Plant Archives Vol. 24, Special Issue (GABELS), 2024 pp.149-153 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.SP-GABELS.022

INFLUENCE OF NANO UREA ON THE FRUIT QUALITATIVE FEATURES OF LITCHI CV. BOMBAI GROWN IN NEW ALLUVIAL ZONE OF WEST BENGAL INDIA

S. Ghosal[1], T.P. Rathour[1*], P. Datta[1], Neladri S Sarkar[2], Deepa Lal[3], Jitendra Gurjar[4], R. M. Reja[1], Mouli Paul[5] and Ritik Chawla[6]

[1]Department of Fruit Science, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur-741252, West Bengal, India

[2]Department of Genetics and Plant Breeding, Tamil Nadu Agricultural University, Coimbatore-641007, India

[3]ACTO (SMS) Horticulture, ICAR Central Institute for Cotton Research KVK, Nagpur-441108, M.H., India

[4]Department of Horticulture, SKRAU, Bikaner, Rajasthan, India

[5]Department of Genetics and Plant Breeding, Ramkrishna Mission Vivekananda Educational and Research Institute, Kolkata, West Bengal, India

[6]Department of Fruit Science, College of Horticulture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni-173 230, Himachal Pradesh, India

*Corresponding Author E-mail: thakurprasad0204rathour@gmail.com

ABSTRACT

Litchi, a subtropical fruit crop native to South China and Southeast Asia, is a significant crop in India, with West Bengal being one of its largest producers. Nano structured urea fertilizer, or "Nano Urea," has been shown to boost crop output and reduce environmental pollution. This innovative approach uses nanotechnology to manufacture smaller urea particles, allowing for more efficient and targeted nutrient delivery. Nano urea has been proven to increase crop yields by up to 20% and reduce nitrogen leakage into groundwater by up to 50%. However, more research is needed to understand its long-term impacts on soil health, plant development, and environmental sustainability. In this background, an experiment was conducted at the Horticultural Research Station, Mondouri, to investigate the effects of nano urea on fruit quality of litchi. The results showed that different treatments of nano urea significantly increased the number of fruits per panicle at harvest, individual fruit weight, diameter, fruit length, and yield. This treatment also exhibited maximum total sugar, reducing sugar, and anthocyanin content of fruit.

***Keywords*:** Nano urea, litchi, qualitative characters.

Introduction

Nanotechnology, a branch of science and engineering, is a promising solution to the challenges of increasing population, stagnant productivity, and limited land and water resources. Nanoparticles are smaller, larger, and can even pass through plant and animal cells, delivering the required product at the cellular level. Nano-fertilizers are economically cheap and require fewer amounts, reducing costs and increasing productivity. They improve soil aggregation, moisture retention, and carbon build-up, and yield per hectare is higher than conventional fertilizers. Nano-fertilizers are crucial in agriculture for improving crop development, enhancing nutrient usage efficiency, and reducing fertilizer loss and cultivation costs (Qureshi, *et al.*, 2018). They are particularly useful for precise nutrient administration, enhancing crop development stages, and providing nutrients when crops are growing. Nanotechnology has immense potential for environmentally friendly agriculture, particularly in developing countries. Liquid nano-urea is more than 80% efficient in providing nitrogen to plants, compared to 30% to 50% effective regular urea. Nano urea liquid particles, with a 30-nanometer size, have a 10,000 times higher surface area to volume ratio than regular granular urea. These tiny particles are more efficient in absorbing nutrients from plants, reducing environmental loss and reducing consumption. Nano fertilizers are nutrient carriers with high surface areas, capable of holding a large number of ions and releasing them slowly and steadily. They have been evaluated for biological safety and toxicity by Indian rules and OECD international standards. Nano fertilizers have been found to improve nutrient use efficiency in fruit crops like mango, pomegranate, and apple. Studies have shown that nano-chitosan has favourable impacts on anatomical, morphological, physiological, physicochemical, and molecular features, boosting fruit yield, quality, and shelf life (Zagzog *et al*., 2017). Additionally, nano-fertilizers have been found to enhance gene regulation, translocation, and expression, lowering abiotic stress.

But very little information is accessible on litchi, a delicious and healthful fruit. Keeping this in mind, the current experiment was conducted under the given term.

Material and Methods

The present investigation was carried out on 20 years-old Bombai cultivar of litchi at the field of Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia district under the subtropical humid agro-climatic zone of West Bengal which is located at 22.56° N latitude and 88.32 E longitudes, with an altitude of 9.75 m above mean sea level. The experiment was laid out in Randomized Block Design (RBD) and 5 treatments with 4 replications. There were five levels of nano-urea, namely T_1- nano urea @1.0 ml/l, T_2- nano urea @1.5 ml/l, T_3- nano urea @2.0 ml/l, T_4- nano urea @2.5 ml/l and T_5- water spray (control). In the present study the trend of litchi cv. Bombai were selected. The selected trees were healthy, sound, uniform in size and above 20 years old. Nano Urea was sprayed in different concentrations twice-once during the period after the fruit had been set and immediately after harvest of fruit along with basal doses of P-300g/plant/year & K-100g/plant/year were also given immediately after the harvest. Crop management measures, including irrigation, weeding, and cultural treatments, were conducted at regular intervals during the trial.

The data on fruit's morphological parameters *viz*., fruits are measured using a vernier calliper, with the length determined by averaging cheek length values in centimetres. Breadth is measured at the widest part of fruits using an automatic Vernier scale. The fruit weight, yield, aril weight, and peel weight of fruits were measured using electronic balances at harvest. Fruit, aril and peel weight were measured in grams and yield was measured in kilograms per plant. These measurements were taken to ensure accurate and reliable fruit production.

The total soluble solids (TSS) content in fruits was determined using an Erma hand refractometer (0-32^0 Brix), calibrated with distilled water. Total sugar (%) was measured by hydrolyzing a 50 ml solution with hydrochloric acid and distilled water. The total amount of sugar was calculated using Fehling A and B solutions, with brick red as the endpoint (Ranganna, 1995). Titratable acidity (%) was calculated by homogenizing fruit pulp with distilled water and filtering through Whatman No. I filter paper. The TSS/acid ratio was calculated by dividing the TSS content by the titratable acidity (Ranganna, 2002). Reducing sugar (%) was estimated using the AOAC (1980) method, with extracts titrated against Fehling's A and B solution using methylene blue as an indicator. The results were expressed as percentages. Ranganna (2002)'s standard procedure was used to estimate the anthocyanin content of fruit peel at harvest, which was expressed as mg per 100g of peel. The study aimed to determine the nutritional value of fruit juices.

The data was analyzed using variance analysis (Panse and Sukhatme, 1985), OPSTAT software, and Fischer- Snedecor's 'F' test. The significance of different sources of variation was tested using error mean square. The standard error of the mean (Sem) was calculated using the formula. If a parameter treatment was significant, the Critical Difference (CD) value was calculated to compare treatments.

Results

The study indicated (Table 1) that different nano urea treatments considerably enhanced fruit weight, with T_3 (Nano urea @2.0 ml/l) having the highest fruit weight (19.20 g), followed by T_4 (Nano urea @2.5 ml/l) (18.94 g), while the control had the lowest (18.14 g). The same treatments increased fruit length and diameter, with T_3 reaching the greatest length (4.12 cm) and the control reaching the minimum (3.91 cm).The study demonstrated substantial variations in fruit breadth among treatments, with the T_3 (Nano urea @2.0ml/l) treatment having the greatest width (3.71 cm) and the control treatment having the smallest fruit diameter (3.03 cm).

The study found substantial differences in aril weight generated by plants treated with varied doses of nano urea, with the maximum (15.12g) recorded with T_3 and the lowest (13.11) in the control treatment.

Table 1 showed substantial variations in the peel weight of litchi fruit across trees treated with various dosages of nano urea, with T_3 (Nano urea treatment @2.0ml/l) having the greatest peel weight (1.95g) and the lowest (1.70g) in T_4. Fruit yield was also altered by the several Nano urea treatments. The highest yield (70 kg/plant) was observed in T_3 (Nano urea @2.0m/I treated fruits), whereas the lowest yield (61.22 kg/plant) was reported in the control plant. The yield of fruits differed significantly across nano urea treatments, as indicated in Table 1.

Table 1: Effect of nano urea on fruit morphological parameters of litchi.

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Aril weight (g)	Peel weight (g)	Yield (kg/plant)
T_1-Nano urea @1.0 ml/l	18.77	4.00	3.21	14.92	1.72	67.12
T_2-Nano urea @1.5 ml/l	18.91	4.09	3.42	14.97	1.82	68.00
T_3-Nano urea @2.0 ml/l	19.20	4.12	3.71	15.12	1.99	70.00
T_4-Nano urea @2.5 ml/l	18.94	4.11	3.57	15.00	1.70	67.44
T_5-control (Water Spray)	18.14	3.91	3.03	13.11	1.95	61.22
S. EM (±)	0.12	0.02	0.05	0.02	0.03	0.82
CD (P=0.05)	0.38	0.9	0.19	0.07	0.11	2.56

The application of nano urea in litchi trees significantly impacted the bio-chemical constituents. The maximum TSS content (16.80° Brix) was recorded in T_3 (Nano urea @2.0ml/l), while the minimum (15.80° Brix) was in control fruits. The exogenous application of nano urea also affected total sugar, with the maximum total sugar (13.92) recorded in T_3 (Nano urea @2.0ml/l), while the control recorded the minimum (12.41%). The reducing sugar also varied significantly, with the maximum value (11.44%) obtained from the plant treated with T_3 (Nano urea @2.0m/l), while the control recorded the lowest value (2.31%).

The study found that the acidity of fruit did not significantly vary with different nano urea treatments. However, fruits treated with T_3 (Nano urea @2.0m/l) showed the minimum acidity (0.31%), while the maximum (0.39%) was observed in the control treatment. The maximum TSS: acid (52.90) was obtained from the plant treated with T_3 nano urea, while the minimum TSS: acid (40.51) was recorded in the control treatment. The anthocyanin content of the fruit significantly varied between 40.11 mg/100g (control) and 42.37 mg/100g (T_3).

Table 2: Effect of nano urea on biochemical attributes of litchi

Treatments	TSS (^{0}Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Acidity (%)	TSS: Acid	Anthocyanin (mg/100g)
T_1-Nano urea @1.0 ml/l	16.00	13.00	10.22	2.48	0.32	50:1	42.14
T_2-Nano urea @1.5 ml/l	16.10	13.10	10.71	2.39	0.37	43.50:1	42.23
T_3-Nano urea @2.0 ml/l	16.80	13.92	11.44	2.78	0.31	52.90:1	42.37
T_4-Nano urea @2.5 ml/l	16.40	13.44	11.02	2.42	0.33	50.90:1	42.11
T_5-control (Water Spray)	15.80	12.41	10.10	2.31	0.39	40.51:1	40.11
S. EM (±)	0.13	0.06	0.07	0.02	0.01	----	0.03
CD (P=0.05)	0.43	0.23	0.24	0.07	NS	----	0.07

Discussion

The application of Nano Urea significantly improved the physical characteristics of litchi fruits, including fruit weight, yield, breadth, aril weight, and peel weight. The biochemical composition of litchi fruits was also significantly improved. The highest fruit weight was observed in treatment T_3 (Nano urea @2.0 ml/l), with the control recording the minimum. This was due to the slow release of Nano fertilizers during peak growth, allowing plants to absorb most required nutrients without losses, resulting in high fruit weight. This is consistent with previous research, such as Zagzog *et al*. (2017). The application of Nano urea also led to a significant increase in yield, with T_3 (Nano urea @2.0 ml/l) showing the highest fruit yield. This is in line with previous research on pomegranate trees (Hasani *et al*., 2016). The physiological and metabolic effects of Nano urea can be attributed to increased fruit production and the transport of carbohydrates, which are essential for flower bud growth, initiation, development, longevity, effective pollination, and fertility (Stiles, 1999; Etehadnejad and Aboutalebi, 2014.).

Nano urea treatment has been shown to increase fruit size and physical attributes in various crops, including pomegranate and other fruits. This is due to the increased effectiveness of metabolic processes, as nitrogen is a component of proteins, enzymes, and chlorophyll involved in photosynthesis and growth. The growing fruit functions as a powerful sink, requiring large quantities of C and N for fast cell division. The increase in fruit weight and length may be related to enhanced cell division and photosynthetic activities influenced by nano urea (Kumaran *et al*., 2019). The beneficial impact of nano urea on fruit development may be related to increased enzyme activities of nitrogen metabolism and improved photosynthesis, which promotes fruit growth (Gornik *et al*., 2008 and Mondal *et al*., 2014). Additionally, nano urea is absorbed quickly into the epidermis of leaves and stems, enhancingthe uptake of bioactive compounds (Malerba and Cerana, 2016). The present study found a significant improvement in total sugar content (TSS) in juice following nano urea application, in line with previous findings in mango (Sarker and Rahim, 2013), and persimmon (Choi *et al*., 2013). Improvements in TSS can be attributed to the crucial functions of nitrogen in chloroplast structure, CO2 absorption, and activation of enzymes associated with photosynthesis (Kumar *et al*., 2017). The increased TSS may be due to the effect of nitrogen on the increase in the translocation of sugar in fruits (Abd El-Razek *et al*., 2011).

The study found that nano urea treatment significantly increased the total sugars in litchi fruits, similar to previous research on other fruit species. Nitrogen fertilizer also increased total, reducing, and non-reducing sugars in pomegranate and Guava fruits (Prasad and Mali, 2000; Sharma *et al*, 2014). This increase in total sugars can be attributed to the hydrolysis of starch into simple sugars, which is a function of nitrogen in fruits (Kumaran *et al*., 2019). The TSS: Acid ratio was highest among litchi trees treated with nano urea, and lowest in control fruits. This finding is consistent with previous studies, such as Gad *et al*. (2016) study on peach and Abd El-Razek *et al*. (2011) study on grapevine. The application of nano urea decreased the acidity of the fruit, with significant variation among the N-treated fruits. This may be due to the effect of nitrogen, which increases sucrose transport in fruits, resulting in low acidity and good-quality fruits. The increase in nitrogen levels is conducive to the delivery of sorbitol and sucrose from the extracellular space into cellsas reported by Li *et al*., 2012.

Conclusion

The data indicate that the use of Nano urea was efficient in affecting all physiochemical components of litchi fruits. Among the many treatments tested, Nano urea @2.0ml/l was the most efficient in enhancing all physical and biochemical properties of litchi fruits.

References

Abd El-Razek, E., Treutter, D., Saleh, M.M.S., EI-Shammaa, M., Abdel-Hamid, N. and Abou-Rawash, M. (2011). Effect of nitrogen and potassium fertilization on productivity and fruit quality of 'Crimson Seedless' Grapes. *Agri. and Bio. J. North America*, 2(2), 330-340

Abd El-Rhman, I.E. and Shadia, A.A. (2012). Effect of foliar sprays of urea and zinc on yield and physico chemical composition on jujube (*Ziziphus mauritiana*). *Middle East J. Agriculture Res*., 1(1), 52-57.

Choi, S., Park, D., Ahn, G., Kim, S. and Choi, T. (2013). Tree growth and nutritional changes in senescing leaves of Fuyu persimmon as affected by different nitrogen rates during summer. *Kor. J. Hort. Sci. Tech*., 31(6), 706-713.

Etehadnejad, F. and Aboutalebi, A. (2014). Evaluating the effects of foliar application of nitrogen and zinc on yield increasing and quality improvement of apple cv.' Golab Kohanz. *Indian J. Fundamental and Applied Life Sci*., 4(2), 125-129.

Gornik, K., Grzesk, M., and Romanowska Duda, B. (2008). The effect of chitosan on the rooting of grapevine cuttings and on subsequent plant growth under drought and temperature stress. *J. Fruit. and Ornamental Plant Res*., 16, 333-343.

Hasani, A., Mahmood, G., Soleiman, A. and Vishekaii, Z.R. (2016). The feasibility for replacement of urea with nitrogen nano-chelated fertilizer in olive (*Olea europaea* L.) orchards. *Iranian J. Plant Physiology*, 10(1), 3047-3058.

Kumar, G.K., Vani, V.S., Rao, A.D., Subbaramamma, P. and Sujatha, R.V. (2017). Effect of foliar sprays of urea, potassium sulphate and zine sulphate on quality of guava cv. Taiwan pink. *Int. J. Chem. Studies*, 5(5), 680-682.

Kumaran P.B., K. Venkatesan, A. Subbiah and Chandrasekhar, C.N. (2019). Effect of pre-harvest Solar spray of potassium scherite and ries, 7 0173993-1aid on yield and quality of grapes var, Muscat Hamburg. *Int, J, Chemical Siudies*, 7(3), 3998-4001.

Malerba, M. and Cerana, R. (2016), Chiosan effects on plant systems. *Int. J. molecular. Sci.*, 17(7), 996.

Mandal, C., Mandal, D.K., Bhattacharya, T., Sarkar, D, Pal, D.K. Prasad and and Thake, S. (2014), Revisiting agro-ecological sub-regions of India a case study of two major food production zones. *Current Sci*., 107(9), 1519-1536.

Panse, V.G. and Sukhatme, P.V. (1985) Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication, 87-89.

Prasad, R.N. and Mali, P.C. (2000). Changes in physico-chemical characteristics of pomegranate squash during storage. *Indian J. Hort.*, 57(1), 18-20.

Ranganna, S. (2002) Handbook of Analysis and Quality Control of Fruit and Vegetable Products. 2nd Edition, *Tata McGrow-Hill Education*, New York, 1118.

Sarker, B.C. and Rahim, M.A. (2013). Yield and quality of mango (*Mangifera indica* L.) as influenced by foliar application of potassium nitrate and urea. *Bangladesh J. Agril. Res*., 38(1), 145-154.

Sharma, S.K., Sharma, P.K. Mandeewal, R.L., Sharma, V., Chaudhary, R., Pandey, R. and Gupta, S. (2022). Effect of foliar application of nanurea under different nitrogen levels on growth and nutrient content of pearl millet (*Pennistum glaucum* L.). *Int. J. Plant & Soil Sci.*, 34(20), 149-155.

Stiles, W. C, Effects or nutritional factors on regular cropping of apple. *Har. Toch*, 9, 328-331.

Zagzog, O.A., Gad, M.M. and Hafez, N.K. (2017). Effect of nano-chitosan on vegetative growth, fruiting and resistance of malformation of mango. *Trends Hort. Res.*, 6, 673-681.