# Effect of Foliar Application of Nano Urea and Nano Dap on Tree Mulberry Growth and Yield Parameters

Shweta[1]*, Ravikumar. A[1], Kirankumar. R[1], D. K. Hadimani[1] , N. Manjunath[4]
[1]*Department of Entomology, College of Agriculture, Hagari*
[1]*Department of Entomology, College of Agriculture, Gangavathi*
[1]*Department of Entomology, College of Agriculture, Raichur*
[1]*Department of Agronomy, College of Agriculture, Hagari*
*University of Agricultural Sciences, Raichur -584 104 Karnataka, India*
**Corresponding author*

***Abstract*—A field experiment was conducted to know the efficacy of nano urea and nano DAP in tree mulberry (*Morus* spp.) of V-1 variety during 2024-25. Different doses of nano urea and nano DAP (foliar spray) were applied at the 25th and 35th day after pruning in combination with reduced doses of conventional fertilizers. Results showed that application of 75 per cent recommended dose of fertilizers (RDF) as soil application, supplemented with foliar sprays of nano urea and nano DAP each at 4 ml/L significantly enhanced shoot height (95.10 cm), number of shoots per plant (49.92), number of leaves per plant (655.98) and leaf area (148.85) at 45th days after pruning compared to lower or sole applications. This treatment also achieved the highest leaf yield (6538.71 g/tree) at 60th days after pruning.**

***Index Terms*—DAP,Nano, *Morus*spp, Tree mulberry, Urea,**

## I. INTRODUCTION

Sericulture is an agro-based rural industry focused on rearing silkworms for raw silk production, playing a vital role in generating employment and income in rural areas. India, the second-largest silk producer in the world, reported the production of 41,121 metric tons (MT) of raw silk in 2024–2025, with mulberry silk comprising 31,119 MT. The mulberry tree (Morus spp.), a fast-growing and deep-rooted perennial species belonging to the Moraceae family, is cultivated under diverse agro-climatic conditions. The silkworm (Bombyx mori L.) is monophagous, relying solely on mulberry leaves for nutrition, with approximately 70% of the silk protein derived from these leaf proteins. Therefore, the quality of mulberry foliage directly affects silkworm growth, cocoon yield, and silk quality (Mala et al., 2017). The growth of mulberry and the quality of its leaves depend heavily on balanced nutrient and water management. Nitrogen encourages vegetative growth, while phosphorus supports root development and protein formation. However, the effectiveness of conventional fertilizers, such as urea, is often low due to nutrient losses through leaching and volatilization, which can diminish soil fertility. Nanotechnology provides a promising solution through the use of nano-fertilizers, which enhance nutrient use efficiency and reduce environmental impact (Duhan et al., 2017). IFFCO's nano urea (4% nitrogen) and nano DAP (8% nitrogen and 16% phosphorus) consist of ultrafine particles that enable faster absorption and more efficient nutrient utilization when applied as a foliar spray.

Applying nano-fertilizers as a foliar treatment ensures rapid nutrient uptake and helps overcome the limitations of soil fixation in deep-rooted crops like mulberry. Research has shown that nano-based nutrient delivery can improve chlorophyll content, leaf yield, and the biochemical composition of mulberry leaves. Despite the advantages, studies on the direct effects of nano urea and nano DAP on tree mulberry and their impact on silkworm performance are still limited. Therefore, this study aims to evaluate the effects of foliar application of nano urea and nano DAP on the growth and productivity of tree mulberry and its influence on the silkworm, Bombyx mori L., to promote sustainable sericulture through improved nutrient efficiency (Solanki et al., 2015)..

## II. MATERIAL AND METHODS

1. Materials used

The experiment was conducted at the Krishi Vigyan Kendra, Hagari, Ballari, in the established Victory-1 (V-1) tree mulberry garden, geographically located in the northern dry zone of Karnataka (Zone-III) of the state, during 2024-25. The tree mulberry variety used in the study was Victory-1 (V-1), cultivated under irrigated conditions with wider spacing 10'×10' (between rows and plants). The experiment was laid in a completely randomized block design with 9 treatments with 3 replications each *viz*., $T_1$: Foliar spray of nano urea @ 2 ml/L, T2: Foliar spray of nano urea @ 4 ml/L, T3: Foliar spray of nano DAP @ 2 ml/L, T4: Foliar spray of nano DAP @ 4 ml/L, T5: 75% RDF of soil application and foliar spray of nano urea @ 2 ml/l+nano DAP @ 2 ml/L, T6: 75% RDF of soil application and foliar spray of nano urea @ 4 ml/l+nano DAP @ 4 ml/L and T7: 50% RDF of soil application and foliar spray of nano urea @ 2 ml/l+nano DAP @ 2 ml/L, T8: 50% RDF of soil application and foliar spray of nano urea @ 4 ml/l+nano DAP @ 4 ml/L, T9: 100 % RDF and water spray. RDF: Recommended dose of fertilizers (RDF) for tree mulberry is 350:140:140 kg of N: P2O5: $K_2O$ kg ha year, and RD FYM is 20 tons $ha^1$ year. Two sprays of nano nitrogen and urea were done on the 25th and 35th day after pruning. At the 45th day after pruning, five plants were selected randomly for recording observations on growth and yield parameters, *viz*., shoot length, number of shoots per tree, number of leaves per tree, leaf area, and leaf yield.

## III. RESULTS AND DISCUSSION

The data on growth and yield parameters influenced by foliar sprays of nanourea and nano DAP on tree mulberry at different days after pruning is presented in Table 1. On the 45th day after pruning, the highest shoot length (95.10 cm) was recorded in T6, which included 75% RDF as a soil application, combined with a foliar spray of nano urea at 4 ml/L and nano DAP at 4 ml/L. This was followed by T5 (75% RDF as a soil application with foliar sprays of nano urea at 2 ml/L and nano DAP at 2 ml/L), which recorded an average shoot length of 88.95 cm, and was statistically similar to T8 (50% RDF plus nano urea at 4 ml/L and nano DAP at 4 ml/L), which resulted in a shoot length of 83.81 cm. In contrast, T9 (100% RDF with water spray) showed the lowest shoot length at 73.48 cm, while T1 (foliar spray of nano urea at 2 ml/L) exhibited the lowest shoot length overall at 51.72 cm.

The highest number of shoots per tree (49.92) was also recorded in T6, followed by T5 with 46.22 shoots per tree. T8 was statistically similar to T5, recording 43.34 shoots per tree. The lowest number of shoots (20.85) was observed in T1.

Regarding the number of leaves per tree, T6 again showed the highest value at 655.98 leaves, compared to T9 (100% RDF with water spray), which had significantly lower results. T5 followed with 610.43 leaves, while T8 recorded 562.18 leaves. In contrast, T1 had the lowest number of leaves per tree at 270.38. On the 45th day after pruning, leaf area also varied significantly. The highest leaf area (148.85 $cm^2$) was observed in T6, followed by T5 with 141.63 $cm^2$, which was statistically similar to T8 at 136.57 $cm^2$. The lowest leaf area was recorded in T1 at 94.45 $cm^2$.

Leaf yield per tree varied significantly among the different treatment combinations. At 60 days after pruning, the highest leaf yield (6538.71 g/tree) was recorded in T6. This was closely followed by T5, which yielded 6156.36 g/tree. T8, with 50% RDF and foliar sprays of nano urea and nano DAP, yielded 5931.84 g/tree, statistically similar to T5. Conversely, the lowest leaf yield was observed in T1, with only a foliar spray of nano urea at 2 ml/L, resulting in 3902.87 g/tree.

Table.1. Effect of foliar spray of nano urea and nano DAP on growth and yield parameters of tree mulberry at 45 days after pruning

| Treatments | Shoot height (cm) | No. of shoots/ tree | No. of leaves/ tree | Leaf area ($cm^2$) | Leaf yield (g/tree) |
|---|---|---|---|---|---|
| $T_1$ | $51.72^h$ | $20.85^h$ | $270.38^h$ | $94.45^h$ | $3902.87^h$ |
| $T_2$ | $62.13^f$ | $28.97^f$ | $369.64^f$ | $109.21^f$ | $4561.03^f$ |

| | | | | | |
|---|---|---|---|---|---|
| $T_3$ | 56.84[g] | 24.67[g] | 321.03[g] | 102.23[g] | 4220.61[g] |
| $T_4$ | 67.26[e] | 32.64[e] | 418.70[e] | 115.95[e] | 4905.15[e] |
| $T_5$ | 88.95[b] | 46.22[b] | 610.43[b] | 141.63[b] | 6156.36[b] |
| $T_6$ | 95.10[a] | 49.92[a] | 655.98[a] | 148.85[a] | 6538.71[a] |
| $T_7$ | 78.63[c] | 39.51[c] | 518.73[c] | 129.51[c] | 5589.97[c] |
| $T_8$ | 83.81[b] | 43.34[b] | 562.18[b] | 136.57[b] | 5931.84[b] |
| $T_9$ | 73.48[d] | 36.64[d] | 469.46[d] | 122.34[d] | 5243.08[d] |
| S. Em (±) | 1.06 | 1.20 | 15.78 | 1.87d | 65.13 |
| C.D @ 5% | 5.12 | 3.61 | 47.32 | 5.62 | 195.26 |
| C.V (%) | 3.84 | 5.82 | 5.86 | 5.32 | 5.15 |

The significant increase in shoot length of tree mulberry following foliar application of nano urea and nano DAP is primarily due to improved nutrient uptake and physiological stimulation. Nano urea delivers nitrogen directly through the leaves, which allows for faster absorption compared to root uptake, promoting cell division and elongation in the shoot apical meristem. The nanoscale particles of nano urea can rapidly penetrate leaf tissues, enhancing nitrogen use efficiency. When paired with phosphorus from nano DAP, this balanced nutrient supply aids in energy transfer and nucleic acid synthesis, both essential for cell growth (Ahmed et al., 2018). Additionally, foliar feeding boosts chlorophyll content and photosynthesis, providing the energy necessary for robust shoot development. As a result, this method produces healthier and longer shoots in comparison to conventional approaches.

Fig. 1.Effect of foliar spray of nano urea and nano DAP on growth parameters of tree mulberry

Treatments receiving nano nitrogen fertilizers along with the recommended dose of fertilizers (RDF) ensured a steady nutrient supply, improving mineralization and uptake efficiency, which significantly increased the number of shoots per tree. Due to their large surface area, nano fertilizers release nutrients gradually, matching plant demand and minimizing losses (Preetha and Balakrishnan, 2017). Nano urea efficiently penetrates leaf tissues, providing readily available nitrogen that promotes chlorophyll, amino acid, and enzyme synthesis for cell division and elongation. Following pruning, this rapid nutrient availability activates dormant buds and encourages early shoot emergence. The combined use of 75% RDF through soil with foliar sprays of nano urea and nano DAP ensures efficient nutrient absorption through roots and leaves, supporting rapid shoot proliferation.

The increase in the number and area of leaves in the mulberry tree treated with nano fertilizers is due to the efficient and timely supply of bioavailable nitrogen and phosphorus. Nano urea ensures rapid nitrogen absorption for amino acid, nucleic acid, and chlorophyll synthesis, driving leaf initiation and expansion. Simultaneously, nano DAP provides phosphorus that supports ATP production and energy transfer for meristematic activity(Bondade, 2021). The controlled-release nature of nano fertilizers maintains a steady nutrient supply, preventing stress and ensuring continuous canopy expansion. This synergy between RDF(soil application) and foliar nano nutrients sustains photosynthesis and results in greater leaf area and higher leaf yield. At 60th days after pruning, the highest yield (6538.71 g/tree) was recorded in T6: 75% RDF + nano urea @ 4 ml/L + nano DAP @ 4 ml/L, followed by T5 (6156.36 g/tree), while the lowest (3902.87 g/tree) was in T1, confirming the importance of balanced soil and foliar nutrition (Kannihalli*et al*., 2024).

The present results are in line with findings of Goutam *et al*. (2023) who reported that highest shoot length, number of shoots per tree, number of leaves per tree (658.45) and leaf area was recorded in tree mulberry raised with foliar application of nano nitrogen at 4 ml/L on 25th and 35th days after treatment along with 60 per cent N applied through soil. Similarly, Pooja *et al.* (2022) observed that the highest shoot height, number of leaves per plant, and total leaf area were recorded when mulberry plants were raised with foliar application of 0.6 per cent nitrogen nano-fertilizer on the 25th day after pruning, along with 50 per cent N applied through soil. Further, combined foliar application of nano Zn + Cu

at 500 ppm each to mulberry resulted in the highest shoot length (202.33 cm), leaf area (266.77 cm2) in mulberry (Choudhury *et al*., 2019). Srilekha (2022) reported that foliar spray of nano Ca + nano S (250 ppm each) at the 25th and 35th day after pruning showed significantly improved mulberry leaf yield, biomass, and biochemical content. Higher shoot height (96.63 cm), number of leaves per shoot (18.60), leaf area (96.90 cm2), and leaf yield (0.46 kg/plant) of mulberry were observed upon foliar application of nano zinc oxide at 50 ppm (Nithya *et al*., 2018).

## IV. SUMMARY AND CONCLUSION

The study revealed that the foliar application of nano urea and nano DAP had a positive impact on the growth and yield parameters of V-1 tree mulberry. The findings indicated that foliar spraying of nano urea @ 4 ml/L + nano DAP @ 4 ml/L on the 25thand 35thdays after pruning, along with 75 per cent RDF through soil application (T6), significantly improved the growth and yield of tree mulberry. Thus, integrating nano-fertilizers with partial RDF enhances nutrient uptake efficiency through controlled and targeted nutrient delivery, minimizes environmental losses, and promotes overall mulberry growth and productivity.

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