide at concentrations of 5ppm, 10ppm, 15ppm, and 20ppm and nitrobenzene at concentrations of 100ppm, 200ppm, 300ppm, and 400ppm, organized in Randomized Block Design with three replications. These treatments were applied twice at fifteen-days interval. The result revealed that T_5 - triacontanol @ 25 ppm demonstrated the most favorable outcomes concerning plant height (63.3 cm), number of leaves per plant (62.6), leaf area (14.9 cm^2), and diameter of shoot (12.9 mm) while T_9 - brassinolide @ 20 ppm marked longer vase life (9.8 days).

Keywords: Asiatic lily, flower, bio-stimulants, triacontanol, brassinolide, nitrobenzene.

Introduction

Asiatic lilies are an exquisite choice for cut flowers, offering a stunning array of sizes, shapes, colours along with striking trumpet-shaped blossoms (Dole *et al.*, 1999*)*. bio-stimulants have the ability to modify physiological processes in plants, which can play crucial role in enhancing the phenotypic characteristics of Asiatic lilies. Bio-stimulants can be defined as substances and materials that when applied to plants in particular compositions, can alter the physiological processes of plants, offering potential advantages for their growth, development, and responses to stress. They exhibit actions like established plant hormone groups (Yaronskaya *et al.*, 2006) and provide an innovative avenue for regulating and altering physiological processes in plants, with the aim of stimulating growth, alleviating the constraints imposed by various biotic and abiotic stress, and ultimately boosting crop quality and yield. Triacontanol, brassinolide and nitrobenzene positively influence the growth and development of plants. Triacontanol is a potential bio-stimulant. It can effectively improve various physiological parameters of Asiatic lily by influencing the metabolism of plant. Brassinolide is steroidal compound which acts as a vital molecule within the plant part for growth as well as development of Asiatic lily. Brassinolide are known as sixth-generation plant hormones (Khripach *et al.*, 2000). Nitrobenzene can be described as a pale-yellow oil which have almond-like odour. Flowering crops have been known to respond well to nitrobenzene, as in past, Nitrobenzene has improved the flowering attributes in many plants. Nitrobenzene are new generation plant growth promoter which have crucial role in energizing flowering stimulant and enhancing the yield *(*Aziz and Miah, 2009, 28-30).

Materials and Methods

The research was carried out during 2021-22 and 2022-23 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Naini, Prayagraj. The experiment compromised of thirteen treatments which were replicated thrice. The treatments were T_1- Control, T_2- 10 ppm Triacontanol, T_3-15 ppm Triacontanol, T_4-20 ppm Triacontanol, T_5- 25 ppm Triacontanol, T_6-5 ppm Brassinolide, T_7-10 ppm Brassinolide, T_8-15 ppm Brassinolide, T_9-20 ppm Brassinolide, T_{10}-100 ppm Nitrobenzene, T_{11}- 200 ppm Nitrobenzene, T_{12}-300 ppm Nitrobenzene, T_{13}- 400 ppm Nitrobenzene. Application of bio-stimulants were done two times. The first application was done after fifteen days of planting.

Results and discussion

Plant height

After 40 days of planting significantly taller plants (45.7 cm) were reported in T_5 (triacontanol at the rate of 25 ppm) which was found to be at par with T_4, (triacontanol at the rate of 20 ppm, 43.4 cm), T_9 (brassinolide at the rate of 20 ppm, 43.2 cm) while T_1 (control,) reported significantly shorter plants (34.6 cm). 60 days after planting, similar results with respect to plant height were obtained, T_5 (triacontanol at the rate of 25 ppm) reported significantly taller plants (63.3cm) which was followed by (triacontanol at the rate of 20 ppm, 58.0 cm) whereas T_1 (control reported significantly shorter plants (47.9 cm). The observed increase in plant height can be attributed to the rapid translocation of triacontanol, facilitating the formation of L adenosine. This, in turn, triggered signals throughout the plant, leading to increased apoplastic ion concentration within stem tissues, promoting shoot development and elongation and consequently increasing plant height (Ries *et al.,* 1990). These findings align with previous research by Koley *et al.* (2019) in gladiolus and Naeem *et al.* (2019) in periwinkle, further supporting the efficacy of triacontanol and bio-stimulants in enhancing plant growth and development

Number of leaves

After 40 days of planting, significantly more number of leaves per plant (56.9) were reported in T_5 (triacontanol at the rate of 25 ppm) which was found to be at par with T_4 (triacontanol at the rate of 20 ppm, 55.5) while T_1 (control) reported significantly lesser number of leaf (40.2). 60 days after planting, similar results with respect to number of leaves per plant (62.6) were reported in T_5 (triacontanol at the rate of 25 ppm) which was at par with T_9 (brassinolide at the rate of 20 ppm, 62.0) whereas T_1 (control) reported significantly lesser number of leaves per plant (49.5). More number of leaves in triacontanol treated plants might be attributed to its role in increasing stomatal conductance and net photosynthesis of the plant. photosynthetic capacity depends on photosynthetic pigment capacity such as accrual of chlorophyll (a, b and a+b) which is induced significantly with application of triacontanol. All these traits significantly influence the internal fixation of CO_2 in the mesophyll tissue thus elevating the number of leaves (Ivanov and Angelov, 1997). Triacontanol positively influences the number of leaf and nodes of *Capsicum frutscens* (Reddy *et al.,*2002). Muthuchelian *et al.* (2001) also discussed positive relation with triacontanol in increasing the integration of chlorophyll *a* and *b* along with CO_2 assimilation in Indian coral tree. Similar findings were reported by Bhandari *et al.* (2021) in kohlrabi, Koley *et al.* (2019) in gladiolus and Moorthy and Kathiresan, 1993 in mangrove.

Leaf area

After 40 days of planting significantly bigger leaf area (11.3 cm^2) were reported in T_5 (triacontanol at the rate of 25 ppm) followed by T_4 (triacontanol at the rate of 20 ppm, 10.1 cm^2), while T_1 (control) reported significantly shorter leaf area. (7.6 cm^2). 60 days after planting, similar results with respect to leaf area were obtained, T_5 (triacontanol at the rate of 25 ppm) reported significantly higher leaf area (14.9 cm^2) which was followed by T_4 (triacontanol at the rate of 15 ppm, 13.4 cm^2) whereas T_1 (control) reported significantly smaller leaf area (10.3cm^2). Triacontanol application is involved in stimulation of calcium, magnesium and potassium by elication of the messenger adenosine. The elevation in the mineral content of plant may be responsible for the increase in blade length, epidermal cells and chlorophyll which have accounted for increased leaf area. (Naeem *et al.*, 2011). Triacontanol have positive effect on leaf area and bract growth of bougainvillea (Khandakar *et al.*, 2013). These are in conformity with the findings of Skogen *et al.* (2009) in chrysanthemum, Mallick *et al.* (2009) in potato and Reddy *et al.* (2002) in capsicum.

Diameter of shoot

After 40 days of planting significantly larger diameter of shoot (8.8 mm) were reported in T_5 (triacontanol at the rate of 25 ppm) which was found to be at par with T_4 (8.4 mm, triacontanol at the rate of 20 ppm), while T_1 (control) reported significantly shorter diameter of shoot (6.1 mm). 60 days after planting, similar results with respect to diameter of shoot were obtained, T_5 (triacontanol at the rate of 25 ppm) reported significantly larger diameter (12.9 mm) which was at par with T_9 (brassinolide at the rate of 20 ppm, 12.3 mm), T_4 (triacontanol at the rate of 20 ppm, 12.2 mm) whereas T_1 (control) reported significantly smaller diameter (9.4 mm). The increase in diameter of shoot may be due to the fact that triacontanol is linked with the rbc*S* gene levels which helps in increment of the activity of photosynthesis and also improves the status of photosystems which is involved in enhancing water absorption, promoting cell division and elongation, along with improving cell membrane permeability which ultimately increased the girth of the shoot (Borowski *et al.*, 2009). Application of triacontanol has a positive role in increasing the shoot development of the plant (Naeem *et al.*, 2012). Triacontanol increased the height and leaf area in tomato plants. (Khan *et al.*, 2009). These are in conformity with the findings of Naeem *et al.* (2011) in mint and karam and keramat (2017) in coriander.

Vase life

Longer vase life (9.8 days) reported in T_9 (brassinolide at the rate of 20 ppm) which was followed by T_8 (brassinolide at the rate of 15ppm, 9.4 days) while T_1 (control) reported significantly shorter vase life (6.8 days). Brassinolides have the potential to improve leaf water use efficiency by influencing the carbon capture by Rubisco enzyme along with maintaining the permeability of plasma membrane (Tanveer *et al.*,2018). Another reason could be that respiration rate is inhibited by application of brassinolide along with enhancing the anti-oxidant capacity. Hence, brassinolide application lead to decline in ethylene production increasing post - harvest life of the flower (Zheng *et al.*, 2018). These findings are in support with Kuri *et al.* (2018) in china aster.

Conclusion

On the basis of experimental findings it was concluded that treatment T_5 - triacontanol at the rate of 25 ppm was found most suitable in respect to plant height, number of leaves per plant, leaf area and diameter of shoot while T_9 - brassinolide at the rate of 20 ppm reported longer vase life
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Table No. 1 Response of bio-stimulants on Plant height and number of leaves per plant in Asiatic lily plants

	Plant height (cm)						**Number of leaves per plant**					
	2021-22		**2022-2023**		**Pooled data**		**2021-22**		**2022-2023**		**Pooled data**	
Treatment	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**
T_1- Control	33.2	46.9	36.0	47.9	34.6	47.4	41.3	48.3	39.1	50.7	40.2	49.5
T_2- 10 ppm Triacontanol	39.1	49.7	39.4	56.0	39.2	53.5	47.8	54.4	52.1	53.7	50.0	54.0
T_3-15 ppm Triacontanol	40.0	52.7	40.9	56.5	40.6	55.3	49.9	59.3	48.8	57.1	49.3	58.2
T_4-20 ppm Triacontanol	42.8	56.9	44.0	59.8	43.4	58.0	54.1	61.3	56.8	59.3	55.5	59.7
T_5- 25 ppm Triacontanol	44.8	59.9	49.9	64.1	45.7	63.3	56.7	62.9	57.0	62.5	56.9	62.6
T_6- 5 ppm Brassinolide	38.8	50.8	37.3	52.0	38.4	51.4	48.3	56.0	44.4	57	46.4	57.2
T_7-10 ppm Brassinolide	40.0	52.1	37.9	53.3	39.1	52.7	49.7	56.5	45.3	57.1	47.5	58.1
T_8-15 ppm Brassinolide	41.4	54.7	39.6	55.2	40.5	54.9	50.3	58.3	45.9	55.4	48.1	57.4
T_9-20 ppm Brassinolide	42.0	56.6	43.0	56.3	43.2	56.5	52.7	61.0	52.6	56.6	52.7	58.0
T_{10}-100 ppm Nitrobenzene	34.6	49.4	36.7	51.2	35.6	50.3	43.3	50.3	42.2	55.4	42.7	52.9
T_{11}- 200 ppm Nitrobenzene	36.6	51.0	38.8	51.3	37.7	51.1	44.9	51.9	43.6	57.0	44.2	54.6
T_{12}-300 ppm Nitrobenzene	38.3	52.4	40.0	51.8	39.2	52.1	46.0	54.9	43.4	57.2	44.7	57.1
T_{13}- 400 ppm Nitrobenzene	37.6	53.3	40.9	52.1	39.3	52.7	47.0	56.3	46.2	57.4	46.6	56.5
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S. Ed (±)	2.220	2.695	2.774	3.742	1.572	2.259	3.006	3.020	1.956	2.630	1.940	1.000
$CD_{0.05}$	4.583	5.564	5.727	7.486	3.246	4.663	6.206	6.233	4.039	5.430	4.004	1.983
CV	6.92	6.25	7.87	8.16	4.84	5.14	6.54	6.56	4.79	5.52	4.98	2.05

Table No. 2 Response of bio-stimulants on the leaf area and diameter of shoot in Asiatic lily plants

	Leaf area (cm^2)						Diameter of shoot (mm)					
	2021-22		2022-2023		Pooled data		2021-22		2022-2023		Pooled data	
Treatment	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**	**40 days**	**60 days**
T_1- Control	7.2	10.3	7.9	10.2	7.6	10.3	6.4	9.0	6.1	9.7	6.14	9.4
T_2- 10 ppm Triacontanol	9.3	11.3	8.8	12.4	9.1	11.8	7.5	11.0	8.0	11.8	7.24	11.4
T_3-15 ppm Triacontanol	9.4	11.5	8.9	12.5	9.2	12.0	8.2	11.4	8.2	12.5	7.89	12.0
T_4-20 ppm Triacontanol	10.8	13.6	9.5	13.3	10.1	13.4	8.5	11.9	8.6	13.0	8.43	12.2
T_5- 25 ppm Triacontanol	12.0	14.4	10.7	15.7	11.3	14.9	8.9	12.9	9.1	13.6	8.86	12.9
T_6- 5 ppm Brassinolide	8.4	12.3	8.7	12.2	8.5	12.2	7.6	10.6	7.5	11.5	8.23	11.1
T_7-10 ppm Brassinolide	8.8	12.4	8.7	12.3	8.8	12.4	7.8	10.9	7.7	11.9	7.68	11.4
T_8-15 ppm Brassinolide	9.3	13.2	8.9	12.3	9.1	12.7	7.9	11.1	7.9	12.1	7.88	11.6
T_9-20 ppm Brassinolide	9.9	13.3	9.3	12.8	9.6	13.0	8.3	11.3	8.1	12.6	8.06	12.3
T_{10}-100 ppm Nitrobenzene	8.2	11.8	8.3	11.7	8.2	11.8	6.6	9.9	6.8	10.2	7.62	10.1
T_{11}- 200 ppm Nitrobenzene	8.1	12.0	8.5	11.6	8.3	11.8	6.5	10.2	7.1	10.7	6.91	10.5
T_{12}-300 ppm Nitrobenzene	8.5	12.2	8.7	12.1	8.6	12.2	7.4	10.4	7.3	11.3	6.99	10.9
T_{13}- 400 ppm Nitrobenzene	8.8	12.6	9.2	12.5	9.0	12.6	7.7	11.3	7.8	12.2	7.65	11.8
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S. Ed (±)	0.656	0.719	0.633	0.938	0.463	0.558	0.466	0.74	0.56	0.695	0.293	0.436
$CD_{0.05}$	1.354	1.484	1.308	1.937	0.957	1.153	0.962	1.527	1.157	1.435	0.606	0.900
CV	8.75	7.15	8.64	9.20	6.26	5.52	7.43	8.29	8.9	7.25	4.70	4.70

Table No.3 Effect of bio-stimulants on vase Life in Asiatic lily plants

	Vase life		
Treatment	**2021-22**	**2022-23**	**Pooled data**
T_1- Control	6.6	7.1	6.8
T_2- 10 ppm Triacontanol	6.7	7.4	7.1
T_3-15 ppm Triacontanol	7.7	7.9	7.8
T_4-20 ppm Triacontanol	7.7	8.0	7.8
T_5- 25 ppm Triacontanol	8.7	8.9	8.8
T_6- 5 ppm Brassinolide	7.9	8.1	8.0
T_7-10 ppm Brassinolide	8.7	8.5	8.6
T_8-15 ppm Brassinolide	9. 1	9. 7	9.4
T_9-20 ppm Brassinolide	9.8	9.9	9.8
T_{10}-100ppm Nitrobenzene	8.6	8.6	8.6
T_{11}- 200 ppm Nitrobenzene	8.0	8.4	8.2
T_{12}-300ppm Nitrobenzene	8 .7	9. 2	9.0
T_{13}- 400 ppm Nitrobenzene	9. 1	9. 1	9.1
F-test	**S**	**S**	**S**
S. Ed (±)	0.375	0.493	0.385
$CD_{0.05}$	0.775	1 .018	0.795
CV	5.57	7.09	5.63

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