GROWTH AND YIELD OF TEA (*Camellia sinensis)* AS INFLUENCED BY NANO UREA DURING PRE AND POST PRUNING OPERTATION

ABSTRACT

The growth and yield 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 2021-22.

Bud breaking number and time attain to tipping height were two growth parameters observed after pruning operation was carried out. Numbers of bud break was counted 30 days, 40 days and 50 days after pruning respectively. After 50 days maximum bud breaking number (106/ plant) was observed in 0.5% Nano-urea applied plot. To attain that height, lesser time was required (51 days) by the same plot. Plucking density, fine leaf count and green leaf yield were three yield parameters observed during first, second and rain flush. Plucking point density was found maximum (50 no/m^2) during rain flush where 0.4% Nano-urea applied in 3 sprays. Fine leaf count was found maximum during first flush than it decreasing during second flush and rain flush respectively. The green leaf yield was found high in the plot where 0.4% Nano-urea applied in 3 sprays during rain flush.

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Keywords: urea, tea, pruning, bud breaking, growth, tipping height,fine leaf count, plucking point density, green leaf yield.

1.INTRODUCTION

Tea [*Camellia sinensis* (L.) O. kuntze] is a potential commercial crop cultivated across the world. It is an economic beverage famous for its health benefits and aroma (Gebrewold, 2018) India produces all types of tea but it is the world's largest producer and consumer of black tea.

The harvesting portion of tea is young pluckable shoots consisted with leaves, leaf buds and internodes collected from tea plant every after 7 (seven) days. So, unlike most other crops, it needs more nitrogen (Han *et al*. 2008) to get more vegetative growth. In tea plantations, nitrogen fertilization is a crucial field management technique. The availability of nitrogen fertiliser is essential for the development and quality of tea plants (Ma *et al*., 2021).

In order to feed and support the bulk of the world's population, fertilisers are fundamental to contemporary civilization. The formation of amino acids and proteins depends on nitrogen, which is one of the three main macronutrients required for agriculture along with phosphorus and potassium. Due to this, urea, ammonium salts, and organic fertilisers including manures, composts, and digestates are the most common forms of nitrogen fertiliser produced and used globally. (Walling *et al*., 2022)

Increased crop yields and improved soil health can be attained through innovative and sustainable agriculture practises. Among these cutting-edge technologies, nanotechnology is one that is proven effective in agriculture. Nanotechnology has a greater nutrient uptake efficiency, and it will soon transform the methods used for foliar application (Mohan *et al*., 2022).

In the agricultural sector, the use of foliar spray of engineered nanoparticles as nano-fertilizers, nano-pesticides, nano-sensors, and nanocarriers is growing. Nano particles applied by foliar spraying increase the efficiency of plant protection technologies compared to traditional soil-root treatment. Foliar-sprayed nano particles mostly enter the leaves through stomata and travel to various plant sections via apoplastic and symplastic routes. (Hong *et al*.,2021)

To address the nitrogen needs of crops, particularly during crucial growth phases, Indian Farmers' Fertilizer Cooperative Limited (IFFCO) created liquid nano urea as an alternative to urea. It is used as a foliar spray, aids in effective nitrogen absorption and penetration into the leaves, reaches plant sections where nitrogen is needed, and releases nutrients in a regulated manner, limiting loss into the environment. Additionally, it strengthens crop physiological features, particularly under drought-stressed environments. Since nano urea has a large surface area, is more soluble, and is smaller than conventional urea, it may aid in a variety of metabolic pathways, enhancing yields and quality metrics while reducing fertiliser waste. (Lakshman *et al*.,2022)

By applying liquid nano urea precisely and strategically to leaves, or "nano nitrogen," one can minimise urea losses, improve nutrient absorption effectiveness, and solve environmental problems including soil, air, and water pollution. It improves crop yield while requiring less nitrogen to be applied per unit area, improving agricultural economics. (Kumar *et al*., 2021)

2. MATERIALS AND METHOD

Mature plants of TV 23 clone with spacing 105cm×60cm was used regarding the experiment. TV 23 was a cambod type yield clone developed by Tocklai Tea Research Institute.The experiment was done by using recommended dose of N, P_2O_5 & K_2O to the control plot. Other treatment plot was treated with different dose of nano urea (NU) instead of urea to fulfill the nitrogen requirement of the plant and recommended dose of P_2O_5 & K_2O.At an interval of 7^{th} and 10^{th} week after pruning number of bud break has been recorded from that of the pruned branches after pruning and was outlined in mean number of buds at various intervals. The time requirement to the buds to attain tipping height (25 cm from the pruning table) from the pruned sticks was recorded weekly basis. After the bud breaking, five plants from each plot were taken and randomly five buds per plants was tagged and recorded the length of the bud in centimeter. The recorded data was expressed in days from the day of pruning.

Comment [M1]: Mention the dose

A grid of 50 cm^2×50 cm^2 area divided into 10 cm^2 was placed on the top of the bush. Number of pluckable shoots and already plucked shoots were counted and converted them into number per 100 cm^2per bush. This method was similar to the method described by Barua and Dutta in the year 1971

Plucking point density

$$= \frac{\text{No. of plucking point of the whole year}}{\text{tea bush spread (cm2)}} \times 100$$

Green leaves were plucked regularly generally in weekly basis. The weight of green leaves recorded during the experimental period. The recorded data was expressed in kg per hector.A bulked of green leaves was collected and weighted. separate the all one leaf and a bud, two leaf and a bud and soft *banji.* Weight them against the total and expressed in percentage. (The planters' Handbook by TRA, 1996).

The Randomized Block Design was used to statistically examine each piece of data (RBD). Calculating the corresponding "F" values allowed us to determine the significance of the variance resulting from the treatment effect (Panse and Sukhatme, 1985).

3.RESULTS AND DISCUSSION

The results of the present experiment on impact of Nano Urea influenced on growth parameters of mature tea plants conducted in the Experimental Garden for Plantation Crop, AAU, Jorhat, were presented below. Both field and laboratory studies were carried out to conduct the experiment. Field studies were conducted to study the growth characters and yield parameters. Laboratory studies were carried out to observe the biochemical parameters and nutrient availability of treated tea leaves. The experiment was conducted for the period of October 2021 to July, 2022.

In order to determine the difference between the tea plants impacted by the effluent and those unaffected by it for the previously mentioned parameters, the 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.

The experimental findings are furnished in this chapter under the following broad heads:

3.1 Effect of Nano Urea on growth parameters of mature tea

The growth parameters studied after light pruned were classified into two categories *viz,* number of bud break and days required to attain the tipping height. Growth parameters were observed after the pruning was done to all the treatment plot and was recorded.

<u>3.1.1 Bud breaking number</u>

First application of all the treatments were done in the last week of November,2022. Light prune was given to the treatments after 15 days from the first spray. Bud breaking was observed 30 days after the first spray *i.e.,* from mid of January,2022. Data of bud breaking number influenced by various treatments of Nano Urea are presented in the Table 1. In the experiment the maximum value for number of bud break amongst the treatment was observed in treatment T_7 after 50 days from light prune. But the data on the number of bud break shows no significant difference over control after one application of Nano Urea under various doses.

Table 1. Numbers of bud breaking as affected by various Nano Urea treatments

Treatment	30 days after pruning	40 days after pruning	50 days after pruning
T_0	19.00	81.33	98.67
T_1	21.67	84.00	101.33
T_2	20.67	83.00	100.33
T_3	22.33	84.66	102.00
T_4	26.00	88.33	105.67
T_5	24.67	87.00	104.33
T_6	22.00	22.00	84.33
T_7	24.33	24.33	86.66
T_8	19.33	19.33	81.66

Comment [M2]: Not explained in materials and methods

Comment [M3]: What all Toto t8?

3.1.2 Time required to attain tipping height

The data of number of days required to attain tipping height after pruning influenced by application of various treatments of Nano Urea are presented in the Table 2 The results showed significant difference on time required to attain the tipping height amongst the treatments. It was observed that application of 0.5% Nano Urea took least time to attain tipping height *i.e.,* in treatment T_4 and treatment T_8 (51.33 and 51.67 days respectively) which is *at par* with application of 0.4% Nano Urea in treatment T_3 and treatment T_7 (52 days for both plots). The maximum days required to attain tipping height was observed in control plot *i.e.,* treatment T_0 (58 days).

The study revealed that with the increasing doses of Nano Urea, number of days required to attain tipping height was decreasing as it took lesser time to unfold buds. Similar findings were reported by Barman *et al.* (1999) in tea crop. Nano Urea improves the metabolic activity of the plant which enhanced the meristematic growth of the plant. (Lakshman *et al.*,2022)

Table2. Days required to attain tipping height due to various treatment of Nano Urea

Treatment	Mean number of days
T_0	58.00
T_1	54.67
T_2	53.67
T_3	52.00
T_4	51.33
T_5	55.67
T_6	54.00
T_7	52.00
T_8	51.67

3.2 Yield parameters

3.2.1 Plucking density

The experimental findings on number of plucking point density/m^2 of tea plants in various treatments of Nano Urea are presented in Fig 1. After 1^{st} application of Nano Urea there is no significance difference amongst the treatment. After 2^{nd} and 3^{rd} application, plucking point density showed significant difference over control. The highest plucking point density/ m^2 was observed in treatment T_7 (35 no/m^2) (0.4% Nano Urea × 3 spray + basal dose of P_2O_5 and K_2O as recommended) after second application of Nano Urea followed by treatments T_8 (31 no/m^2) (Nano Urea 0.5% × 3spray with basal dose of P_2O_5 and K_2O). Lowest rate of plucking point density was observed in treatment T_0 (20 no/m^2).

After 3rd application of Nano Urea, the highest plucking point density was observed in treatment T_7 (50 no/m^2) (0.4% Nano Urea × 3 spray + basal dose of P_2O_5 and K_2O as recommended) followed by treatments T_4 (44 no/m^2) and T_8 (42 no/m^2). (Nano Urea 0.5% × 2 spray and 0.5% × 3 spray respectively with basal dose of P_2O_5 and K_2O). Lowest rate of plucking point density was observed in treatment T_0 (34 no/m^2).

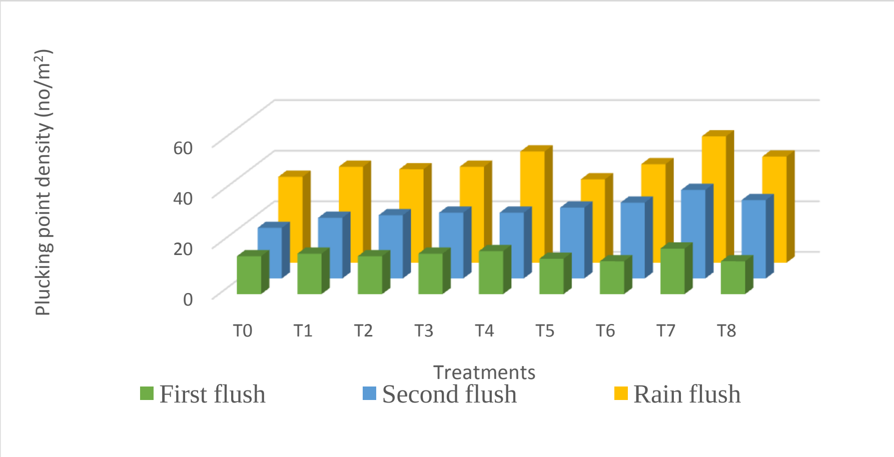

Fig.1.Plucking point density (no/m^2) after 1st, 2nd and rain flush after application of Nano Urea.

Comment [M4]: ??

3.2.2 Fine leaf count

The percentage of fine leaf during plucking after application of Nano Urea are presented in the Fig 2 below. No significant difference was observed in fine
leaf percentage after 1st application of Nano Urea amongst the treatments. But after 2nd and 3rd application of Nano Urea, it showed significance difference over control. The highest fine leaf percentage was observed in treatment T_7 (71.33%, treated with 0.4% Nano Urea × 3 spray + basal dose of P_2O_5& K_2O as recommended) followed with treatments T_8(69.33%) and T_4 (69%). (0.5% Nano Urea × 3 spray and 0.5% in × 2 spray respectively with basal dose of P_2O_5& K_2O as recommended).
After 3rd application, the highest fine leaf percent was observed in T_7 (63.33% treated with 0.4% Nano Urea × 3 spray + basal dose of P_2O_5& K_2O as recommended) which is *at par* with treatments T_8 (61.66%) and T_4 (59.66%) (Nano Urea was applied 0.5% Nano Urea × 3spray and 0.5% Nano Urea × 2 spray respectively with basal dose of P_2O_5& K_2O).

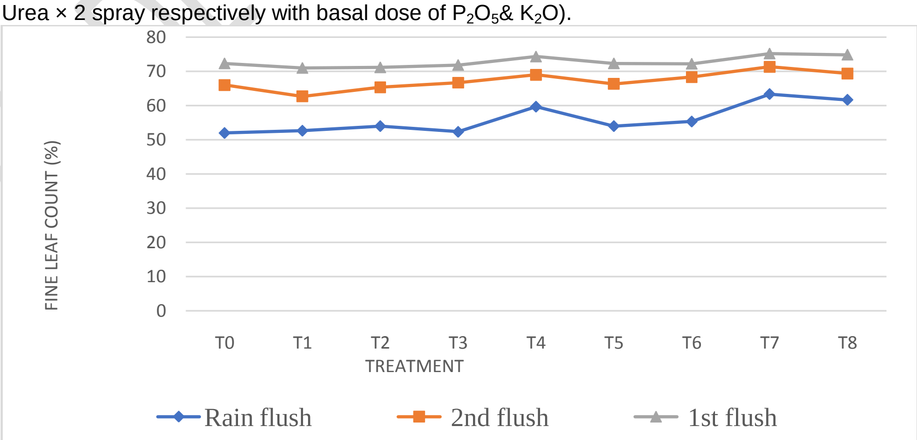

Fig.2. Fine leaf (%) after 1st ,2nd and rain flush after application of Nano Urea

3.2.3 Green leaf yield

Green leaf yield (kg/ha) of tea after application of Nano Urea in various treatments are presented in the Fig 3. After first application of Nano Urea, the highest green leaf yield was recorded in treatment T_7 (154.33 kg/ha) (0.4% Nano Urea × 3 spray + basal dose of P_2O_5& K_2O as recommended). But there were no significant differences amongst the treatments after the 1st application of Nano Urea in green leaf yield of tea.

Both after second and third application, the green leaf yield showed statistical significance difference over the control. After second application of Nano Urea, the highest green leaf yield was found in treatment T_7 (380.67 kg/ha with 0.4% Nano Urea × 3 spray + basal dose of P_2O_5& K_2O as recommended) which is *at par* with treatment T_8 (368 kg/ha) (Nano Urea was applied 0.5% Nano Urea × 3 spray with recommended dose of P_2O_5& K_2O).

After third application of Nano Urea the highest green leaf yield was recorded in treatment T_7 (493 kg/ha with 0.4% Nano Urea × 3 spray + recommended dose of P_2O_5& K_2O) and lowest yield was recorded in treatment T_0 (385kg/ha).

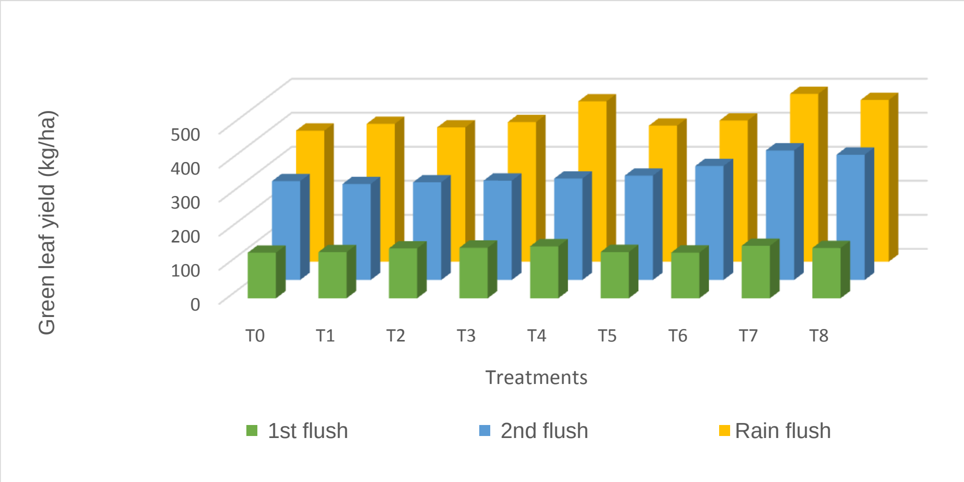

Fig. 3. Green leaf yield (kg/ha) of tea after 1st, 2nd and 3rd application of Nano Urea

Nitrogen application increases the vegetative growth of the plants. Harvested part of tea is leaves *i.e.,* vegetative part so the yield of tea is increased with increasing dose of nitrogen. Majid *et al.* (2017)observed yield traits and yield of maize increased with increasing dose of nitrogen level.Rajguru et al. (2020)observed that after application of urea nanohybrid, yield of tea increased.

4.CONCLUSION

The application of Nano Urea, pruned branches can be brought earlier due to the faster growth of primaries.The yield and yield attributes show significant improvement at the application of Nano Urea 0.4%.

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. The present findings shows that Nano Urea effect the growth and yield of tea. It increased both growth and yield as compared to 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.

Comment [M5]: Environment is health. Its is healthy for the people who consume the product out of this?

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