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Shivam Rai
Research Scholar, Department of Horticulture, ITM University, Gwalior, Madhya Pradesh, India

Kunal Adhikary
Assistant Professor Department of Horticulture, ITM University, Gwalior, Madhya Pradesh, India

Pushpendra Singh
Assistant Professor Department of Horticulture, ITM University, Gwalior, Madhya Pradesh, India

Hiral Gundaniya
Assistant Professor Department of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Pinkey Dukpa
Assistant Professor Department of Horticulture, ITM University, Gwalior, Madhya Pradesh, India

Deepshikha Ganveer
Research Scholar, Department of Botany, Prof. Ramkrishna More Arts, Commerce and Science College, Pune, Maharashtra, India

Corresponding Author:
Shivam Rai
Research Scholar, Department of Horticulture, ITM University, Gwalior, Madhya Pradesh, India

To study of the combined effect of nano urea with biofertilizer on growth yield attributes of *Capsicum annum* L. var. grossum (var. Arka Mohini)

Shivam Rai, Kunal Adhikary, Pushpendra Singh, Hiral Gundaniya, Pinkey Dukpa and Deepshikha Ganveer

Abstract
The present research "To Study of The Combined Effect of Nano Urea with Biofertilizer on Growth Yield Attributes of *Capsicum annum* L. Var. Arka Mohini." aimed to unravel the synergistic impact of combining nano urea with biofertilizer on the growth and yield attributes of *Capsicum annum*, commonly known as capsicum or bell pepper. The field experiment was carried out at the Crop Research Canter (CRC-2) School of Agriculture, Department of Horticulture ITM University, Gwalior (MP). The study was held in the Rabi season (2022-2023) from the second week of September to mid of January. Considering the escalating global demand for sustainable agricultural practices, the study explores innovative methods to enhance crop productivity while minimizing environmental footprint. Through a meticulous experimental design and comprehensive analysis, this research establishes a comprehensive understanding of the potential benefits that arise from the interaction between nano urea and biofertilizer with different doses of Phosphate Solubilizing Bacteria (PSB) and Potassium Solubilizing Bacteria (KSB) significantly influenced the growth and yield of chili. In the present study, treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) was found to be the best treatment for both 30 and 60 minutes among all the 16 Treatments and it gave the maximum growth, yield, and economic parameters, whereas the minimum growth, yield, and economic parameters were recorded in Treatment T_0 (Control).

Keywords: Biofertilizers, PSB (Phosphate solubilizing bacteria), KSB (Potassium solubilizing bacteria), growth, yield, treatment

Introduction
Capsicum annum L. is a popular vegetable grown and consumed throughout the world. It belongs to the family Solanaceae which comprises 90 genera and 2500 specie. *Capsicum* also called pepper, is a main vegetable and spice crop that originated in the American tropics and is today cultivated all over the world for fresh, dried, and processed products (Hunziker 2001) [6]. It was Fuchs, who proposed for the first time in 1543, the botanical term by Linneo (Walsh and Hoot 2001) [13]. *Capsicum* Species consists of a high level of ascorbic acid (Vitamin C) able to satisfy the recommended daily intake (FDA 2018, attested to 60 mg for 100 g of raw pepper) [4] and is commonly found in both sweet and hot types and widely documented in the literature (Padayatty *et al*., 2003; Howard and Wildman 2007) [9, 5]. As the world grapples with the dual challenges of feeding an ever-growing population and preserving the environment, the agricultural sector is under increased pressure to adopt sustainable practices. The utilization of chemical fertilizers has played a pivotal role in boosting crop yields; however, their adverse environmental impacts have raised concerns. Consequently, there is a dire need to explore alternative strategies that ensure optimal productivity without compromising ecological balance. The cost-effectiveness, environmentally friendly characteristics, and composition of biofertilizers are widely recognized. They present a viable and effective substitute for harmful synthetic fertilizers. While entirely replacing chemical fertilizers for promoting high-yielding varieties and hybrids of diverse vegetable crops might not be entirely feasible, there exists a promising avenue for diminishing the reliance on inorganic fertilizers. This can be achieved by gradually decreasing fertilizer amounts and concurrently elevating the application of appropriate quantities of organic manures and biofertilizers to strike a balanced approach. Keeping in view the balanced nutrition of organic, inorganic, and biofertilizers the present investigation entitled research "To Study of The Combined Effect of Nano Urea with Biofertilizer on Growth Yield Attributes of *Capsicum Annum* L. Var. Arka Mohini" was

carried out to find the suitable dose of nano urea and biofertilizers along with PSB and KSB for growth and yield of *Capsicum annum.* This study investigates the concurrent application of nano urea and biofertilizer with KSB and PSB as a potential solution to this challenge.

Materials and Methods

Table 1: Representation of Experimental Details:

Experimental Duration	Rabi 2022-2023
Experimental Design	Completely Randomize Block Design (CRD)
Treatment	16
Replication	3
Plot size	1.5×1.5 meter
Spacing	60 × 60 cm
Date of sowing	17 September 2022
Total Number of Plots	96
Number of Plants Per Plot	4
Field size	288 meters

Treatment details

The experiment was laid on a Completely Randomized Design (CRD) with sixteen treatments. The details of treatments are given in the table.

Table 2: Treatments with Different Combinations of Fertilizers:

T_0	Control (no treatment)
T_1	RDF
T_2	Nano urea (NU) 0.2%
T_3	Nano urea (NU) 0.5%
T_4	50% RDF + PSB + NU 0.2%
T_5	50% RDF + KSB + NU 0.2%
T_6	50% RDF + PSB + NU 0.5%
T_7	50% RDF + KSB + NU 0.5%
T_8	25% RDF + PSB + NU 0.2%
T_9	25% RDF + KSB + NU 0.2%
T_{10}	25% RDF + PSB + NU 0.5%
T_{11}	25% RDF + KSB + NU 0.5%
T_{12}	50% RDF + KSB + PSB + 0.2% NU
T_{13}	50% RDF + KSB + PSB + 0.5% NU
T_{14}	25% RDF + KSB + PSB + 0.2% NU
T_{15}	25% RDF + KSB + PSB + 0.5% NU

Note: -
RDF: - Recommended dose of fertilizer
KSB: - potassium solubilising bacteria
PSB: - phosphate solubilising bacteria
NU:- Nano Urea

Experimental details

Field Investigation was carried out During the Rabi season 2022 to 2023 at Polyhouse of the Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.). The Experiment was laid out in a Completely Randomize Block Design (CRD) with 3 Replications. Treatments Comprised of T0– Control (Blank), T_1 – (RDF), T_2 – (Nano urea (NU) 0.2%), T_3- (Nano urea (NU) 0.5%), T_4- (50% RDF + PSB + NU 0.2%), T_5- (50% RDF + KSB + NU 0.2%), T_6- (50% RDF + PSB + NU 0.5%), T_7- (50% RDF + KSB + NU 0.5%), T_8- (25% RDF + PSB + NU 0.2%), T_9- (25% RDF + KSB + NU 0.2%), T_{10}- (25% RDF + PSB + NU 0.5%), T_{11}- (25% RDF + KSB + NU 0.5%), T_{12}- (50% RDF + KSB + PSB + 0.2% NU), T_{13}- (50% RDF + KSB + PSB + 0.5% NU), T_{14}- (25% RDF + KSB + PSB + 0.2% NU) and T_{15}- (25% RDF + KSB + PSB + 0.5% NU) Respectively. Here the RDF, Nitrogen, Phosphorus, and Potassium are given in the form of Urea, DAP, and MOP, however, the dose of Urea was 24.9 gm/1.5-meter sq., Dose of DAP was 19.5 gm/1.5meter sq. and the dose of MOP was 7.5 gm/1.5meter sq. The land was brought to a fine tilth by Ploughing and harrowing, then the beds are made of 1-foot height and 1.5 meters width, the distance between the two beds was 1 meter, then each bed was divided into 16 plots respectively. The size of each plot was 1.5 meters square, distance between the two plots was 0.5 meters square. Seeds were sown in Portrays on 17th September 2022 and seedlings were ready for Transplanting at 30 days after seed sowing. at 30 days of healthy and uniform seedlings were used for transplanting. Roots of seedlings are dipped into phosphate solubilizing bacteria (PSB) and potassium solubilizing bacteria (KSB) for 30 and 60 min separately, before transplanting on the beds. After dipping the roots Seedlings were transplanted in the plots with a Spacing of 60 cm (Plant to plant) and 60 cm (between row to row), Irrigation was given immediately after transplantation. The plots were kept free from weeds by periodic hand weeding. Regular irrigation was given on a regular basis to keep the soil moist. The stacking of plants was done to keep the plants upright. Stacking operations were carried out in the main field to keep the plants in an upright position. The schedule of different plant protection measures taken against pests and diseases during the period of investigation. The fully developed green fruits were harvested for recording different observations and data recorded on various parameters. The data obtained from the set of observations for each character were subjected to Analysis of Variance as advocated by (Panse and Sukhatme 1985) [10].

Result and Discussion

Plant height

The study investigated the impact of the combined effect of Nano Urea with bio-fertilizer (PSB and KSB) on the growth and yield attributes of *Capsicum* var. Arka Mohini. The data showed that the tallest plant height (34.68, 43.25, and 46.70 cm) at 30, 60, and 80 days after transplanting (DAT) was observed in Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) for 30 minutes. Similarly, the highest plant height (35.13, 44.67, and 47.28 cm) at 30, 60, and 80 DAT was seen in Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) for 60 minutes, outperforming other treatments. Conversely, the lowest plant height (16.08, 24.35, and 31.25 cm) at 30, 60, and 80 DAT occurred in the control treatment (T_0) for 30 minutes, minimum plant height (16.97, 25.02, and 31.75) for 60 minutes was found in the treatment T_0 (Control) Respectively.

Number of Leaves

In terms of leaf number, Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) demonstrated the maximum number of leaves (28.17 at 90 DAT) for 30 minutes and (28.75 at 90 DAT) for 60 minutes in T_{15} (25% RDF + KSB + PSB + 0.5% NU). In contrast, the least leaves were observed in Treatment T_4 (50% RDF + PSB + NU 0.2%) was (14.50 at 90 DAT) for 30 minutes and (15.17 at 90 DAT) in T_4 (50% RDF + PSB + NU 0.2%) for 60 minutes. The minimum number of leaves observed in Treatment T_4 (50% RDF + PSB + NU 0.2%) is Perhaps because the treatment contains a low quantity of Potassium.

Number of Branches

For the number of branches per plant, Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) again excelled with the highest count (3.33 at 90 DAT) for 30 minutes and (2.92 at 90 DAT) in Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) for 60 minutes. The minimum branches found in Treatment T4 (50% RDF + PSB + NU 0.2%) found to be (1.33 at 90 DAT) for 30 minutes, and (1.25 at 90 DAT) for 60 minutes at T_{12} (50% RDF + KSB + PSB + 0.2% NU).

Number of Flower

Flowering patterns were influenced by the treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) displayed the highest number of flowers (8.83 at 60 DAT and 9.42 at 90 DAT) for 30 minutes, and (9.83 at 60 DAT and 9.17 at 90 DAT) for 60 minutes at Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU). In contrast, the lowest flowering count was noted in Treatment T_0 (3.75 at 60 DAT for 30 minutes and 5.00 at 90 DAT for 30 minutes) and Treatment T_0 (Control) (4.83 at 60 DAT for 60 minutes) and (5.08 at 90 DAT for 60 minutes) at treatment T_9 (25% RDF+KSB+NU 0.2%).

The study indicated that nitrogen availability, both from chemical fertilizers and nano urea, positively impacted plant height and branching, potentially due to improved nitrogen availability from organic manure, in agreement with the findings of Bharathi *et al*. (2011) [1], Bhuvaneswari *et al*. (2013) [2], Sakthivel (2021) [12], and Khurshid *et al*. (2021) [7].

Effect of nano urea and Biofertilizers (PSB and KSB) on yield parameters attributes of (*Capsicum annum* L.)

Number of Flower

Flowering patterns were influenced by the treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) displayed the highest number of flowers (8.83 at 60 DAT and 9.42 at 90 DAT) for 30 minutes, and (9.83 at 60 DAT and 9.17 at 90 DAT) for 60 minutes at Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU). In contrast, the lowest flowering count was noted in Treatment T_0 (3.75 at 60 DAT for 30 minutes and 5.00 at 90 DAT for 30 minutes) and Treatment T_0 (Control) (4.83 at 60 DAT for 60 minutes) and (5.08 at 90 DAT for 60 minutes) at treatment T_9 (25% RDF+KSB+NU 0.2%).

Number of Fruits

The study investigated the effects of nano urea, PSB, and KSB on various yield parameters of *Capsicum annum* L. Notably, treatment T15 (25% RDF + KSB + PSB + 0.5% NU) emerged as the most effective among all treatments. This treatment exhibited the highest number of fruits per plant, with (12.17 for 30 min at 90 DAT) and (11.67 for 60 min at 90 DAT), whereas the lowest count of fruits per plant (6.00) and (6.08) was observed in the control treatment T_0 (Control) for both time intervals.

Fruit Diameter

Furthermore, the utilization of nano urea and biofertilizers significantly influenced fruit diameter. Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) yielded a diameter of 94.10 mm for 30 min, while treatment T_{10} (25% RDF + PSB + NU 0.5%) resulted in 78.03 mm for 60 min, both of which were optimal. In contrast, the minimum fruit diameter was 26.03 mm for 30 minutes and 43.30 mm for 60 minutes in the T_0 control treatment.

Fruit Weight

The study also highlighted the substantial impact of these treatments on average fruit weight. Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) again led the way with 131.33g for 30 minutes and an impressive 171.17g for 60 minutes, whereas the least average fruit weight was 37.90 g for 30 minutes and 40.97g for 60 minutes in the T_0 control group.

Yield per Plant

For yield per plant, treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) exhibited the highest yield at 1.26 kg for both 30 and 60 minutes, outperforming other treatments. Conversely, the control treatment yielded the lowest results of 0.34 kg for both time intervals.

Yield per Plot

When considering yield per plot, treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) again excelled with 5.05 kg for 30 minutes and 4.93 kg for 60 minutes. Meanwhile, the control treatment had the lowest yield per plot, measuring 1.33 for 30 minutes and 1.37 for 60 minutes.

Effect of nano urea and Biofertilizers (PSB and KSB) on Quality parameter attributes of (*Capsicum annum* L.)

Shelf Life

In terms of shelf life, treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) was found to be (5.33 for 30 minutes and 4.33 for 60 minutes) demonstrating the longest shelf life for capsicum annum fruit, while the minimum shelf life was 2.00 for 30 minutes and 2.33 for 60 minutes in the T_0 control treatment.

In summary, the data strongly supported the effectiveness of treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) across all yield parameters, showcasing its positive influence on the growth and yield of *Capsicum annum* L.

The enhanced quality and yield of the plant, coupled with increased economic grains, could be attributed to the plant's utilization of nutrients from inorganic, organic fertilizers, and bio-fertilizers. This synergistic blend of fertilization methods contributed to the positive outcomes observed. Similar results for most of the characters were also reported by Manna *et al*., (2012) [8]; Raturi *et al*., (2019) [11]; Khurshid *et al*., (2021) [7].

The observed outcomes lend support to the hypothesis that the interaction between nano urea and biofertilizer with PSB and KSB stimulates plant growth and yield attributes synergistically. The enhanced nutrient availability and absorption, facilitated by the biofertilizer, coupled with the controlled-release properties of nano urea, seem to contribute to the observed positive outcomes. This study underscores the importance of harnessing innovative approaches to address the challenges facing modern agriculture.

Table 3: Effect of nano urea and biofertilizers with PSB and KSB on Growth attributes of chili (*Capsicum annum* L.) for 30 min.

Treatment	Plant height (30 days)	Plant height (60 days)	Plant height (80 days)	No. of leaves (90 DAT)	No. of Branches (90 DAT)
T_0 Control (no treatment)	16.08	24.35	31.25	17.50	1.92
T_1 RDF	24.45	34.00	39.75	20.67	2.33
T_2 Nano urea (NU) 0.2%	27.29	39.08	41.75	18.58	2.00
T_3 Nano urea (NU) 0.5%	22.33	36.33	37.92	22.75	2.50
T_4 50% RDF +PSB+ NU 0.2%	22.02	33.00	35.33	14.50	1.33
T_5 50% RDF + KSB + NU 0.2%	23.60	33.67	35.00	17.33	1.67
T_6 50% RDF + PSB + NU 0.5%	24.64	35.67	38.42	18.83	2.08
T_7 50% RDF +KSB + NU 0.5%	27.83	37.25	40.50	20.67	2.42
T_8 25% RDF + PSB + NU 0.2%	29.53	36.17	38.92	22.42	2.42
T_9 25% RDF + KSB + NU 0.2%	27.28	33.00	34.83	19.08	2.16
T_{10} 25% RDF + PSB + NU 0.5%	28.17	40.83	43.17	24.33	3.25
T_{11} 25% RDF + KSB + NU 0.5%	22.69	35.50	37.00	23.00	2.58
T_{12} 50% RDF + KSB + PSB + 0.2% NU	25.54	38.67	39.92	17.17	1.58
T_{13} 50% RDF + KSB + PSB + 0.5% NU	26.84	34.83	36.00	23.67	2.75
T_{14} 25% RDF + KSB + PSB + 0.2% NU	22.13	40.83	42.08	24.00	3.17
T_{15} 25% RDF + KSB + PSB + 0.5% NU	34.68	43.25	46.70	28.17	3.33
S.Em.±	1.67	1.87	1.83	1.42	0.17
C.D. at 5%	4.84	5.40	5.27	4.09	0.50
C.V. %	5.87	5.79	5.80	6.06	9.24

Table 4: Effect of nano urea and biofertilizers with PSB and KSB on Growth attributes of chili (*Capsicum annum* L.) for 60 min.

Treatment	Plant height (30 days)	Plant height (60 days)	Plant height (80 days)	No. of leaves (90 DAT)	No. of Branches (90 DAT)
T_0 Control (no treatment)	16.97	25.02	31.75	19.17	1.75
T_1 RDF	25.19	33.42	40.25	21.17	2.25
T_2 Nano urea (NU) 0.2%	27.95	39.58	42.17	19.25	2.50
T_3 Nano urea (NU) 0.5%	22.68	36.60	38.50	24.17	2.00
T_4 50% RDF +PSB+ NU 0.2%	22.75	33.50	35.75	15.17	1.58
T_5 50% RDF + KSB + NU 0.2%	23.69	34.33	35.33	18.08	1.58
T_6 50% RDF + PSB + NU 0.5%	24.70	37.08	38.75	19.67	2.50
T_7 50% RDF +KSB + NU 0.5%	29.38	38.83	41.58	21.33	2.00
T_8 25% RDF + PSB + NU 0.2%	29.89	37.17	39.42	23.42	2.83
T_9 25% RDF + KSB + NU 0.2%	27.45	33.58	35.67	19.75	2.00
T_{10} 25% RDF + PSB + NU 0.5%	28.62	41.33	43.83	25.08	2.08
T_{11} 25% RDF + KSB + NU 0.5%	22.69	36.00	37.67	23.75	2.33
T_{12} 50% RDF + KSB + PSB + 0.2% NU	25.86	39.33	40.58	18.00	1.25
T_{13} 50% RDF + KSB + PSB + 0.5% NU	26.89	35.67	36.67	24.25	2.42
T_{14} 25% RDF + KSB + PSB + 0.2% NU	22.19	41.58	42.42	24.58	2.58
T_{15} 25% RDF + KSB + PSB + 0.5% NU	35.13	44.67	47.28	28.75	2.92
S.Em.±	1.63	1.87	1.84	1.42	0.24
rC.D. at 5%	4.70	5.39	5.32	4.09	0.71
C.V. %	5.43	5.79	5.59	5.74	9.44

Table 5: Effect of nano urea and biofertilizers with PSB and KSB on Yield attributes of chili (*Capsicum annum* L.) for 30 min.

Treatment	No. of Flowers (60 DAT)	No. of Flowers (90 DAT)	No. of Fruits (90 DAT)	Fruits diameter in mm	Fruits weight in gram
T_0 Control (no treatment)	3.75	5.00	6.00	26.03	37.90
T_1 RDF	5.67	6.08	8.83	54.57	61.67
T_2 Nano urea (NU) 0.2%	7.25	7.50	9.17	67.57	71.17
T_3 Nano urea (NU) 0.5%	8.83	9.25	11.00	53.30	53.43
T_4 50% RDF +PSB + NU 0.2%	6.67	7.08	8.92	65.77	72.53
T_5 50% RDF + KSB + NU 0.2%	6.75	6.92	8.92	71.13	90.13
T_6 50% RDF + PSB + NU 0.5%	7.08	7.25	9.00	64.63	71.23
T_7 50% RDF +KSB + NU 0.5%	8.33	8.50	9.58	88.91	111.43
T_8 25% RDF + PSB + NU 0.2%	7.42	7.58	9.33	68.53	92.60
T_9 25% RDF + KSB + NU 0.2%	6.42	6.75	8.83	83.07	97.03
T_{10} 25% RDF + PSB + NU 0.5%	8.42	8.75	10.08	88.43	112.33
T_{11} 25% RDF + KSB + NU 0.5%	7.08	7.33	9.00	76.33	103.50
T_{12} 50% RDF + KSB + PSB + 0.2% NU	7.33	7.58	9.25	82.00	98.33
T_{13} 50% RDF + KSB + PSB + 0.5% NU	6.08	6.33	8.75	61.35	67.12
T_{14} 25% RDF + KSB + PSB + 0.2% NU	7.50	7.92	9.42	54.30	52.20
T_{15} 25% RDF + KSB + PSB + 0.5% NU	8.83	9.42	12.17	94.10	131.33
S.Em.±	0.50	0.44	0.44	3.18	4.19
C.D. at 5%	1.45	1.27	1.27	9.19	12.09
C.V. %	5.91	6.05	5.87	5.60	5.81

Table 6: Effect of nano urea and biofertilizers with PSB and KSB on Yield attributes of chili (*Capsicum annum* L.) for 60 min.

Treatment	No. of Flowers (60 DAT)	No. of Flowers (90 DAT)	No. of Fruits (90 DAT)	Fruits diameter in mm	Fruits weight in gram
T_0 Control (no treatment)	4.83	5.83	6.08	43.30	40.97
T_1 RDF	6.25	8.75	9.58	54.07	63.63
T_2 Nano urea (NU) 0.2%	8.58	7.83	9.58	58.53	59.07
T_3 Nano urea (NU) 0.5%	8.25	8.50	9.17	56.17	55.40
T_4 50% RDF +PSB+ NU 0.2%	8.92	7.50	9.25	61.70	64.13
T_5 50% RDF + KSB + NU 0.2%	6.75	7.25	9.33	71.85	62.00
T_6 50% RDF + PSB + NU 0.5%	7.42	7.83	9.00	64.07	83.00
T_7 50% RDF +KSB + NU 0.5%	8.67	7.67	10.00	77.80	98.73
T_8 25% RDF + PSB + NU 0.2%	6.75	7.25	9.00	52.70	54.53
T_9 25% RDF + KSB + NU 0.2%	5.25	5.08	8.83	69.77	101.90
T_{10} 25% RDF + PSB + NU 0.5%	8.50	8.58	10.42	78.03	110.50
T_{11} 25% RDF + KSB + NU 0.5%	7.58	7.33	8.92	72.19	101.73
T_{12} 50% RDF + KSB + PSB + 0.2% NU	5.42	6.08	9.58	77.11	79.13
T_{13} 50% RDF + KSB + PSB + 0.5% NU	4.92	5.92	9.25	63.87	73.62
T_{14} 25% RDF + KSB + PSB + 0.2% NU	7.25	6.25	9.83	60.23	74.73
T_{15} 25% RDF + KSB + PSB + 0.5% NU	9.83	9.17	11.67	77.03	171.17
S.Em.±	0.39	0.41	0.40	2.65	4.26
C.D. at 5%	1.14	1.19	1.15	7.66	12.29
C.V. %	9.49	9.79	7.36	5.00	5.68

Table 7: Effect of nano urea and biofertilizers with PSB and KSB on Yield and Quality attributes of chili (*Capsicum annum* L.) for 30 min.

Treatment	Yield Per Plant	Yield Per Plot	Shelf life of fruit in Days
T_0 Control (no treatment)	0.34	1.33	2.00
T_1 RDF	0.54	2.20	3.33
T_2 Nano urea (NU) 0.2%	0.67	2.67	3.00
T_3 Nano urea (NU) 0.5%	0.51	2.05	3.33
T_4 50% RDF +PSB+ NU 0.2%	0.64	2.58	3.67
T_5 50% RDF + KSB + NU 0.2%	0.84	3.38	3.00
T_6 50% RDF + PSB + NU 0.5%	0.66	2.64	3.33
T_7 50% RDF +KSB + NU 0.5%	1.12	4.49	3.33
T_8 25% RDF + PSB + NU 0.2%	0.85	3.40	3.33
T_9 25% RDF + KSB + NU 0.2%	0.86	3.45	2.67
T_{10} 25% RDF + PSB + NU 0.5%	1.21	4.83	4.00
T_{11} 25% RDF + KSB + NU 0.5%	0.93	3.71	3.00
T_{12} 50% RDF + KSB + PSB + 0.2% NU	0.86	3.45	2.67
T_{13} 50% RDF + KSB + PSB + 0.5% NU	0.60	2.42	3.00
T_{14} 25% RDF + KSB + PSB + 0.2% NU	0.46	1.85	3.33
T_{15} 25% RDF + KSB + PSB + 0.5% NU	1.26	5.05	5.33
S.Em.±	0.05	0.21	0.34
C.D. at 5%	0.15	0.61	0.97
C.V. %	5.90	6.02	20.70

Table 8: Effect of nano urea and biofertilizers with PSB and KSB on Yield and Quality and Quality attributes of chili (*Capsicum annum* L.) for 60 min.

Treatment	Yield Per Plant	Yield Per Plot	Shelf life of fruit in Days
T0 Control (no treatment)	0.34	1.37	2.33
T1 RDF	0.61	2.44	3.00
T2 Nano urea (NU) 0.2%	0.56	2.26	3.00
T3 Nano urea (NU) 0.5%	0.50	2.02	3.00
T4 50% RDF +PSB+ NU 0.2%	0.59	2.37	3.33
T5 50% RDF + KSB + NU 0.2%	0.58	2.31	3.33
T6 50% RDF + PSB + NU 0.5%	0.75	2.98	3.67
T7 50% RDF +KSB + NU 0.5%	0.99	3.95	4.00
T8 25% RDF + PSB + NU 0.2%	0.49	1.95	3.00
T9 25% RDF + KSB + NU 0.2%	0.90	3.60	3.67
T10 25% RDF + PSB + NU 0.5%	1.15	4.60	4.00
T11 25% RDF + KSB + NU 0.5%	0.93	3.66	2.67
T12 50% RDF + KSB + PSB + 0.2% NU	0.78	3.03	3.67
T13 50% RDF + KSB + PSB + 0.5% NU	0.67	2.69	2.33
T14 25% RDF + KSB + PSB + 0.2% NU	0.74	2.95	2.67
T15 25% RDF + KSB + PSB + 0.5% NU	1.26	4.93	4.33
S.Em.±	0.04	0.20	0.33
C.D. at 5%	0.12	0.58	0.96
C.V. %	5.05	5.38	20.83

1. Pictorial Representation of Growth, Yield, and Quality Parameters for 30 Minutes

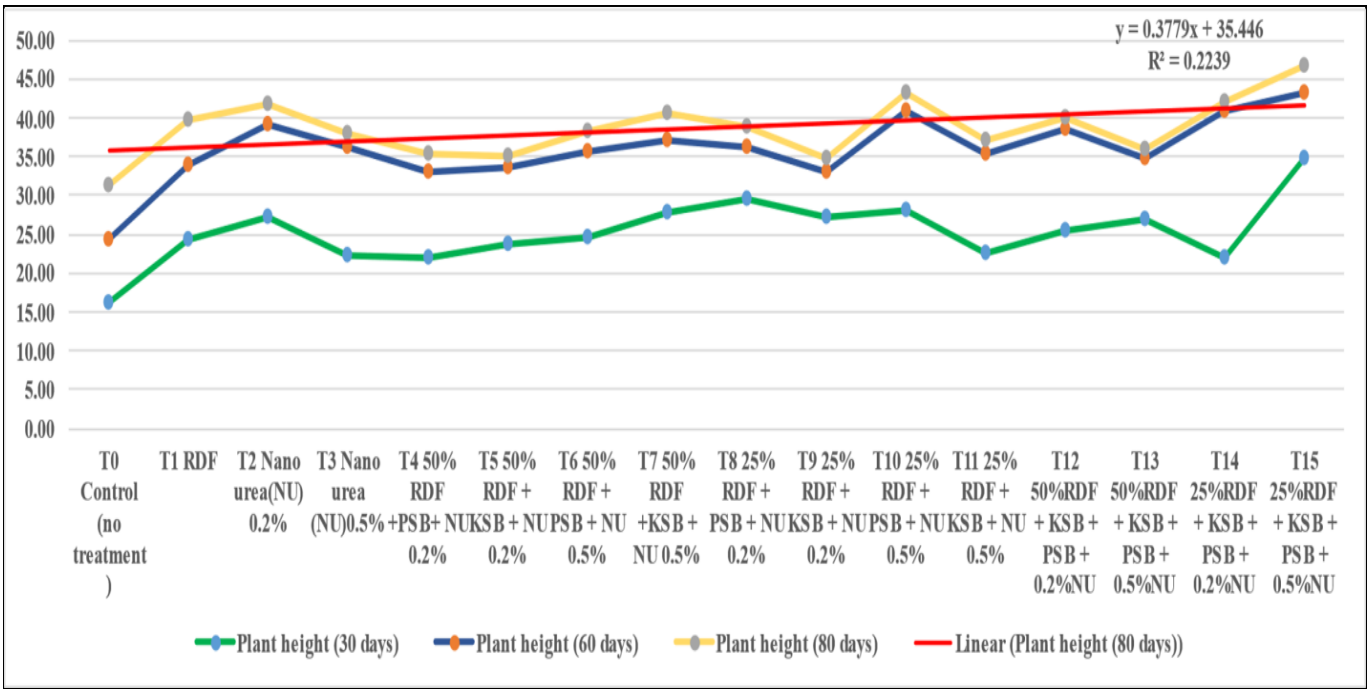

Fig 1: Representation of plant height of 30, 60, and 80 days

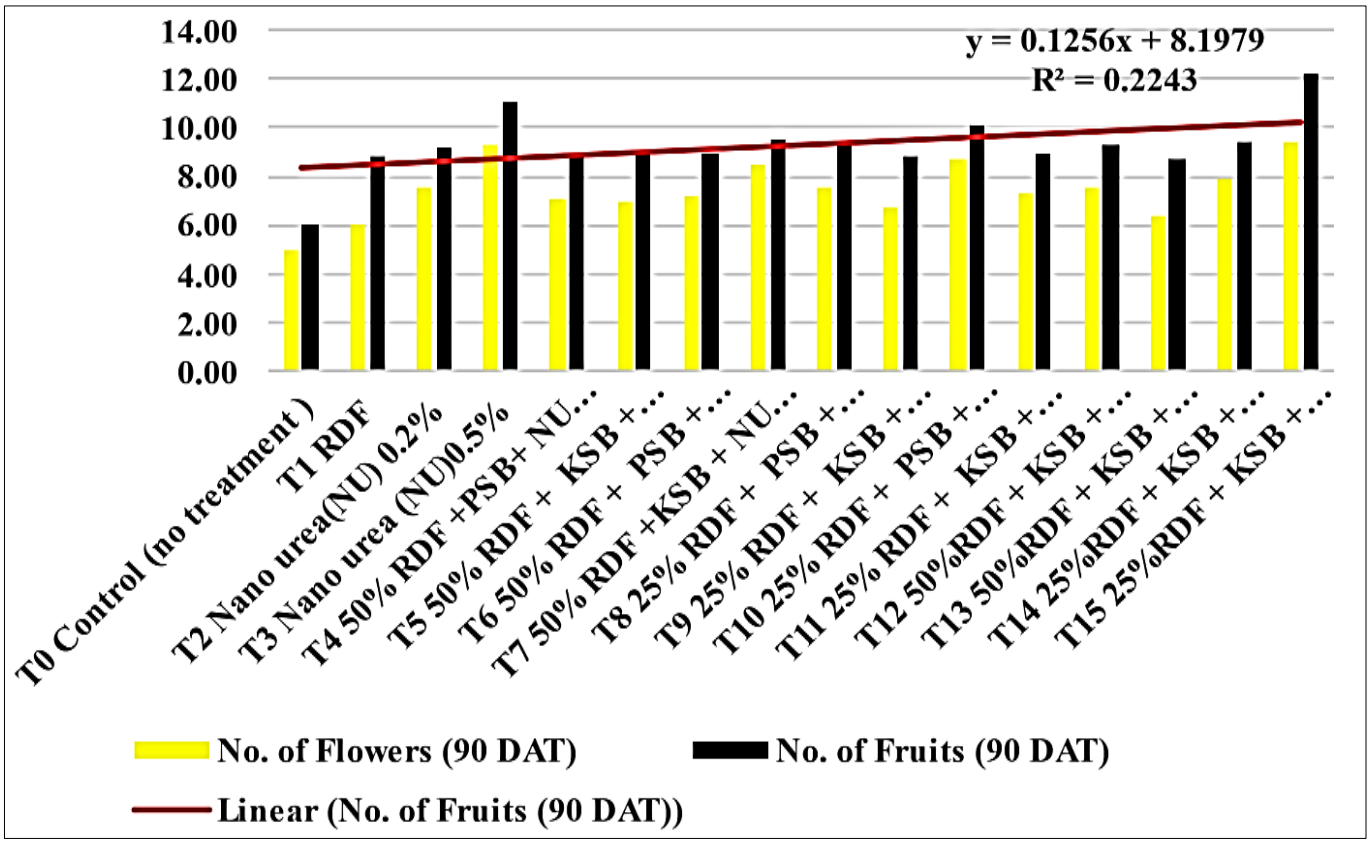

Fig 2: Representation of No. of Flowers & No. of Fruits

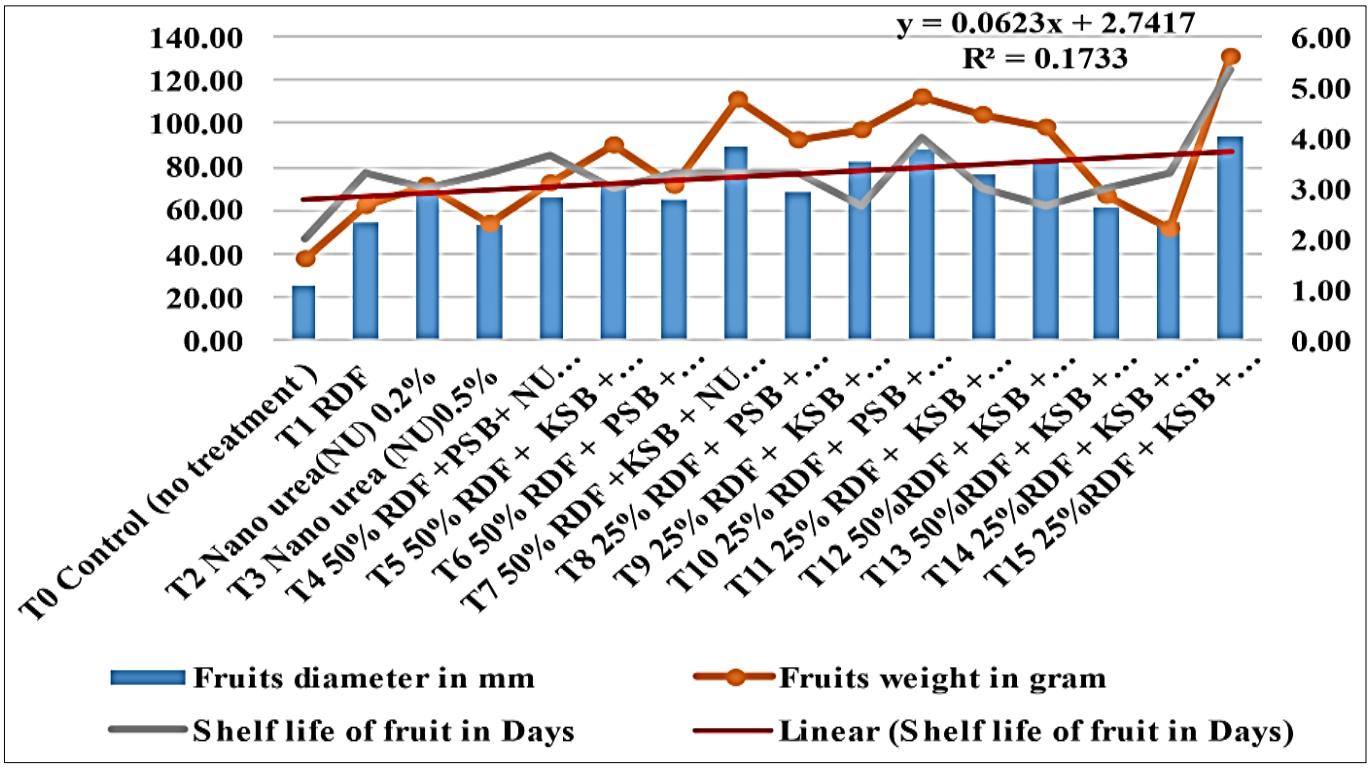

Fig 3: Representation of Fruits in Diameter, Fruits Weight in Gram, and Shelf Life of Fruits

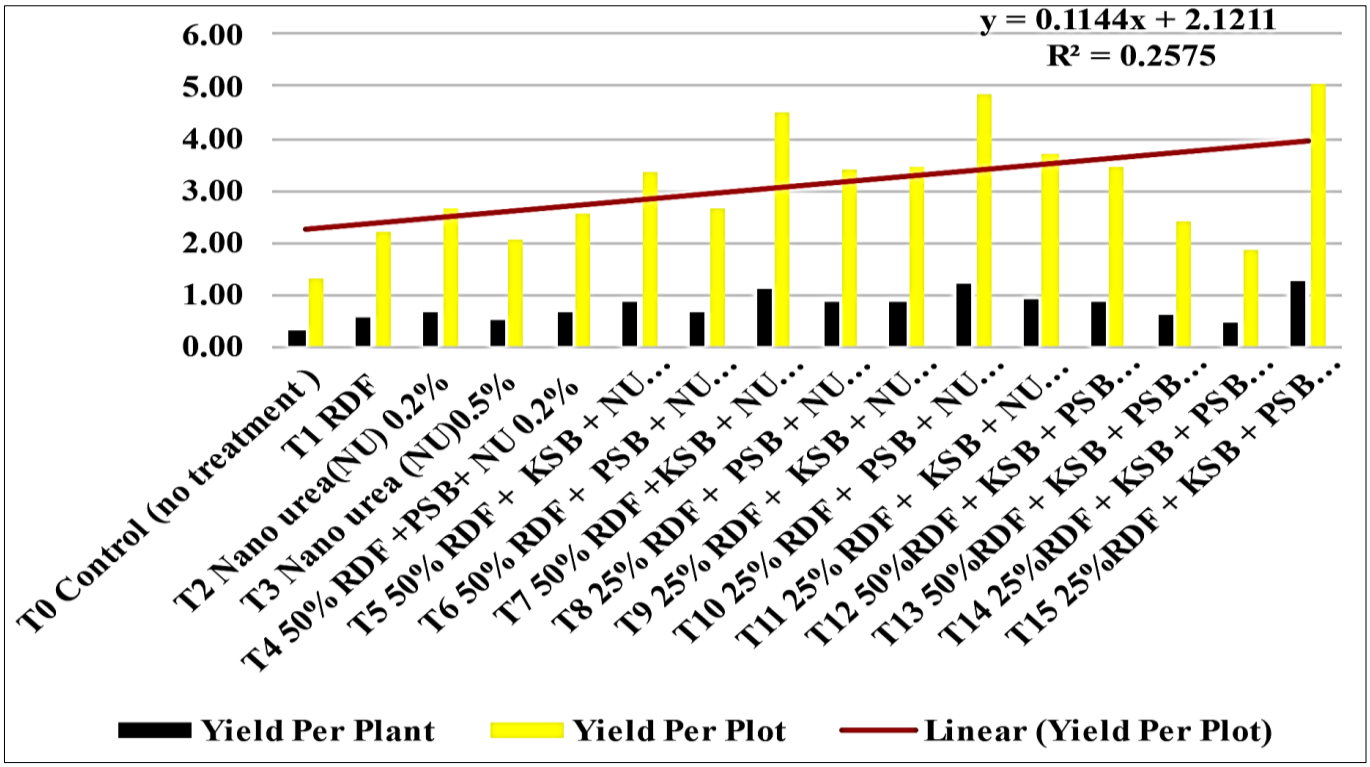

Fig 4: Representation of Yield Per Plant and Yield Per Plot

2. Pictorial Representation of Growth, Yield, and Quality Parameters for 60 Minutes

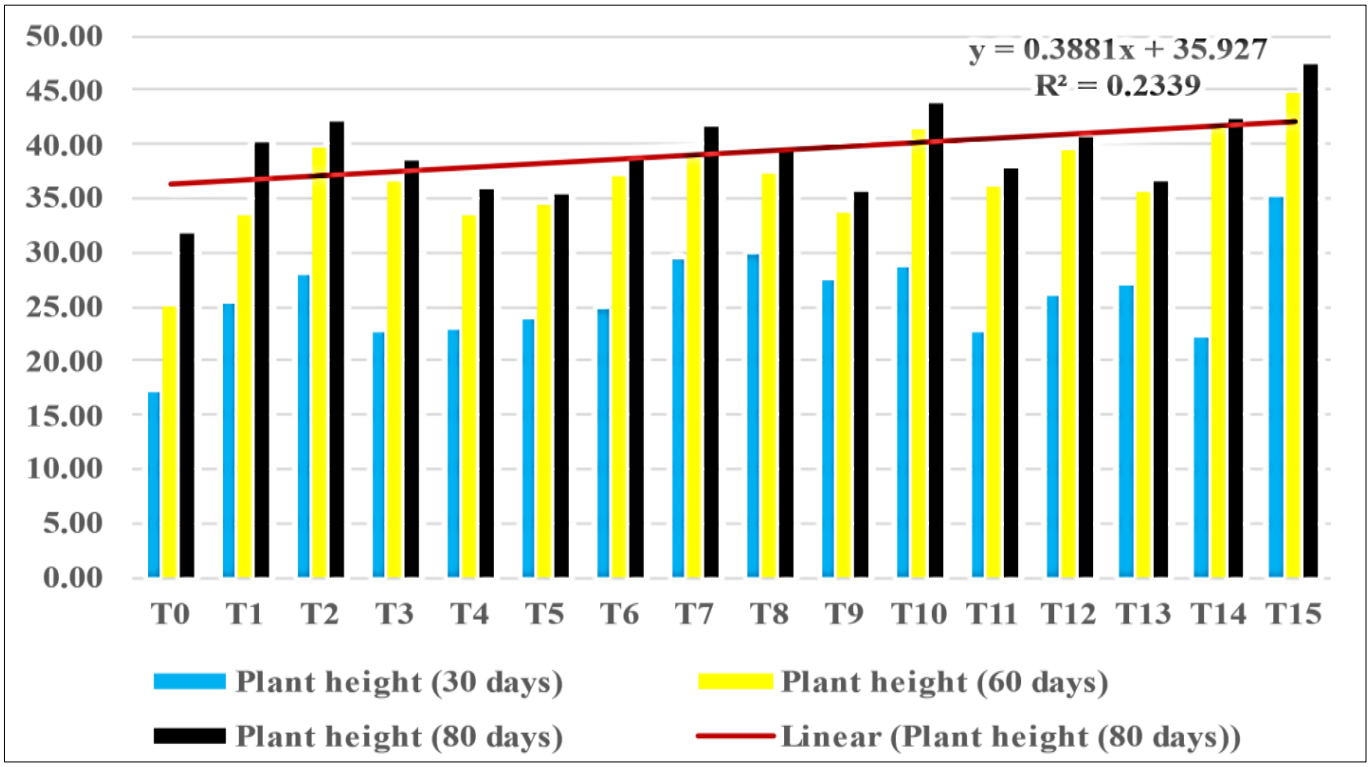

Fig 5: Representation of plant height of 30, 60, and 80 days

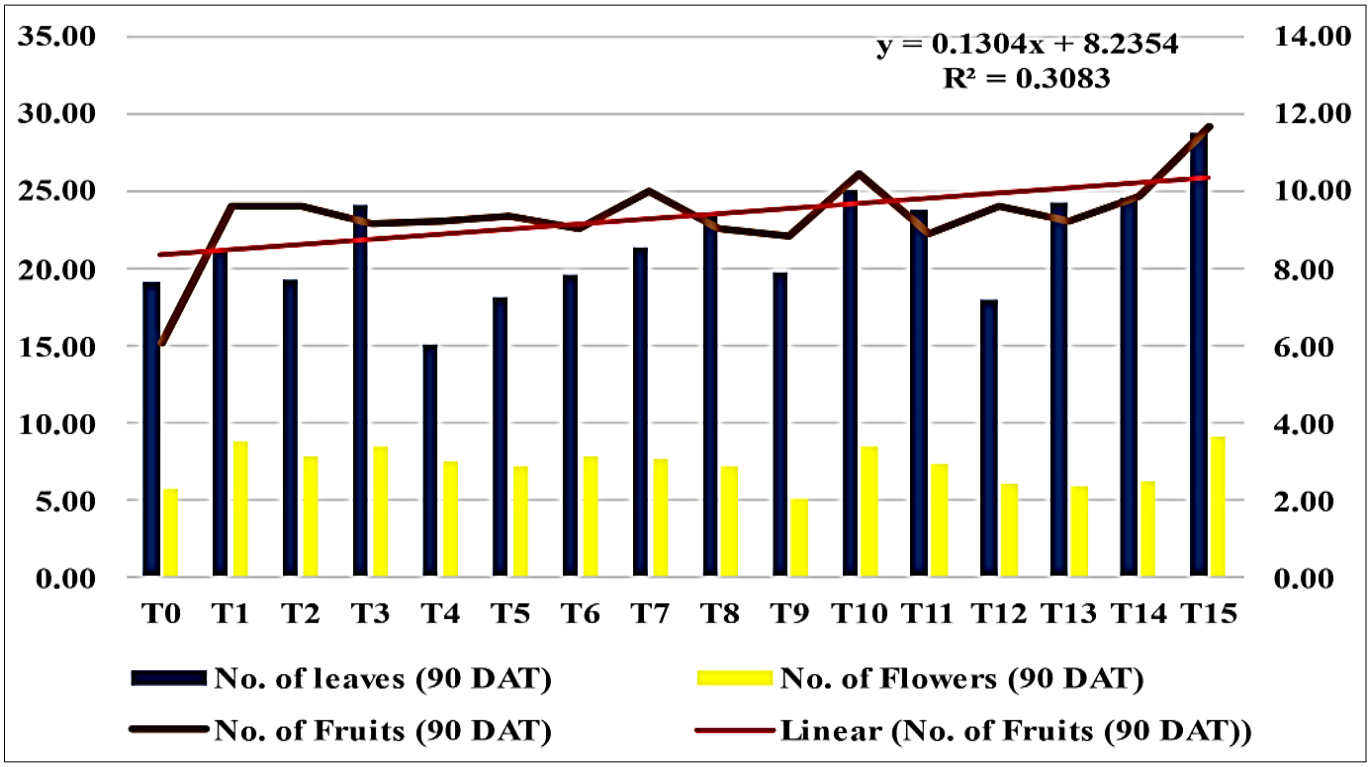

Fig 5: Representation of No of leaves, No of Flower, and No. of Fruits

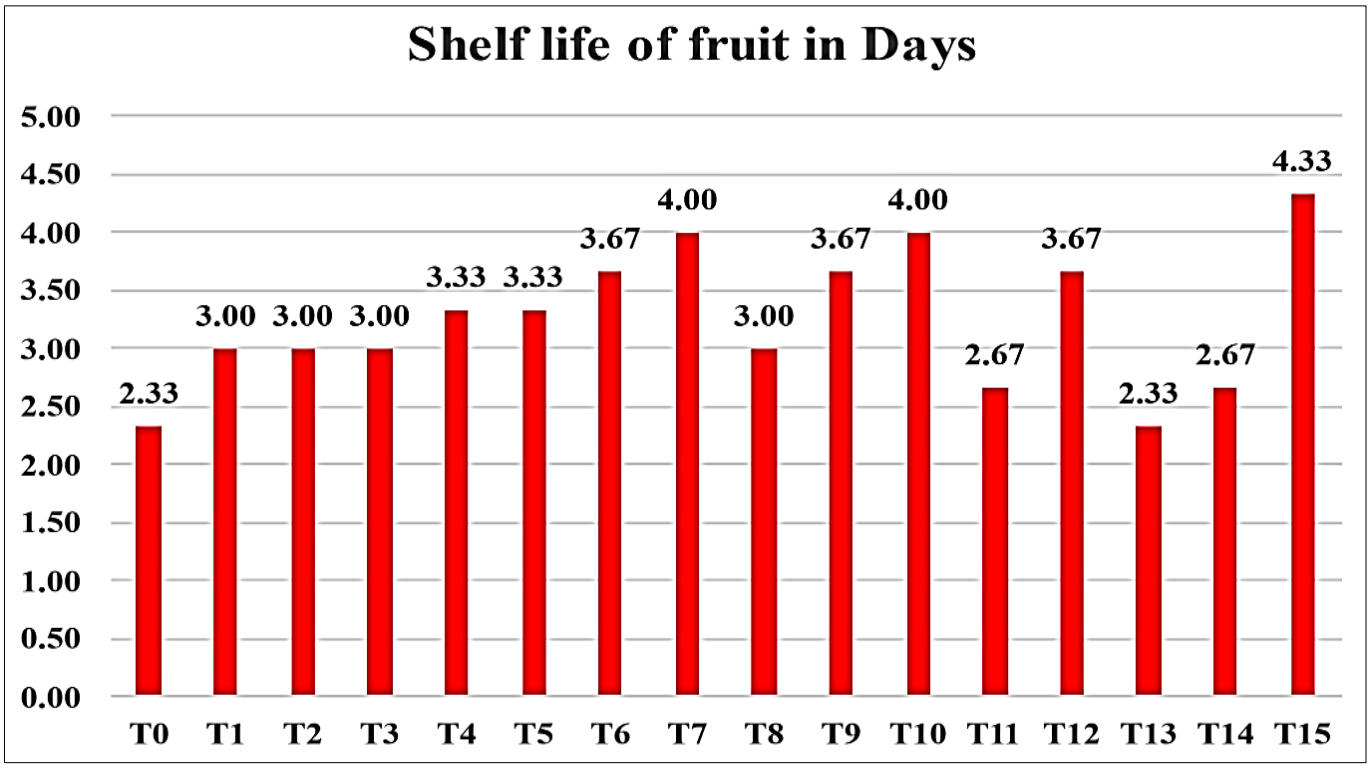

Fig 6: Representation of Shelf Life of Fruits in days

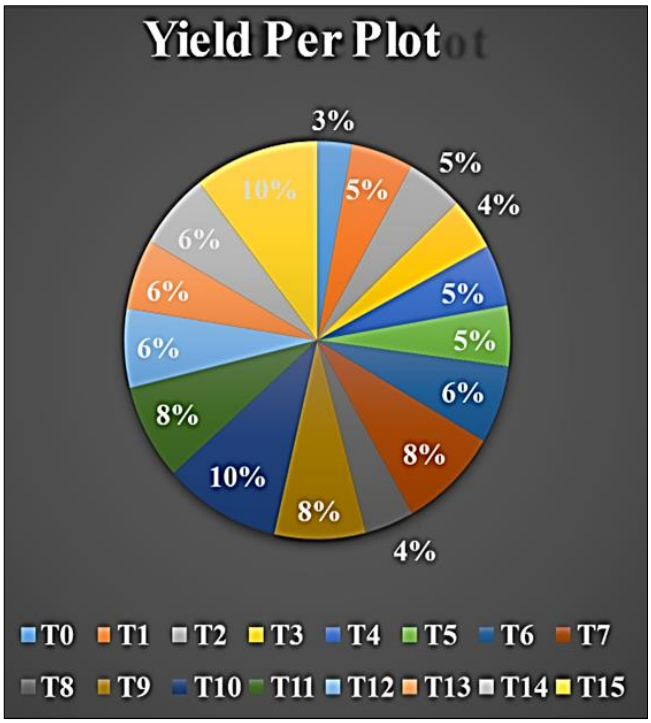

Fig 8: Representation of Yield Per Plot

Conclusions

It can be concluded from the result that the combined application of Nano Urea and Biofertilizers with Different doses of Phosphate Solubilizing Bacteria (PSB) and Potassium Solubilizing Bacteria (KSB) holds promise as a viable strategy for improving the growth and yield attributes of *Capsicum annum*. The treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) for 30 Minutes was found to be the best treatment among all the 16 Treatments and it gave the maximum growth, yield, and economic parameters, whereas the minimum growth, yield, and economic parameters were recorded in Treatment T_0 (Control). As well as For the 60 Minutes the Treatment T_{15} (25% RDF + KSB + PSB + 0.5% NU) was found to be the best treatment among all the 16 Treatments, whereas the minimum growth, yield, and economic parameters were recorded in Treatment T_0 (Control). The observed positive outcomes warrant further exploration of this approach across a broader spectrum of crops and environments. By integrating nanotechnology and biological principles, this study contributes to the growing body of research aiming to achieve sustainable agricultural practices while ensuring food security and environmental preservation.

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