

**Original Research Article**

**Effect of nano urea on leaf nutrients and some quality parameters of tea (*Camellia sinensis* (L.) O. Kuntze)**

**ABSTRACT**

Some important parameters of tea on mature plants of TV 23 clone were studied after application of Nano-urea as foliar spray at Experimental Garden for Plantation Crops, Assam Agricultural University, Jorhat during the period 2021-2022. The usage of "Nano Urea" (Liquid), a novel product created and patented by Indian Farmers Fertilizer Cooperative Limited (IFFCO), is projected to replace the use of urea granules, one of the most widely used fertilizers in the world.

Leaf nutrients i.e., nitrogen, phosphorus, potassium and quality parameters i.e., Caffeine, polyphenol were observed after application of nano urea. Leaf nitrogen, leaf phosphorus and leaf potassium were found to be increased with the application of higher dose of Nano Urea. Leaf nitrogen was observed maximum (4.57%) in the plot where 0.4% Nano-urea applied in three sprays. Total phosphorus content of leaf was found to be the highest in treatment T<sub>7</sub> (0.423%) the lowest was observed in treatment T<sub>0</sub> (0.370%). Total potassium content of leaf was the highest in treatment T<sub>7</sub> (2.517%) and lowest K<sub>2</sub>O content was observed in treatment T<sub>0</sub> (2.013%) which was a control.

In quality parameters, it was found that application of Nano Urea showed significant impact on the total caffeine content of tea leaf. The highest value of caffeine was found in treatment T<sub>7</sub> (3.233%) and lowest was found in treatment T<sub>0</sub> (3.10%) (control).

*Keywords: Nano-urea; tea; caffeine; polyphenol; leaf N, P, K.*

**INTRODUCTION**

India is the world's largest producer and consumer of all tea varieties, specially the production of black tea. Tea [*Camellia sinensis* (L.) O. kuntze] is a commercially cultivated plantation crop across the world. It is an economic beverage also famous due to its flavour and aroma (Gebrewold, 2018).

Nitrogen is important for plant development, chlorophyll production, and the photosynthetic process that turns sunlight into food for plants. Without sufficient nitrogen, plants may experience stunted growth and lower output. Because it is an essential component of chlorophyll, which converts the energy from sunlight and carbon dioxide into sugar molecules, nitrogen is extremely important.

In order to increase the production of chlorophyll and consequently the yield of tea, long-term nitrogen treatment increased the expression of critical genes for this process. Additionally, it greatly reduced the catechin level while increasing the total free amino acid content, or theanine, in fresh tea leaves, which is helpful for maintaining the freshness of the tea beverage. Long-term nitrogen administration resulted in a considerable decrease in the levels of nerolidol and indole in withered leaves as well as benzyl alcohol and 2-phenylethanol in fresh tea leaves, both of which were unfavourable to the development of aroma compounds with floral and fruity undertones. Generally, a balanced fertiliser nitrogen level balanced tea output and quality. In this way nitrogen application impacts tea quality. (Chen et al., 2021)

Indian Farmers' Fertilizer Cooperative Limited (IFFCO) developed liquid nano urea as an alternative to urea to satisfy the nitrogen demands of crops, particularly during critical growth periods. It is applied as a foliar spray, helps the leaves absorb nitrogen effectively, penetrates to the parts of the plant that need nitrogen, and releases nutrients in a controlled way, reducing loss into the environment. Additionally, it increases crop physiological characteristics, especially in conditions with drought stress. Lakshman *et.al.* in 2022 in his work found that Nano urea may help in a number of metabolic processes, improving yields and quality metrics while decreasing fertiliser waste since it has a larger surface area, is more soluble, and is smaller than regular urea.

Considering the various aspects of nano urea in agriculture, a research work had been carried out to study the leaf nutrient and quality parameters of tea (*Camellia sinensis*) as influenced by application of nano urea.

## **MATERIALS AND METHODS**

### **1. Study area and climate**

An attempt has been made to study the effect of application of Nano urea in mature tea plants in the Experimental Garden for Plantation Crops, Department of Tea Husbandry & Technology, Assam Agricultural University, Jorhat on leaf nutrient content, polyphenol content and caffeine content in plucked tea shoots.

Jorhat, Assam has a subtropical humid climate, and the monsoon season typically lasts from April until September. During the experimental period (November 2021 to July 2022) the observations of various weather parameters recorded at the meteorological observatory of the Department of Agricultural Meteorology, Assam Agricultural University, Jorhat are shown in Table 3.1. During the period of research works the maximum temperature ranges from 23.3°C to 33.5°C and minimum temperature ranges from 9.6°C to 25°C. The relative humidity ranges from 93 to 99% during morning hours and 49 to 80% during evening hours. Total 1559.6 mm rainfall was received during the period with maximum rainfall of 321.8 cm in June, 2022 and minimum rainfall of 0.6 cm in December, 2021.

### **2. Treatment detail**

Planting material taken for the experiment was TV 23 which is a yield clone. There are a total of 27 plots with 9 treatments having 3 replications for each treatment. To satisfy the plant's need for nitrogen and the recommended dose of  $P_2O_5$  &  $K_2O$ , treatment plot was treated with different doses of nano urea (NU) rather than urea as mentioned below-

T<sub>0</sub> - Recommended dose of N,  $P_2O_5$  &  $K_2O$

T<sub>1</sub>- 0.2% NU × 2 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>2</sub>-0.3% NU × 2 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>3</sub>- 0.4% NU × 2 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>4</sub>- 0.5% NU × 2 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>5</sub>- 0.2% NU × 3 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>6</sub>- 0.3% NU × 3 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>7</sub>- 0.4% NU × 3 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

T<sub>8</sub>- 0.5% NU × 3 sprays + recommended dose of  $P_2O_5$  &  $K_2O$

### **3.Polyphenol estimation**

Estimation of polyphenol was done following the method given by Bray and Thorpe, 1954 using Folin-ciocalteu reagent. The absorbance was measured with a spectrophotometer at 650 nm. A standard curve was created using various gallic acid concentrations. Total polyphenol was expressed in percentage.

### **4.Caffeine estimation**

The total caffeine in fresh tea leaves was calculated in percentage. By taking weight of crude caffeine and weight of fresh leaves in gram, the amount of caffeine was calculated.

### **5.Nitrogen estimation**

According to AOAC's description of the modified Kjeldahl method the calculated nitrogen was displayed as a percentage of the dried sample.

The process entails the oxidative destruction of the plant matter using several digestion mixtures, the most popular of which is the nitro-perchloric digestion (di-acid) mixture. In order to produce a colourless solution, digestion must continue until the acid liquid has entirely volatilized. Following that, numerous elemental analyses are performed on the filtered solution using the proper methods.

### **6. $P_2O_5$ Estimation**

To measure leaf  $P_2O_5$ , 5 ml of the filtered solution were placed in a 50 ml volumetric flask together with 10 ml of the nitric acid-molybdate-vanadate mixture. The volume was then filled, and the mixture was thoroughly mixed. In about 30 minutes, the colour has fully developed. On a spectrometer with a 450 m $\mu$  filter, measure the amount of yellow hue that has generated.

## 7. K<sub>2</sub>O Estimation

To measure available K<sub>2</sub>O put the solution straight into the atomizer of the flame photometer, the 100 of which has been set with 40 ppm K solution, and record the reading to find out how much leaf K<sub>2</sub>O is there. Find the standard curve measurement that corresponds to the extract's K concentration. The concentration measurement allowed for the calculation of the K content of the plant sample.

## 8. Statistical analysis

A statistical analysis of each piece of data (RBD) was performed using the Randomized Block Design. The significance of the variance resulting from the treatment effect might be ascertained by calculating the relevant "F" values (Panse and Sukhatme, 1989).

## RESULT

The results of the experiment on impact of Nano Urea influenced on growth parameters of mature tea plants was conducted for the period of October 2021 to July, 2022 in the Experimental Garden for Plantation Crop, AAU, Jorhat, were presented below. Nutrient availability and the biochemical parameters of treated tea leaves were studied in laboratory condition whereas field studies were conducted to study the phytotoxicity. The experimental data was statistically analysed. The mean values were tabulated, and the associated CD values at the 5 percent probability level were computed and displayed in tables.

### 3.1 Available nutrients in plucked shoots (N, P, K)

Better vegetative growth is facilitated by nitrogen, and quick, precocious growth is facilitated by an adequate supply of nitrogen. Increases plant growth, gives plants a dark green hue, and enhances the flavour and juiciness of forage plants and leafy vegetables. encourages fruit bud growth, boosts fruit set, and enhances fruit quality.

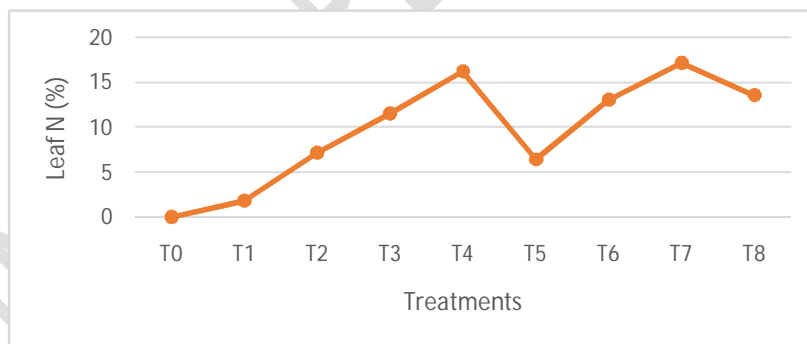
The experimental data (Table .1) showed significant difference on leaf nitrogen (%), P<sub>2</sub>O<sub>5</sub> (%) & K<sub>2</sub>O (%) as influenced by application of Nano Urea. The highest value of leaf nitrogen was found on treatment T<sub>7</sub> (4.57%) which was followed by treatments T<sub>4</sub> (4.53%) and T<sub>8</sub> (4.43%). The lowest leaf nitrogen was found in treatment T<sub>0</sub> (3.90%) (control).

Total phosphorus content of leaf (Table 1) was found to be the highest in treatment T<sub>7</sub> (0.423%) which was followed by treatment T<sub>4</sub> (0.410%). The lowest phosphorus content of tea leaves was observed in treatment T<sub>0</sub> (0.370%) (control).

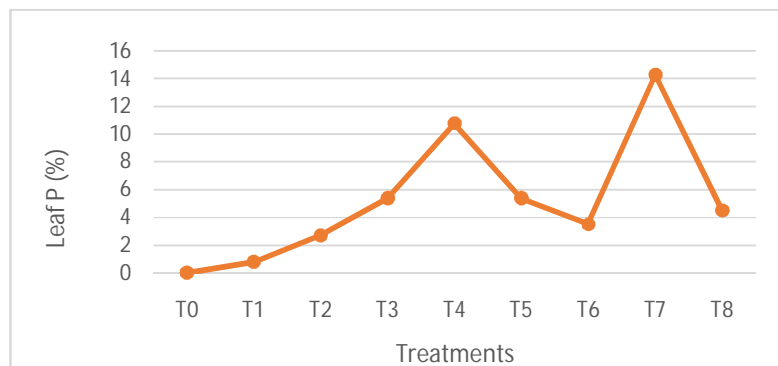
**Table .1 Nitrogen, Phosphorus and Potassium percentage tea leaf under various treatments of Nano Urea**

Treatment	Leaf nitrogen (%)	Leaf phosphorus (%)	Leaf potassium (%)
T <sub>0</sub>	3.90	0.370	2.013
T <sub>1</sub>	3.97	0.373	2.200
T <sub>2</sub>	4.18	0.380	2.240
T <sub>3</sub>	4.35	0.390	2.363
T <sub>4</sub>	4.53	0.410	2.503
T <sub>5</sub>	4.25	0.390	2.387
T <sub>6</sub>	4.41	0.383	2.460
T <sub>7</sub>	4.57	0.423	2.517
T <sub>8</sub>	4.43	0.387	2.383

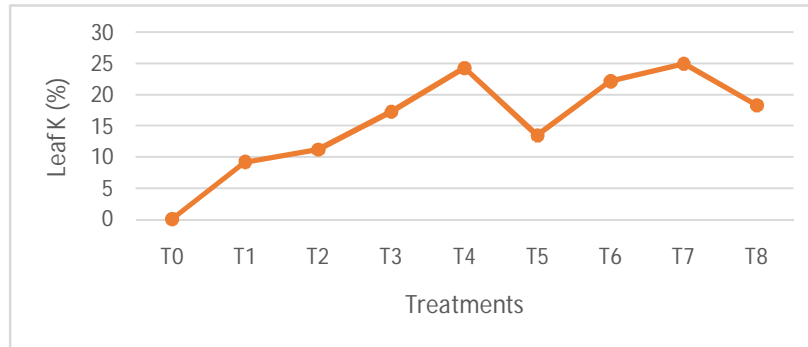
Significant difference was observed in K<sub>2</sub>O content of tea leaves as influenced by application of Nano Urea with different doses (Table.1). Total potassium content of leaf was the highest in treatment T<sub>7</sub> (2.517%) followed by treatments T<sub>4</sub> (2.503%) and T<sub>6</sub> (2.460%). Lowest K<sub>2</sub>O content (2.013%) was observed in treatment T<sub>0</sub> which was a control.



**Fig. 1.increasing percentage leaf nitrogen over control**



**Fig. 2. Increasing percentage leaf phosphorus over control**



**Fig. 3. Increasing percentage leaf potassium over control**

### 3.2 Quality parameters of tea

Quality of tea is a very important parameter. The study revealed that some quality parameter like caffeine, polyphenol, leaf nitrogen, phosphorus and potassium gradually increased with increasing dose of Nano Urea.

The experimental data of total polyphenol (%) are presented in the Table.1 as influenced by various treatment of Nano Urea. The impact of Nano Urea on total polyphenol (%) on tea leaves was found to be non-significant. The highest value of total polyphenol was found in treatment T<sub>7</sub> (28%) (0.4% Nano Urea × 3 sprays + basal dose of P<sub>2</sub>O<sub>5</sub>& K<sub>2</sub>O as recommended). The lowest value of total polyphenol was found in treatment T<sub>0</sub> (22%).

Owuor et.al. in 1994 reported that black tea's caffeine concentration increased as nitrogen application rates were raised. In the experiment it was found that application of Nano Urea showed significant impact on the total caffeine content of tea leaf. The highest value of caffeine was found in treatment T<sub>7</sub> (3.233%) and lowest was found in treatment T<sub>0</sub> (3.10%) (control).(Table 2)

**Table 2 Total polyphenol and caffeine (%) of tea leaf under various treatments of Nano Urea**

Treatment	Total polyphenol (%)	Total caffeine (%)
T <sub>0</sub>	22.00	3.100
T <sub>1</sub>	25.00	3.157
T <sub>2</sub>	23.67	3.153
T <sub>3</sub>	25.33	3.197

T <sub>4</sub>	26.67	3.160
T <sub>5</sub>	24.00	3.217
T <sub>6</sub>	24.00	3.223
T <sub>7</sub>	28.00	3.233
T <sub>8</sub>	23.33	3.130

## DISCUSSION

Leaf nitrogen content was found maximum in T<sub>7</sub> treatment, where 4% Nano Urea was applied in three sprays with recommended P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O as basal dose. It is the maximum dose of Nano Urea as per recommendation. As after application of Nano Urea, unutilized nitrogen was stored in the vacuoles and easily distributed through phloem when the sink needs so the leaf nitrogen percentage was increased as it presents in the leaves in available form. So, due to that reason leaf nitrogen percentage might be increased. This result can be supported with the findings of [Zatylny et al. \(2006\)](#). They found that leaf nitrogen content of saskatoon crop had a correlation with nitrogen application. The percentage of leaf nitrogen increased linearly with increasing dose of nitrogen application in saskatoon plants. [Raguraj et al. \(2020\)](#) applied a slow-release fertilizer urea-hydroxyapatite nanohybrids to tea plants (*Camellia sinensis*) in Sri Lanka. They found increasing rate of leaf nitrogen as compared to plots where conventional urea was used.

Leaf phosphorus percentage was found highest in treatment T<sub>7</sub> where total 4% Nano Urea was spray in 3 sprays with recommended basal dose of P<sub>2</sub>O<sub>5</sub> & K<sub>2</sub>O. Also leaf potassium percentage was found maximum in T<sub>7</sub> treatment. Nitrogen increases the uptake of phosphorus and requirement of potassium as potassium helps in nitrogen metabolism. According to [Huang et al. \(2022\)](#) potassium is one of the essential elements for tea plant. It helps in growth and yield of tea. Potassium is directly correlated with the nitrogen element. During Nano Urea application leaf nitrogen was increased and due to that leaf potassium was also increased. In Sri Lanka, [Raguraj et al. In 2020](#) found evidences of increased nitrogen content in tea leaf with the increased dose of application of nitrogen.

Grunes in 1959 observed that nitrogen frequently increases the root growth of plant and foraging capacity of phosphorus. Top growth of plant simultaneously increases the absorption of phosphorus. [Thummanatsakun and Yampracha in 2018](#) recorded that with increasing dose of nitrogen fertilizer, potassium requirement of the plant is high in cassava plant. In the present research similar results were found i.e., the phosphorus content in tea leaf was increased with the higher doses of nano urea.

The current analysis demonstrates that Nano Urea at the prescribed dose was more cost-effective than traditional urea. Nano urea was applied by foliar application, which increased efficiency and decreased environmental losses. It was a fertilizer that released slowly and was targeted specifically for sustainable crop production. The nano urea is an environmentally friendly product because urea leaching is one of the major issues in crop fields that causes

soil and water contamination. Agricultural economics are improved since it increases crop output while needing less nitrogen to be sprayed per unit area. ([Kumar et al., 2021](#))

## CONCLUSION

The application of Nano Urea, it was observed that leaf nitrogen, phosphorus and potassium content were increased with increasing dose. All the three parameters were found maximum in the plots where 0.4% Nano Urea was applied.

Higher application may adversely affect the quality of Nano Urea. Present investigation shows that recommended dose Nano Urea was economically beneficial than the conventional urea. Nano Urea was applied through foliar application so, efficiency was more and it reduced losses to the environment. It was a slow releasing fertilizer also target specific, good for sustainable crop production and healthy environment.

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