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Influence of Nitrogen Fixing Biofertilizers on Growth, Flowering, Quality and Yield of Lupine (*Lupinus perennis* L.) Cut Flower at Graded Levels of Nitrogen

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ABSTRACT: Lupine (*Lupinus perennis* L.) cut flower is a very versatile cut flower with a lot of potential for usage. Since very little study has been done on the "Influence of nitrogen fixing biofertilizers on growth, flowering, quality and yield of Lupine at graded levels of nitrogen", a study was carried out to obtain quality produce of Lupine cut flower. The experiment was laid out in Randomized Complete Block Design (RCBD) with 8 treatments and 3 replications. As the recommended dose of nitrogen is high, nitrogen is reduced up to 25 % and incorporated with biofertilizers which not only improved the flower quality and yield but also reduced the use of inorganic nitrogen which may affect the soil. The results revealed that growth parameters like plant height (59.36 cm), number of branches per plant (19.44) and number of leaves per plant (87.67) recorded maximum in treatment T_7 (100% Recommended dose of nitrogen (75 kg/ha) + P (25 kg/ha) + K (45kg/ha) + *Rhizobium* + *Azotobacter* (625ml/ha))Whereas, flowering parameters such as minimum days taken for flower bud initiation (46.67), flower stalk emergence (49.60), 50 per cent flowering (22.20) and duration of flowering (164.52 days), whereas flower quality parameters like stalk length (69.51 cm), number of florets per stalk (135.20), diameter of flower (1.57 cm) and yield parameters like number of stalks per plant (6.25), per plot (224.88) and per hectare (4.63 lakhs) in treatment T_8 (75 % Recommended dose of nitrogen (75 kg/ha) + P (25 kg/ha) + K (45 kg/ha) + *Rhizobium* + *Azotobacter*). Hence treatment T_8 can be recommended.

Keywords: Lupine, Biofertilizers, Cut flower, flower quality, flower yield and stalk length.

INTRODUCTION

Lupines, scientifically known as (*Lupinus perennis* L.), belong to the family Fabaceae or Leguminosae and are native to various regions worldwide, including North and South America, Europe, and Africa. Lupine is a spectacular hardy annual and biennial flowering plant with the chromosomal number 2n = 36, 48, or 96 (Naganowska *et al*., 2003). Lupinus comes from the Latin word 'Lupus,' meaning wolf. They are commonly grown as ornamentals as well as a source of food. Sundial Lupine, blue Lupine, Indian beet, or old maid's bonnets are some of their common names (Drummond *et al*., 2012). Lupine cut flowers, with their vibrant colours and graceful spikes of flowers, are a popular choice among florists and gardening enthusiasts. These perennial plants are prized for their showy, vertical flower spikes that rise above clusters of palmate leaves. The use of nitrogen fixing biofertilizers can have a significant impact on the morphological characteristics of Lupine (*Lupinus* spp.) plants when applied at graded levels of nitrogen.

However, Artificial nitrogen fixation for the manufacturing of synthetic fertilisers, have substantial carbon footprints and pollution (Pikaar *et al*., 2018). Organic fertilisers slowly release nutrients, reducing P fixation and N losses through leaching (Dion *et al*., 2020). According to Sakarkika *et al.* (2019), the microbial community can act as fertiliser directly or indirectly. Biological (symbiotic) fixing of nitrogen (BNF, SNF) is a sustainable and cost-effective method of providing nitrogen to legume crops (Thilakarathna and Raizada 2018). A high dosage of nitrogen fertiliser inhibits nitrogen fixing, as demonstrated by Akter *et al.* (2018). The use of co-inoculation *Rhizobium* from nitragine significantly increased the mass of aboveground parts and roots of Lupine plants (Sulewska *et al.*, 2019). The application of biofertilizers gained the highest values regarding plant height (Ahmad *et al*., 2014). Applying 250 kg of nitrogen per ha resulted in the maximum number of leaves per plant (Singh *et al.*, 2020).

MATERIAL AND METHODS

The experiment was conducted at the experimental block of the Horticulture Department. College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga during 2022-23. Which consists of 8 treatments *i.e.*, T_1- 100 % RDN, T_2-75 % RDN, T_3- 100 % RDN + *Rhizobium*, T_4- 100 % RDN + *Azotobacter*, T_5- 75 % RDN + *Rhizobium*, T_6- 75 % RDN + *Azotobacter*, T_7- 100 % RDN + *Rhizobium* + *Azotobacter*, T_8-75 % RDN + *Rhizobium* + *Azotobacter*, where P, K and FYM are kept constant, with three replications in Randomized Complete Block Design (RCBD) with spacing 45 cm × 30 cm. observations were recorded on Morphology and Flower parameters.

The experimental site was prepared using a tractor and the site was divided into 24 plots with a net plot size of 2.7 × 1.8 m of raised beds and a 0.5m width path kept for the irrigation channel. Well-decomposed Farm Yard Manure at the rate of 2.5 kg per m^2 and NPK at 75:25:45 kg/ha was applied. Seeds soaked in *Rhizobium* were sown directly in the plots at a depth of 2 to 3 cm, later light irrigation was given immediately after sowing. The cultural operations like irrigation, earthing up, weeding and plant protection measures were done during the experimentation when required. Observations were recorded at 60 DAS.

RESULT AND DISCUSSION

The findings were considerably interpreted and listed in Table-1-4 and Plate 1 based on the observations recorded in the present research.

Influence of nitrogen fixing biofertilizers on growth parameters of Lupine

Plant height (cm). A perusal of the data presented in Table 1. Indicates the performance of Lupine for different growth parameters.

Results show that treatment T_7 (100 % RDN + *Rhizobium* + *Azotobacter* + P + K) recorded a maximum plant height of 59.36 cm whereas, minimum plant height (52.34 cm) recorded in treatment T_2 (75 % RDN + P + K) at 60 DAS. Different nitrogen levels led to a considerable rise in the plant's height and number of leaves per plant. Singh *et al.* (2020) The availability of an easily obtainable type of nitrogen was the cause of the rise in plant height. *Azospirillum* enhanced nutrient uptake by plants, both macro and micro. The use of co-inoculation *Rhizobium* from nitrogen significantly increased the mass of aboveground parts and roots of Lupine plants (Sulewska *et al.*, 2019). The results were in accordance with the reports of Chakradhar *et al.* (2018); Pansuriya and Chauhan (2015) in gladiolus and Dalawai *et al.* (2017) in carnation.

Number of branches per plant. During the investigation, Table 1 shows that treatment T_7 (100 % RDN + *Rhizobium* + *Azotobacter* + P + K) cm recorded a maximum number of branches per plant (19.44) whereas, T_2 (75 % RDN + P + K) recorded a minimum (16.59) branches per plant. This is due to application of organic manures and biofertilizers to dahlias has a major impact on the quantity of main branches. The application of nitrogen and potassium obtained similar results and significantly increased the number of branches (Nikam *et al.*, 2018) in chrysanthemum. Applying different levels and combinations of biofertilizers and organic manures increases the number of primary branches (Pandey *et al.*, 2017) in Dahlia and Dalawai *et al.* (2017) in carnation.

Number of leaves per plant. During investigation, Table 1. shows that treatment T_7 (100 % RDN + *Rhizobium* + *Azotobacter*+ P + K) cm recorded maximum number of branches per plant (87.67) whereas, T_2 (75 % RDN + P + K) recorded minimum (76.67) branches per plant. This may be the result of the substantial impact that applying organic manures and biofertilizers to dahlias has on their leaf count. The number of leaves was higher in the biofertilizer and organic manure treated in plots than in the control plots, showing the influence of these fertilizers and manures on leaf count. Pandey *et al*. (2017). Similarly, applying biofertilizers and organic manures to dahlia significantly affected the number of leaves (Pandey *et al.*, 2017). The results were in accordance with the reports of (Dawar, 2019) in tuberose, Adhikari *et al*. (2018) in gladiolus, Chakradhar *et al.* (2018) in gladiolus and Dalawai *et al.* (2017) in carnation.

Influence of nitrogen fixing biofertilizers on flowering parameters at graded levels of nitrogen. A perusal of the data presented in Table 2 indicates the performance of Lupine for different flowering parameters.

The earliest flower bud initiation (46.67 days), flower stalk emergence (49.60 days) and 50 per cent flowering completion (23.33 days) was recorded under treatment T_8 (75 % RDN + *Rhizobium* + *Azotobacter* + P + K) while maximum days taken to flower bud initiation (53.47), flower stalk emergence (57.33) and 50 percent flowering (28.13) recorded under treatment T_2 (75 % RDN + P + K). This may be because of the result of the substantial impact that applying organic manures and biofertilizers to dahlias has on their leaf count. The number of leaves was higher in the biofertilizer and organic manure treated in plots than in the control plots, showing the influence of these fertilizers and manures on leaf count Pandey *et al.* (2017). Applying the recommended quantity of FYM and NPK causes the gladiolus cv. White Prosperity to blossom 50% earlier than expected (Gangadharan and Gopinath 2000). The results were in accordance with the reports of Dahal *et al.* (2014); Dawar (2019) in tuberose, Shaukat *et al*. (2012) in gladiolus, Kumar *et al.* (2016) in carnation and Adhikari *et al.* (2018) in gladiolus.

Influence of nitrogen fixing biofertilizers on cut flower quality and yield parameters. It is evident from the data presented in Tables 3 and 4. That maximum flower stalk length (69.51 cm), number of florets per stalk (135.20), diameter of flower (1.57 cm) and duration of flowering (164.52) (Fig. 1.) recorded under treatment T_8 (75 % RDN + *Rhizobium* + *Azotobacter* + P + K) whereas, minimum stalk length (61.24 cm), number of florets per stalk (121.33), diameter of flower (1.43 cm) and duration of flowering (140.33) (Fig 1.) was recorded in treatment T_2 (75 % RDN + P + K). Whereas, the maximum number of flower stalks per plant (6.25), per plot (224.88), per hectare (4.63 lakhs) recorded under treatment T_8 (75 % RDN + *Rhizobium* + *Azotobacter* + P + K) whereas, a minimum number of flower stalk per plant (5.05), per plot (181.80), per hectare (3.70 lakhs) recorded in treatment T_2 (75 % RDN + P + K). The increased floret diameter may be attributed to increased nutrition availability and enhanced macronutrient levels, which positively influence floral features. The results are in line with those reported by Kulkde *et al.* (2006) in tuberose. It might be the result of the interaction between RDF and biofertilizers, which enhanced the availability of micronutrients like zinc as well as nitrogen and phosphorus. Zinc serves as a precursor to auxin, which enhances gladiolus vegetative growth, dry matter accumulation, and their partitioning towards spike production. Chakradhar *et al.* (2019). Gupta (2006) suggested that Phosphate Solubilizing Bacteria (PSB) species, such as *Bacillus polymyxa* and *Pseudomonas striata*, are helpful in raising the amount of phosphate available in soil, which enhances yield. This finding may be explained by a higher nitrogen supply, which may have aided in promoting vegetative growth and resulting in a greater quantity of assimilates needed for improvements in spike and rachis length. Additionally, the reason for an increase in spike count at higher nitrogen treatment doses may be that nitrogen, a component of protein, is necessary for the formation of protoplasm, which in turn led to the emergence of new shoots, which in turn caused an increase in spike count. Singh *et al.* (2020). The results were in accordance with the reports of Murthy (2021) in Lupine, Dawar (2019); Sudhagar *et al.* (2020) in tuberose, Kumar *et al.* (2016); Zamin *et al.* (2020); Dalawai *et al.* (2017) in carnation and Topno *et al.* (2022) in gladiolus.

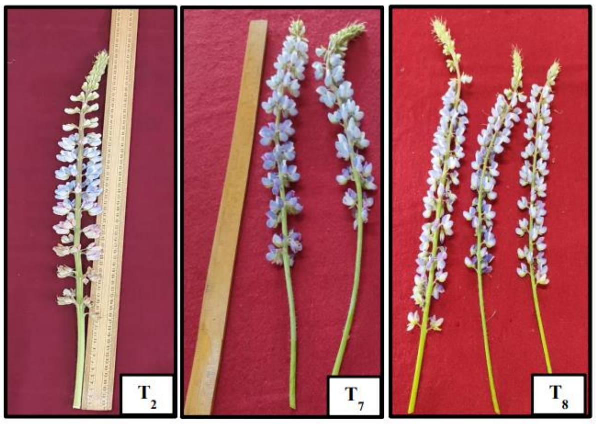

Plate 1. Stalk length of Lupine cut flower.

Table 1: Influence of nitrogen fixing biofertilizers on growth of Lupine at graded levels of nitrogen.

Tr. No.	Treatments	Plant height (cm)	Number of branches	Number of leaves
T_1	100 % Recommended Dose of Nitrogen (RDN) (check)	53.61	16.83	77.73
T_2	75 % RDN	52.34	16.59	76.67
T_3	100 % RDN + *Rhizobium*	58.28	17.58	84.53
T_4	100 % RDN + *Azotobacter*	58.02	17.83	82.60
T_5	75 % RDN + *Rhizobium*	57.43	18.59	80.55
T_6	75 % RDN + *Azotobacter*	55.25	17.26	78.24
T_7	100 % RDN + *Rhizobium* + *Azotobacter*	59.36	19.44	87.67
T_8	75 % RDN + *Rhizobium* + *Azotobacter*	58.62	18.97	86.57
S.Em±		0.07	0.02	0.17
C.D @ 5 %		0.22	0.07	0.51

Table 2: Influence of nitrogen fixing biofertilizers on flowering parameters of Lupine at graded levels of nitrogen.

Tr. No.	Treatments	Days taken for flower bud initiation	Days taken for flower stalk emergence	Days taken for 50% flowering
1	100 % Recommended Dose of Nitrogen (RDN) (check)	52.60	55.40	26.87
T_2	75 % RDN	53.47	57.33	28.13
T_3	100 % RDN + *Rhizobium*	48.92	51.80	24.53
T_4	100 % RDN + *Azotobacter*	49.53	52.67	24.80
T_5	75 % RDN + *Rhizobium*	50.27	53.67	25.73
T_6	75 % RDN + *Azotobacter*	51.40	54.40	26.67
T_7	100 % RDN + *Rhizobium* + *Azotobacter*	47.47	50.67	23.33
T_8	75 % RDN + *Rhizobium* + *Azotobacter*	46.67	49.60	22.20
S.Em±		0.16	0.10	0.29
C.D @ 5 %		0.50	0.30	1.23

Table 3: Influence of nitrogen fixing biofertilizers on flower quality parameters of Lupine at graded levels of nitrogen.

Tr. No.	Treatments	Stalk length (cm)	Number of florets per stalk	Diameter of flower (cm)
T_1	100 % Recommended Dose of Nitrogen (RDN) (check)	62.40	123.47	1.45
T_2	75 % RDN	61.24	121.33	1.43
T_3	100 % RDN + *Rhizobium*	67.55	131.23	1.52
T_4	100 % RDN + *Azotobacter*	66.34	130.43	1.48
T_5	75 % RDN + *Rhizobium*	64.68	126.73	1.46
T_6	75 % RDN + *Azotobacter*	63.37	128.63	1.47
T_7	100 % RDN + *Rhizobium* + *Azotobacter*	68.26	132.47	1.53
T_8	75 % RDN + *Rhizobium* + *Azotobacter*	69.51	135.20	1.57
S.Em±		0.13	0.15	0.06
C.D @ 5 %		0.39	0.45	0.19

Table 4: Influence of nitrogen fixing biofertilizers on flower yield parameters of Lupine at graded levels of nitrogen.

Tr. No.	Treatments	Number of flower stalks per plant	Number of flower stalks per plot	Number of flower stalks per hectare (lakhs)
T_1	100 % Recommended Dose of Nitrogen (RDN) (check)	5.10	183.72	3.73
T_2	75 % RDN	5.05	181.80	3.70
T_3	100 % RDN + *Rhizobium*	5.97	214.92	4.43
T_4	100 % RDN + *Azotobacter*	5.71	205.56	4.20
T_5	75 % RDN + *Rhizobium*	5.55	199.92	4.10
T_6	75 % RDN + *Azotobacter*	5.27	189.60	3.83
T_7	100 % RDN + *Rhizobium* + *Azotobacter*	6.05	217.68	4.47
T_8	75 % RDN + *Rhizobium* + *Azotobacter*	6.25	224.88	4.63
S.Em±		0.03	1.23	0.03
C.D @ 5 %		0.10	3.71	0.09

Note - P (25 kg/ha), K (45 kg/ha) and FYM (25 t/ha) are constant for all the treatments
- *Rhizobium* and *Azotobacter* @ 625ml/ha.

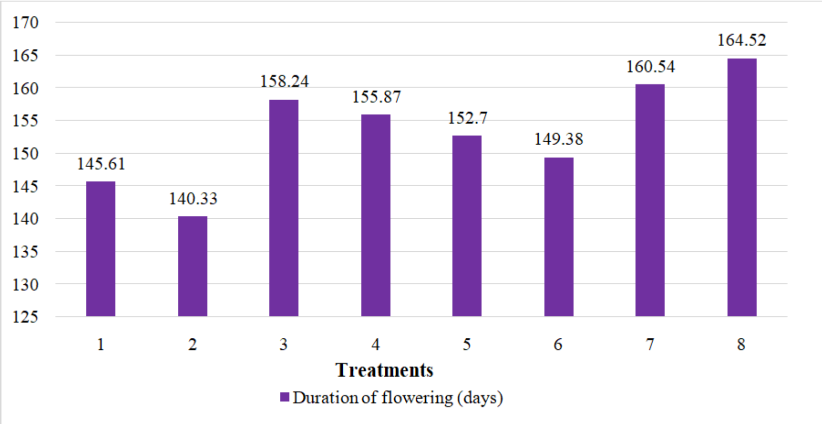

Fig. 1. Influence of nitrogen fixing biofertilizers on duration of flowering at graded levels of nitrogen.

CONCLUSIONS

Based on results obtained and facts mentioned in this chapter, among the different treatments T_7(100 % RDN + *Rhizobium* + *Azotobacter* + P + K) influenced morphological parameters whereas T_8 (75 % RDN + *Rhizobium* + *Azotobacter* + P + K) influenced flowering, cut flower quality and yield of Lupine, hence, it can be concluded that treatment T_8 may be recommended for commercial cultivation of Lupine for cut flower production as it saves 25 % of nitrogen.

FUTURE SCOPE

Further scope for experiment needed to be carried out with different combinations of biofertilizers to study the effect of other nitrogen fixing biofertilizers on crop growth, flowering and yield parameters of Lupine.

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Conflict of interest. None.

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