Published with Open Access at Journal BiNET
Vol. 30, Issue 02: 2551-2558
Journal of Bioscience and Agriculture Research

Journal Home: www.journalbinet.com/jbar-journal.html

Growth and flowering of Lisianthus with different nitrogen doses

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Article received: 10.06.2023; Revised: 20.08.2023; First published online: 30 August, 2023

ABSTRACT

A field experiment was accomplished at the Horticulture farm of Sher-e-Bangla Agricultural University to study the effect of nitrogen doses on the growth and flowering of Lisianthus (variety-SAU Blue Nandini). Nitrogen doses viz. N_1=225 kg ha^{-1} (BARI recommended for marigold), N_2= 250 kg ha^{-1}, N_3= 275 kg ha^{-1} of urea were used in this experiment arranged in a Randomized Complete Block Design with three replications. Data on different growth and flower yield attribute parameters were taken in which all the treatments showed significant variations. The results showed that alluded nitrogen applications had a synergistic effect on growth and flowering attributes positively. Tallest plants (80.4 cm), the maximum number of leaves (74.1), highest SPAD value (60.9), highest stem length (63.1 cm) and maximum stem diameter (5.8 mm), highest peduncle length (13.4 cm), maximum stem number per plant (7.2), flower number per plant (42.6) was found from N_3 whereas minimum in N_1. The study showed that higher nitrogen application would be the potential for Lisianthus production among all the doses.

***Key Words**: Nandini, Eustoma grandiflorum, Growth and Flowering.*

Cite Article: Husna, M. A., Sultana, M. N., Maliha, M., Raisa, I. and Uddin, A. F. M. J. (2023). Growth and Flowering of Lisianthus with Different Nitrogen Doses. Journal of Bioscience and Agriculture Research, 30(02), 2551-2558.
Crossref: https://doi.org/10.18801/jbar.300223.308

I. Introduction

Lisianthus (*Eustoma grandiflorum*) belongs to the family Gentianaceae, originating from the eastern slope of the Rocky Mountains, USA (Halevy and Kofranek, 1984). Lisianthus is a newcomer in Bangladesh and popularly known as Nandini. Lisianthus has been ranked one of the most lucrative and expensive cut flowers in the world. It has a great cosmopolitan demand mainly for its large and attractive flowers, long and hard stem, long vase life, wide range of colors, especially have purple, blue, lavender. However, in Bangladesh, there is no recommended technology for Lisianthus production. In particular, optimum fertilizer doses are still unknown for Lisianthus flower production to meet the demand and it is imperative to provide more information to the growers for higher productivity and quality. For the sustainable flower, production requires optimal fertilizer management and nutrients. Nutrients such as nitrogen play a major role in the growth and development of plants (Scott, 2008).

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Nitrogen is one of the very important major plant nutrients which directly affect plant growth and flowering behavior. Among different essential plant nutrients, nitrogen is considered to be the most crucial and nitrogen applied as fertilizer is considered the key source for meeting the nitrogen requirements of plant growth (Konnerup and Brix, 2010) because it is a constituent of protein and nucleic acid which is helpful in plant growth (Haque, 2001). On the other side, excessive and improper use of nitrogen fertilization has a detrimental effect because high nitrogen application influences dark green leaves and leads to delayed flowering. Proper nitrogen application at the correct rates and time contributes to the optimal growth and higher number of flower and seed yield of ornamentals (Swetha et al., 2018). Therefore, this study aims to determine the optimum nitrogen doses for growth and flowering of Lisianthus production in Bangladesh condition.

II. Materials and Methods

The experiment was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, from January until March 2023, to study the performance of growth and yield of Nandini (Lisianthus) to different applications of nitrogen. Seeds of Lisianthus (variety-SAU Blue Nandini) were used in this experiment and seeds were collected from Takii Seed Co. The seeds were sown in 200 holes plug trays filled with growth medium and placed in Plant factory (growth chamber). Required care for proper development of seedlings was taken and 70 days old seedlings (with 2-3 pair true leaves) were taken for transplanting into the field. The field experiment was accomplished with three replications following Randomized Complete Block Design (RCBD). This study was conducted with three doses of Nitrogenous fertilizer (Urea), where N_1 = 225 kg/ha urea (103.5 kg N), N_2 = 250 kg/ha urea (115.0 kg N), N_3 = 275 kg/ha urea (126.5 kg N). Data have been collected based on three attributes: growth-related parameters, yield attributing parameters and quality attributes parameters. All the data recorded for different parameters were statistically analyzed using Statistix-10 scientific analysis software to find out the significance of variation among the treatments and treatment means were compared by LSD test at a 5% level of probability.

III. Results and Discussion

Plant height

Significant variation was found in the effect of different nitrogen doses regarding plant height. The shortest plant height ranged from 15.1 cm to 80.4 cm at 30, 45, 60, 75 and 90 DAT. The tallest plant (26.7 cm, 42.1 cm, 55.7 cm, 69.0 cm and 80.4 cm at 30, 45, 60, 75 and 90 DAT, respectively) was found from N_3 where the shortest plant (15.1 cm, 30.6 cm, 45.2 cm, 57.5 cm and 66.6 cm at 30, 45, 60, 75 and 90 DAT respectively) was observed from N_1 (Figure 01). The present finding also agreed with the results of Baral et al. (2012). Plant height as well as growth of plants significantly increased with the application of nitrogen fertilizers, as reported by Dahal et al. (2014). Hong et al. (2008) reported optimizing nitrogen (N) nutrition is required for healthy and vigorous plants. The plants absorbed nitrogen, stimulating plant growth and induced the plant protoplasm, increasing plant height (Jamil et al., 2016).

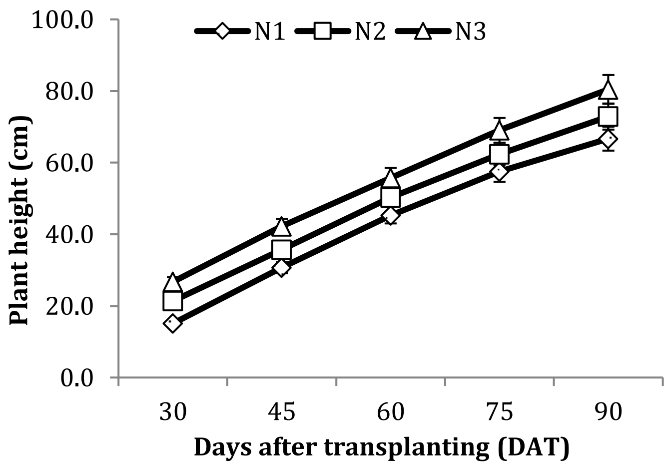

Figure 01. Effect of different nitrogen doses on plant height (cm) at different days after transplanting (Here, N_1: 225 kg Urea/ha.; N_2: 250 kg urea/ha. and N_3: 275 kg urea/ha.)

Number of leaves per plant

Significant variation was recorded for number of leaves per plant of Lisianthus with application of different levels of nitrogen at 30, 45, 65, 75 and 90 DAT (Figure 02). At 30, 45, 65, 75 and 90 DAT the maximum number of leaves per plant was 23.7, 37.0, 50.0, 62.7 and 74.1, respectively, which was obtained from N_3 (275 kg urea/ha) and the minimum number of leaves per plant (12.6, 21.2, 35.2,47.4 and 57.2 at 30, 45, 65, 75 and 90 DAT respectively) was found from N_1 (225 kg urea/ha). It was revealed that the number of leaves per plant varied with the variation of nitrogen doses, where higher doses of nitrogen level showed a higher number of leaves per plant at all growth stages. Maximum number of leaves per plant was recorded for highest level of nitrogen because nitrogenous fertilizer ensures favorable conditions for the growth of Lisianthus. Similar findings were observed by Tittonell et al. (2003), Rincon et al. (1998) and Boroujerdnia and Ansari (2007).

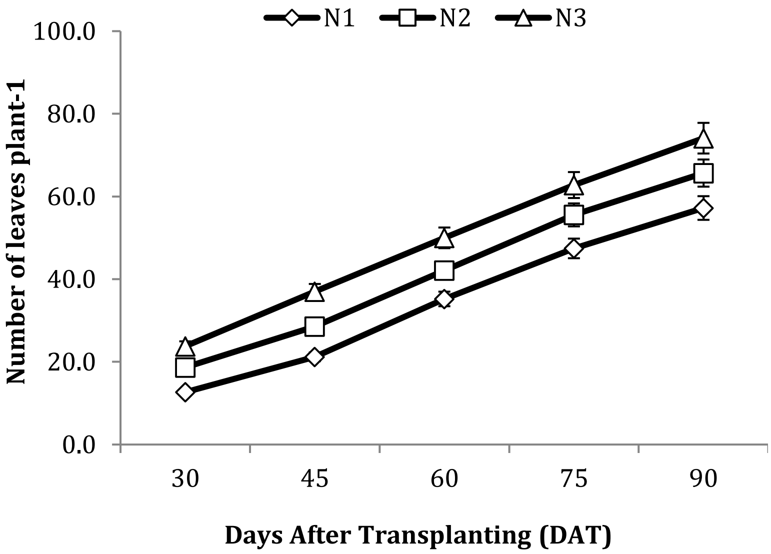

Figure 02. Effect of nitrogen doses on number of leaves per plant at different days after transplanting (Here, N_1: 225 kg Urea/ha.; N_2: 250 kg urea/ha. and N_3: 275 kg urea/ha.)

Leaf length

Application of different levels of nitrogen showed statistically significant variation for leaf length of Lisianthus (Table 01). The highest leaf length was 6.7 cm, which was achieved from N_3 (275 kg urea/ha). Again, the lowest leaf length 4.5 cm, was found from N_1 (225 kg urea/ha). Results showed that higher doses of nitrogen cause higher leaf length. Optimum vegetative growth occurred due to higher amount of nitrogen fertilizer, leading to the growth of Lisianthus and the ultimate result was the longest leaf (Plate 01). Application of nitrogen helps synthesize protein, which is the main constituent in plants. Thus, the higher supply of nitrogen through fertilizer in the experiment had increased the synthesis of amino acids in plants, thereby increasing vegetative growth of the plant. Mishra (1998) also reported that growth characters in gaillardia plant were significantly increased with higher doses of nitrogen application.

Table 01. Effect of nitrogen doses on SPAD value, leaf length, stem number per plant of Lisianthus

Treatment	SPAD Value	Leaf length (cm)	Stem Number/plant
N_1	41.2 c	4.5 c	4.8 c
N_2	48.6 b	5.7 b	6.1 b
N_3	55.8 a	6.7 a	7.2 a
LSD	2.4	0.1	0.4
CV	2.9	1.6	6.4

SPAD Value

Chlorophyll enhances the growth of a plant, which is correlated with plant growth (Plate 01). Chlorophyll (%) on leaves (SPAD reading) showed significant variation with the application of different nitrogen doses at different days after transplanting (Table 01). The highest SPAD value, 55.8 was measured at 80 DAT from $N_{3,}$ whereas the lowest was 41.2 at 80 DAT from N_1 (Table 01).

Chlorophyll content of leaves is frequently correlated with photosynthetic capacity, with leaf N status, and RuBP carboxylase activity (Evans, 1998; Seemann et al., 1987).

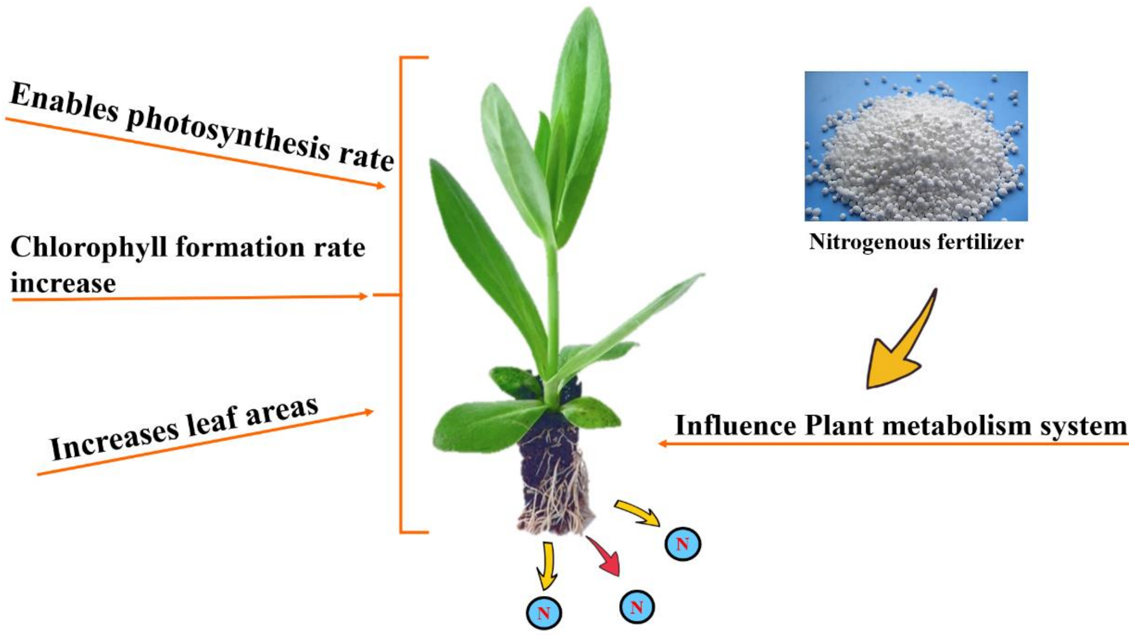

Plate 01. Nitrogen uptake efficiency of plant during growth stages

Number of stems per plant

Significant difference was revealed in number of stems per plant with different doses of nitrogen application. Among them, the maximum stem per plant (7.2) was observed in N_3, while minimum stem number (4.7) was found in N_1 (Table 01). Acharya and Dashora (2004) reported that nitrogen produced the maximum vegetative growth in marigold plants. This might be due to an increased uptake of the nutrient. Being, nitrogen is a constituent of protein, component of protoplasm and chlorophyll, all these factors contribute to cell multiplication, cell enlargement and cell differentiation, resulting in increased photosynthesis and translocation.

Stem length

Stem length at harvest showed statistically significant difference due to the effect of different nitrogen doses (Figure 03). The highest stem length (63.1 cm) was recorded in N_3 (Figure 03). On the other hand, lowest length (49.9 cm) was recorded in N_1 treatment. Iqbal et al. (2008) observed that various nitrogen levels significantly affect plant physiological parameters. Nitrogen promotes vegetative growth and stimulates the flower opening cycle during flowering (Fan et al., 2005 and Plate 02).

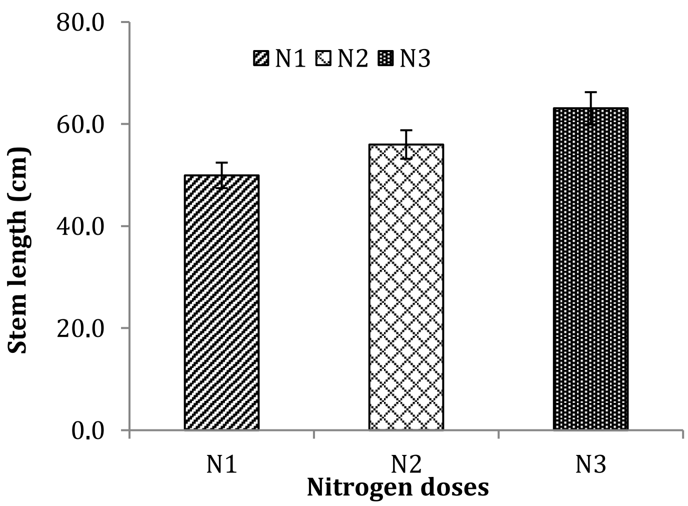

Figure 03. Effect of nitrogen doses on stem length

(Here, N_1: 225 kg Urea/ha.; N_2: 250 kg urea/ha. and N_3: 275 kg urea/ha.

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Stem diameter

The difference in nitrogen doses for stem diameter (mm) was significant (Figure 04). The maximum diameter of stem (5.8 mm) was observed in N_3, while the lowest stem diameter (4.2 mm) was found in N_1 (Figure 04). The increase in growth characters and yield components from increased nitrogen levels might be due to the role of nitrogen in stimulating vegetative growth. The hypothesis is that nitrogen is a constituent of protein, nucleic acids and nucleotides that are essential to the metabolic function of plants. Parallel findings to this experiment have been cited in other research (Ayub et al., 2007).

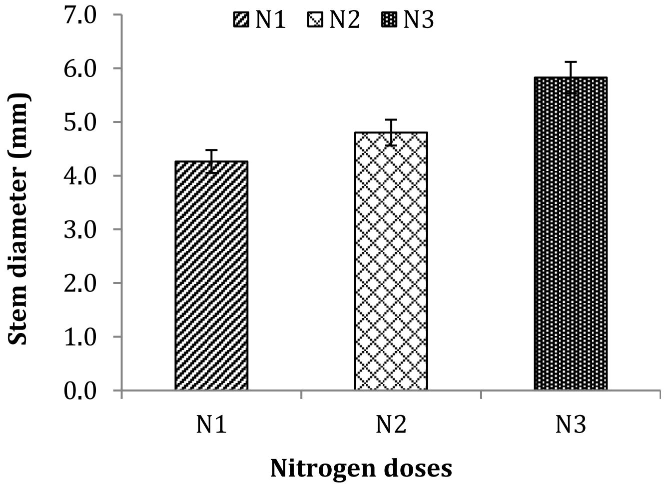

Figure 04. Effect of nitrogen doses on stem diameter

(Here, N1: 225 kg Urea/ha.; N2: 250 kg urea/ha. and N3: 275 kg urea/ha.)

Number of flower buds per stem

Significant variation was found in case of number of flower buds/stem among different levels of nitrogen application (Table 02). The highest number of flower buds/stem was observed in N_3 (9.8) and the minimum was observed in N_1 (7.5) (Table 02). This finding is in agreement with that of Mojiri and Arzani (2003). It may be due to application of nitrogen fertilizer (urea) and higher doses of urea induced flower.

Number of flowers per stem

Number of flowers per stem of Lisianthus showed a prominent effect among different doses of nitrogen levels (Table 02). The results revealed that a higher nitrogen fertilizer application rate induced maximum flower. The maximum number of flowers (5.8) was observed in N_3 treatment, while the minimum number (4.44) was found in N_1 treatment (Table 02). Similar results were found in Adhikari et al. (2020). Flower number increased due to quick vegetative growth and thereafter, enhancing reproductive development of flower under optimum nitrogen treatment. Higher content of nitrogen might have also accelerated protein synthesis which promotes earlier floral primordial development.

Number of flowers per plant

Significant variation was found in case of number of flowers per plant among different levels of nitrogen application (Table 02). The results revealed that higher the rate of nitrogen fertilizer application induced maximum flower. The maximum number of flowers (42.6) was observed in N_3 treatment, while the minimum number (21.5) was found in N_1 treatment (Table 02). These findings are similar to those of Rajiv and Misra (2003). Higher rate of nitrogen might have quick vegetative growth that promotes floral development and increased Flower number (Table 02 and Plate 02).

Number of flowers per plot

Significant variation was observed in number of flowers per plant among different levels of nitrogen application (Table 02). The results revealed that higher rate of nitrogen fertilizer application induced maximum flower. The maximum number of flowers (1219.3) was observed in N_3 treatment, while the minimum number (605.0) was found in N_1 treatment (Table 02). A similar result was found in marigold plant (Singh and Kumar, 2009). This might be due to high nitrogen-enhanced vegetative growth that promotes the number of flowers per plant (Plate 02).

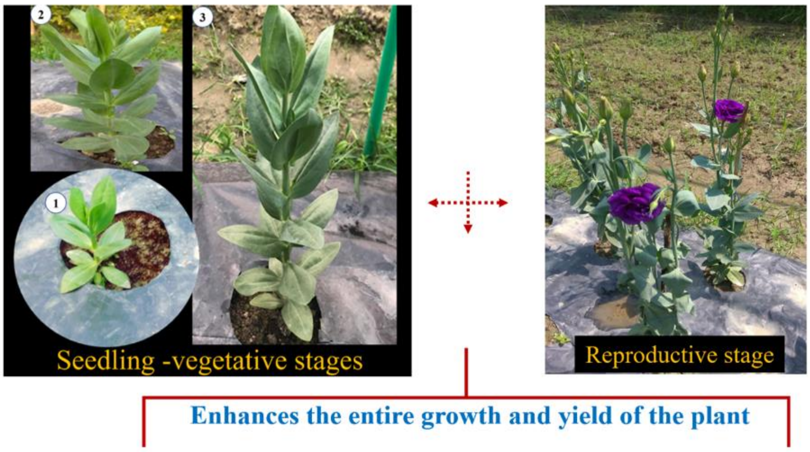

Plate 02. The Significant role of nitrogen as nitrogenous fertilizer influences the entire life cycle of plant

Table 02. Effect of nitrogen doses on number of flower buds per stem, number of flowers per stem, number of flowers per plant and number of flower yield per plot of Lisianthus

Treatment	Flower bud per stem		Flower per stem		Flower per plant		Flower yield per plot	
N_1	7.5	c	4.4	c	21.5	c	605.0	c
N_2	8.4	b	5.3	b	32.5	b	923.3	b
N_3	9.8	a	5.8	a	42.6	a	1219.3	a
LSD	0.7		0.4		1.5		8.6	
CV	9.0		8.4		4.8		0.9	

Here, N_1: 225 kg Urea/ha.; N_2: 250 kg urea/ha. and N_3: 275 kg urea/ha.)

Peduncle length

Significant variation was observed in peduncle length of flower among different levels of nitrogen application (Table 03). The highest peduncle length (13.4 cm) was recorded in N_3 (Table 3) On the other hand, lowest length (10.6 cm) was recorded in N_1 treatment. This might have important role in metabolic activities of the plant resulting in the synthesis of chlorophyll and cytochromes, which are essential for photosynthesis and respiration process in the plants (Thanapornpoonpong et al., 2008) that increase growth.

Receptacle diameter

This study showed that application of nitrogen levels significantly influenced flower receptacle diameter of Lisianthus compared to the control and receptacle diameter increased when the nitrogen rate increased (Table 03). The maximum peduncle diameter (8.4 mm) was recorded in N_3 (Table 03). On the other hand, lowest result (7.5 mm) was recorded in N_1 treatment. This might be due to greater uptake of nutrients into the plant system, which involved cell division, cell elongation and protein synthesis, which ultimately enhanced the plant parts. Similar results were found by Lehri et al. (2011).

Flower head diameter

Flower head diameter greatly varied with the application of different doses of nitrogen fertilizer (Table 03). The maximum flower head diameter (6.2 cm) was observed in N_3, while the lowest diameter (5.1 cm) was found in N_1 (Table 03). This might be a facilitative response of nitrogen to extend the plant growth stages due to its involvement in structural support of cell membrane as well as in non-structural components of enzymes, nucleic acids, amino acids and chlorophyll pigments (Seilsepour and Rashidi, 2011).

Petal number per flower

Significant variation was observed in number of petals per flower among different levels of nitrogen application (Table 03). The results revealed that higher nitrogen fertilizer application rate induced maximum number of petals per flower. The maximum number of flowers (19.89) was observed in N_3 treatment, while the minimum number (15.2) was found in N_1 treatment (Table 03). Fertilizer

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application with an appropriate dose of nitrogen seemed to have increased the number of flowers per plant in Gerbera. Similar result was obtained by Nayak et al. (2005).

Table 03. Effect of nitrogen doses on peduncle length, receptacle diameter, flower head diameter and number of petals per flower of Lisianthus

Treatment	Peduncle length (cm)		Receptacle dia. (mm)		Flower head dia. (cm)		No. of petal/ flower	
N_1	10.6	c	7.5	c	5.1	c	15.2	c
N_2	12.1	b	7.8	b	5.7	b	18.3	b
N_3	13.4	a	8.4	a	6.2	a	19.8	a
LSD	0.7		0.1		0.1		0.5	
CV	6.2		1.6		2.7		3.0	

*Here, N_1: 225 kg Urea/ha.; N_2: 250 kg urea/ha.; N_3: 275 kg urea/ha

IV. Conclusion

Concerning the above results, it can be articulated that different doses of nitrogen showed significant variation in Lisianthus growth and flowering. According to result, nitrogen doses N_3 (126.5 kg N) showed tallest plant height, maximum stem number, SPAD value, stem length, stem diameter, flower head diameter, peduncle length, receptacle diameter and ultimately the highest yield, even recorded maximum petal number per flower. To sum up, it can be concluded that N_3 (126.5 kg N) as a source of (275 kg/ha urea) was the most suitable dose for the better growth, yield and quality attributes of Lisianthus production.

Acknowledgment

We would like to express our gratitude to Krishi Gobeshona Foundation (KGF) for providing financial support for this research work.

V. References

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