***Original Research Article***

**Effect of Foliar Application of Nano Urea on Growth and Flowering of Rose cv. Gladiator**

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**ABSTRACT**

The present experiment was carried out at Instructional Unit, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during *Rabi* season in the year 2022-23 and 2023-24 in open field conditions with randomized block design and three replications. The object of the study was to find out the effect of nano urea on growth and flowering of rose cv. Gladiator. ~~Total seven treatments were taken~~ *~~viz.~~*~~, recommended dose of fertilizer (40:20:40 g NPK/plant) (T~~~~1~~~~), 75 percent recommended dose of nitrogen + 2 spray nano urea (2 ml/l) (T~~~~2~~~~), 75 percent recommended dose of nitrogen + 2 spray nano urea (3 ml/l) (T~~~~3~~~~), 75 percent recommended dose of nitrogen + 2 spray nano urea (4 ml/l) (T~~~~4~~~~), 75 percent recommended dose of nitrogen + 3 spray nano urea (2 ml/l) (T~~~~5~~~~), 75 percent recommended dose of nitrogen + 3 spray nano urea (3 ml/l) (T~~~~6~~~~) and 75 percent recommended dose of nitrogen + 3 spray nano urea (4 ml/l) (T~~~~7~~~~)~~.The pooled results indicated that higher growth attributes in rose *viz.*, plant height (incremental) (39.86 cm), plant spread (incremental) (1544.13 cm2) and number of flowering shoots per plant (19.89) were recorded with treatment T1. While, maximum stem diameter (1.89 cm) was recorded with treatment T7.Flowering parameters *viz.*, days taken for flower bud appearance after pruning and flowering after pruning remained non-significant by application of different treatments.

***Keywords:*** *rose, Gladiator, nano urea, growth, flowering*

1. **INTRODUCTION**

Rose is one of the oldest flowers under cultivation and most popular of all garden flowers all over the world. Rose named after ‘Eros’- The Greek god for love. It is universally called as queen of flower, which was first referred by Sappho, a poetess about more than 2500 years ago.Roses are one of the most important commercial flowers in the world, and they hold significant potential for higher production in India, and in Gujarat. Roses are heavy feeders of major nutrients, and they are considered long-duration crops. Roses indeed require proper nutrition to thrive. As heavy feeders, they benefit from well-balanced fertilization.

The use of conventional fertilizers and pesticides in agriculture is not sustainable for a number of reasons, including high inefficiency of delivery and utilization, significant inputs of energy and water, and great potential for negative environmental implications.The use of nanomaterials in agriculture as nano fertilizers, nano pesticides or nano-enable sensors to increase crop yield is gaining increasing interest [1]. Nanoparticles can have made from fully bulk materials. Nano-fertilizers deliver more surface area for different metabolic reactions in the plant which increase rate of photosynthesis and produce more dry matter and yield of the crop. It is also preventing plant from different biotic and abiotic stresses [2].Engineered nanoparticles can penetrate the stomatal pores with the size of less than 50 nm [3]. The uptake of nanoparticles into plant cells via binding to carrier proteins through aquaporin, ion channels and endocytosis [4-5].

The use of nano technology in agriculture gained the momentum; use of nano urea in various agricultural crops reduces the consumption of urea fertilizer. Research studies have shown that 30 to 50 percent of crop yield can be attributed to nutrient input from commercial fertilizers. Considering the advantages of nano materials, these nutrients can be supplied in nano sized forms to improve release and enhance efficiency of use; so as to achieve greater improvement in plant crop with lower environmental impacts. In case of rose, which are very sensitive to nutrient deficiencies, the use of nano urea could provide a more effective way to targeting the foliar tissues and promote the healthy growth and abundant improved plant growth and better flowering quality, longer blooming periods as well as significantly reduce the traditional fertilization doses.

1. **MATERIALS AND METHODS**

The present experiment was carried out at Instructional Unit, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during *Rabi* season in the year 2022-23 and 2023-24 in open field conditions.The randomized block design was used with three replications for the experiment. Rose was planted at 60x60x75 cm paired row system in a raised bed condition. All the plants were pruned at 45 cm from the soil level in second half of October in both the year.

Total seven treatments were taken *viz.*, recommended dose of fertilizer (40:20:40 g NPK/plant) (T1), 75 percent recommended dose of nitrogen + 2 spray nano urea (2 ml/l) (T2), 75 percent recommended dose of nitrogen + 2 spray nano urea (3 ml/l) (T3), 75 percent recommended dose of nitrogen + 2 spray nano urea (4 ml/l) (T4), 75 percent recommended dose of nitrogen + 3 spray nano urea (2 ml/l) (T5), 75 percent recommended dose of nitrogen + 3 spray nano urea (3 ml/l) (T6) and 75 percent recommended dose of nitrogen + 3 spray nano urea (4 ml/l) (T7). The phosphorus and potash were applied as per the recommended dose equally in all the treatments. IFFCO nano urea (4 percent urea) was used in the study for foliar application. The foliar application was applied at 30 and 60 days after pruning for T2 to T4 (2 sprays). While, it applied at 30, 45 and 60 days after pruning for T5 to T7 (3 sprays).

Plant height and plant spread indicated in the data represents increase in the respective parameters after pruning (incremental). Five plants were randomly selected from each treatment and labelled for the purpose of recording different observations. The mean value of the five selected plants from each treatment was taken for statistical analysis.

1. **RESULTS AND DISCUSSION**
   1. **Effect on growth parameters**

The effect of various treatments on growth parameters were observed in Table 1. The maximum increase in plant height (39.86 cm), increase in plant spread (1544.13 cm2) and numbers of flowering shoots per plant (19.89) were recorded in treatment T1 (40:20:40 g NPK/plant which was statistically at par with treatment T7in plant spread and numbers of flowering shoots per plant. While, diameter of stem (1.89 cm) was maximum in treatment T7. All the parameters were lower in treatment T2.

This might be due to enhanced synthesis and accumulation of proteins, amino acids and enzymes, which are responsible for cell division and cell elongation hence growth of the plant was increased [6]. Increasing dose of nano urea can increase growth traits is due to carrier delivery systems of nano-fertilizers can synchronize their release withtheir uptake by crops thus preventing undesirable loss of nutrients to soil [7]. The similar findings were also reported by Bhakher*et al.*[8] in sunflower, Gowtham  
and Karuppaiah[9] in crossandra, Venkatesh *et al.*[10] in marigold and Mohammed *et al.*[11] in box plants.

**Table 1. Growth and flowering parameters of rose cv. Gladiator influenced by foliar application of nano urea (pooled over two years)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Plant spread (cm2)** | **No. of flowering shoots per plant** | **Stem diameter (cm)** | **No. of days taken for flower bud appearance after pruning** | **No. of days takenflowering after pruning** |
| T1 | 39.86 | 1544.13 | 19.89 | 1.59 | 30.43 | 41.97 |
| T2 | 29.87 | 1077.27 | 15.23 | 1.38 | 27.69 | 38.09 |
| T3 | 30.90 | 1187.13 | 15.59 | 1.75 | 27.82 | 38.66 |
| T4 | 31.54 | 1241.68 | 16.28 | 1.77 | 28.13 | 39.30 |
| T5 | 31.22 | 1211.42 | 15.73 | 1.77 | 27.13 | 38.22 |
| T6 | 33.01 | 1278.78 | 17.51 | 1.80 | 30.02 | 41.13 |
| T7 | 35.48 | 1441.05 | 17.95 | 1.89 | 30.91 | 42.27 |
| C.D. at 5% | 4.05 | 180.52 | 1.95 | 0.16 | NS | NS |

* 1. **Effect on flowering parameters**

The data related to flowering parameters clearly indicates that different levels of nitrogen and its split application failed to exert significant effect on number of days taken to flower bud initiation and days taken for flowering. This finding was in accordance with the research by Singh et al. [12] in rose.

1. **CONCLUSION**

On the basis of above findings, it may be concluded that 3 foliar applications of nano urea (4 ml/l) at 30, 45 and 60 days after pruning with 25 percent reduced dose of nitrogen (T7) can gave statistically at par results with recommended dose of NPK (T1) in terms of growth parameters in rose cv. Gladiator under open field condition.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

We hereby declare that NO generative AItechnologies such as Large Language Models(ChatGPT, COPILOT, etc) and text to imagegenerators have been used during writing orediting of manuscripts.

**COMPETING INTERESTS**

We declared that no competing interests exist.

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