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## Effect of foliar spray of nano urea on growth and yield of chilli

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### Abstract

The field experiment entitled, “Effect of foliar spray of nano urea on growth and yield of chilli” was conducted during the year Summer 2024 – 2025 at the Research Farm of the Interfaculty Department of Irrigation Water Management, MPKV Rahuri Dist. Ahilyanagar, Maharashtra, India with an objective of effect of foliar spray nano urea application on growth, yield and economics of chilli (cv. Navtej). The experiment was laid out in a Randomized Block Design with ten treatments and three replications and experiment comprises of T<sub>1</sub> -100 % RDF, T<sub>2</sub>- 75% RDN, T<sub>3</sub>- 50% RDN, T<sub>4</sub> - 75% RDN with two foliar spray of nano urea @ 0.5% at 30 and 50 DAP, T<sub>5</sub> - 75% RDN with two foliar spray of nano urea @ 1% at 30 and 50 DAP, T<sub>6</sub>- 75% RDN with two foliar spray of conventional urea @ 1 % at 30 and 50 DAP, T<sub>7</sub> - 50 % RDN with two foliar spray of nano urea @ 0.5% at 30 and 50 DAP, T<sub>8</sub> - 50 % RDN with two foliar spray of nano urea @ 1 % at 30 and 50 DAP, T<sub>9</sub>- 50% RDN with two foliar spray of conventional urea @ 1 % at 30 and 50 DAP and T<sub>10</sub> - Absolute control. Chilli crop was planted by hand dibbling at 45cm × 60 cm spacing. The irrigation was done as per climatological parameter. The Results revealed that all the growth, yield and economics contributing character were recorded higher and significantly superior in T<sub>1</sub>- 100% RDF. Significantly higher yield of chilli (153.17 q ha<sup>-1</sup>) was recorded in 100% RDF and it was at par with T<sub>5</sub> - 75 % RDN with two foliar sprays of nano urea @ 1% at 30 and 50 DAP (128.51 q ha<sup>-1</sup>) and T<sub>6</sub> - 75% RDN with two foliar sprays of conventional urea @ 1 % (107.32 q ha<sup>-1</sup>). The same trend recorded in economics of chilli i.e. T<sub>1</sub> 100% RDF recorded significantly superior in gross monetary returns (530578 ₹ ha<sup>-1</sup>), net monetary returns (346736 ₹ ha<sup>-1</sup>), and benefit cost ratio (2.88). It is concluded that, 100 % RDF (100:50:50 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>) and 75 % foliar application of nano urea @1% at 30 and 50 DAP and 75 % foliar application of conventional urea @1% at 30 and 50 DAP is an effective and eco-friendly strategy to enhance chilli productivity while reducing reliance on chemical fertilizers.

**Keywords:** Capsicum annuum, nano urea, foliar nutrition, nitrogen management, nutrient use efficiency, yield

### Introduction

Chilli (*Capsicum annuum* L.) is one of the most important solanaceous crops cultivated across tropical and subtropical regions of the world, primarily grown by small and marginal farmers due to its high market value and multipurpose utilization as a vegetable, spice and condiment. The crop originated in Central and South America, where it was first domesticated around 7000 BC, and later spread globally through Spanish and Portuguese explorers during the 15th–16th century. Chilli holds significant economic, nutritional and medicinal importance, serving as a rich source of vitamins A, C, B-complex and essential minerals such as potassium, iron and magnesium. The pungency in chilli is attributed to capsaicin, which possesses therapeutic properties and is utilized in pharmaceutical and food industries for treating ailments such as neuralgia, rheumatic disorders and non-allergic rhinitis (Bhutia *et al.*, 2018) [4].

India is one of the leading chilli-producing countries globally, with major cultivation concentrated in states like Madhya Pradesh, Karnataka, Andhra Pradesh, Bihar and Maharashtra (Anonymous, 2023) [1]. Despite its wide cultivation, chilli productivity is constrained by imbalanced nutrient management particularly nitrogen (N) which is highly susceptible to leaching, volatilization and denitrification, leading to only 30–40% N-use efficiency in conventional urea fertilizers. Excessive use of chemical fertilizers further causes soil degradation, environmental pollution and increased production cost for farmers.

In horticultural crops including chilli, the application of nano-fertilizers has shown significant improvement in growth traits, yield attributes and fruit quality due to efficient nutrient uptake and physiological enhancement (Malik *et al.*, 2020; Rather *et al.*, 2022; Sunil *et al.*, 2024)<sup>[11, 19, 21]</sup>. Moreover, nano urea-based nutrient management has demonstrated economic viability by lowering fertilizer inputs and increasing benefit-cost ratio (Mishra *et al.*, 2020; Hemavathi, 2022)<sup>[13, 9]</sup>.

Considering the increasing global emphasis on sustainable agricultural intensification, nano urea presents a promising alternative to conventional nitrogen fertilizers. However, scientific information on its efficiency in chilli under summer production and drip irrigation conditions is still limited.

Therefore, the present investigation entitled “*Effect of foliar sprays of nano urea on growth and yield of chilli*” during summer 2024 at interfaculty Department of irrigation water management, PGI, M.P.K.V., Rahuri, with an objective of to study growth, yield and economics of chilli as influenced by foliar spray of nano urea.

### Material and Method

The present research entitled, “Effect of foliar spray of nano urea on growth and yield of chilli” was carried out at Post Graduate Institute, on farm of Interfaculty Department of Irrigation Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri, during Summer 2024-25 with an

objective to study growth, yield and economics of chilli as influenced by foliar spray of nano urea. The experiment was laid out in a Randomized Block Design with ten treatments and three replications and experiment comprises of T<sub>1</sub> -100 % RDF, T<sub>2</sub>- 75% RDN, T<sub>3</sub>- 50% RDN, T<sub>4</sub> - 75% RDN with two foliar spray of nano urea @ 0.5% at 30 and 50 DAP, T<sub>5</sub> - 75% RDN with two foliar spray of nano urea @ 1% at 30 and 50 DAP, T<sub>6</sub>- 75% RDN with two foliar spray of conventional urea @ 1 at 30 and 50 DAP %, T<sub>7</sub> - 50 % RDN with two foliar spray of nano urea @ 0.5% at 30 and 50 DAP, T<sub>8</sub> - 50 % RDN with two foliar spray of nano urea @ 1 % at 30 and 50 DAP, T<sub>9</sub>- 50% RDN with two foliar spray of conventional urea @ 1 % at 30 and 50 DAP and T<sub>10</sub> - Absolute control. The treatments plots were prepared after ploughing and harrowing the experimental field was divided in thirty-unit plots with plot size 7.2 m x 2.4 m as per the plan of layout of the experimental plot. The recommended dose of fertilizer for chilli 100:50:50 N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O Kg ha<sup>-1</sup> and foliar application of Nano urea @ 1 % at 30 and 50 DAP and foliar application of conventional urea @ 1% at 30 and 50 DAP. Chilli crop was planted by hand dibbling at 45 cm × 60 cm spacing with variety Navtej. The irrigation was done as per climatological parameter. Uniform plant population was maintained by gap filling at 15 days after planting. Statistically significance of the treatments effects on growth, yield and economics were tested by analysis of variance (ANOVA) using Microsoft excel.

**Table 1:** Initial chemical properties of soil

Sr. no.	parameters	Composition	Method used	References
1.	pH (1:2.5)	8.01	Potentiometer	Piper (1966)
2.	EC (dS m <sup>-1</sup> )	0.26	Conductometer	Jackson (1973)
3.	Organic carbon (%)	0.65	Wet oxidation method	Nelson and Sommer (1982)
4.	Available N (kg ha <sup>-1</sup> )	207.15	Alkaline permanganate method	Subbiah and Asija (1956)
5.	Available P (kg ha <sup>-1</sup> )	18.52	0.5 M NaHCO <sub>3</sub> (pH 8.5)	Watanabe and Olsen (1965)
6.	Available K (kg ha <sup>-1</sup> )	414.4	N N NH <sub>4</sub> OAc	Hanway and Heidal (1967)

**Table 2:** Effect of foliar spray of nano urea on growth parameters of chilli at harvest

Tr. No.	Treatments	Plant height plant <sup>-1</sup> (cm)	Number of leaves plant <sup>-1</sup>	Number of branches plant <sup>-1</sup>	Girth of stem plant <sup>-1</sup> (cm)	Chlorophyll content (by SPAD value)
T <sub>1</sub>	100 % RDF	69.80	315.80	32.63	7.99	63.96
T <sub>2</sub>	75 % RDN	67.33	299.88	29.92	7.88	61.81
T <sub>3</sub>	50 % RDN	65.40	292.30	25.57	7.46	56.29
T <sub>4</sub>	75 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	68.13	301.43	30.50	7.91	62.94
T <sub>5</sub>	75 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	69.70	310.17	31.95	7.96	63.57
T <sub>6</sub>	75 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	69.06	303.13	30.63	7.93	62.96
T <sub>7</sub>	50 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	66.16	295.01	26.06	7.76	58.22
T <sub>8</sub>	50 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	66.83	299.59	29.07	7.84	61.36
T <sub>9</sub>	50 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	66.53	298.30	28.45	7.81	58.71
T <sub>10</sub>	Absolute control	64.80	282.60	25.43	7.27	54.82
	S.E.(m) ±	0.09	0.52	0.15	0.05	0.44
	C.D at 5 %	0.28	2.14	0.46	0.17	1.34
	General mean	67.37	299.82	29.03	7.78	60.46

**Table 3:** Effect of foliar spray of nano urea on yield and yield attributes of chilli at harvest

Tr. No.	Treatments	Average number of fruit plant <sup>-1</sup>	Average weight of fruit plant <sup>-1</sup> (g)	Dry matter (g)	Yield (q ha <sup>-1</sup> )
T <sub>1</sub>	100 % RDF	581.36	1046.43	89.24	153.17
T <sub>2</sub>	75 % RDN	459.85	889.73	87.44	128.51
T <sub>3</sub>	50 % RDN	414.53	774.53	83.10	107.32
T <sub>4</sub>	75 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	426.98	953.73	88.07	134.10
T <sub>5</sub>	75 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	581.08	1038.50	89.21	147.58
T <sub>6</sub>	75 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	505.14	978.50	89.18	139.10
T <sub>7</sub>	50 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	412.58	781.58	83.52	107.89
T <sub>8</sub>	50 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	446.01	866.59	86.39	121.76
T <sub>9</sub>	50 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	427.69	816.36	85.13	113.67
T <sub>10</sub>	Absolute control	347.16	747.16	81.50	100.57
	S.E.(m) ±	3.72	4.84	0.30	2.97
	C.D at 5 %	11.17	14.52	0.92	8.91
	General mean	460.24	889.31	86.38	125.36

**Table 4:** Effect of foliar spray of nano urea on economics of chilli at harvest

Tr. No.	Treatments	Gross Monetary Return (₹ ha <sup>-1</sup> )	Cost of Cultivation (₹ ha <sup>-1</sup> )	Net Monetary Return (₹ ha <sup>-1</sup> )	B:C ratio
T <sub>1</sub>	100 % RDF	530578	183841	346736	2.88
T <sub>2</sub>	75 % RDN	445156	181110	264046	2.45
T <sub>3</sub>	50 % RDN	371754	186020	185734	1.99
T <sub>4</sub>	75 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	464520	186378	278141	2.49
T <sub>5</sub>	75 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	511214	189066	322147	2.70
T <sub>6</sub>	75 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	481834	183757	298081	2.62
T <sub>7</sub>	50 % RDN + two foliar sprays of Nano Urea @ 0.5 % at 30 and 50 DAP	373729	186048	187680	2.01
T <sub>8</sub>	50 % RDN + two foliar sprays of Nano Urea @ 1.0 % at 30 and 50 DAP	421774	188736	233037	2.23
T <sub>9</sub>	50 % RDN + two foliar sprays of conventional urea @ 1.0 % at 30 and 50 DAP	393751	183427	210323	2.14
T <sub>10</sub>	Absolute control	348372	179481	168891	1.94
	S.E.(m) ±	10299.01		10299.01	
	C.D at 5 %	30876.44		30876.44	
	General mean	434273		249258.40	

## Result and discussion

### Effect of foliar spray of nano urea on growth parameter of chilli

The growth parameters are presented in table 1 and revealed that, the T<sub>1</sub> 100% RDF was recorded significantly higher in plant height plant<sup>-1</sup> (68.80 cm), number of leaves plant<sup>-1</sup> (315.80), number of branches plant<sup>-1</sup> (32.63), girth of stem plant<sup>-1</sup> (7.99 cm), chlorophyll content plant<sup>-1</sup> by SPAD value (63.96) at harvest. However, it was found at par with treatment T<sub>5</sub> 75% RDN with two foliar sprays of nano urea @1 % at 30 and 50 DAP, T<sub>6</sub> 75% RDN with two foliar sprays of conventional urea @1 % at 30 and 50 DAP. These results might be due to the nano-sized particles having a large surface area and an advanced delivery mechanism, such as a controlled nutrient release pattern. This enhances nutrient use efficiency. The improved availability of nitrogen key component of chlorophyll and proteins leads to more effective photosynthesis. Similar observations were reported by Drostkar *et al.* (2016), Merghany *et al.* (2019) and Neeruggi *et al.*, (2024) [6, 12, 14] in chilli,

### Effect of foliar application of nano urea on yield and yield attributing characters of chilli

The data regarding yield and yield contributing parameters of soybean are presented in Table 2. the treatment T<sub>1</sub> 100% RDF was recorded significantly higher in average number of fruits plant<sup>-1</sup> (581.36) weight of fruit plant<sup>-1</sup> (1046.43) dry matter content plant<sup>-1</sup> (89.24) and yield (153.15q ha<sup>-1</sup>). However, it was found at par with treatment T<sub>5</sub> 75% RDN with two foliar sprays of nano urea @1 % at 30 and 50 DAP, T<sub>6</sub> 75% RDN with two foliar sprays of conventional urea @1 % at 30 and 50 DAP. These results might be due to the chilli is primarily influenced by the plant's photosynthetic activity and the efficiency of assimilate translocation. Photosynthetic output, in turn, is dependent on various growth parameters such as plant height and leaf number, which contribute to increased fruit number and overall fruit weight per plant as well as dry matter and yield. These findings are consistent with the observations of Merghany *et al.* (2019) and Panda *et al.* (2020), Mishra *et al.* (2020) and Neeruggi *et al.*, (2024) [13, 12, 14, 16] also reported similar findings.



### Effect of foliar spray of nano urea on economics of chilli at harvest

The data on economics of soybean are presented in Table 3. Significantly higher gross monetary returns and net monetary returns were recorded in treatment T<sub>1</sub> 100% RDF was recorded significantly higher in gross monetary returns recorded ₹5,30,578 ha<sup>-1</sup> and net monetary returns ₹3,46,736 ha<sup>-1</sup>. However, it was statistically at par with treatment T<sub>5</sub> i.e. 75 % RDN + two foliar sprays of Nano Urea @ 1.0 %, at 30 and 50 DAP, amounting ₹5,11,214 ha<sup>-1</sup>. The higher B:C ratio was recorded in treatment T<sub>1</sub> i.e. 100 % RDF was recorded 2.88, followed by the treatment T<sub>5</sub> i.e. 75 % RDN + two foliar sprays of Nano Urea @ 1.0 %, at 30 and 50 DAP with a ratio of 2.70. These findings are consistent with the reports of Asawale *et al.* (2021) and Hemavathi *et al.* (2022), Panda *et al.* (2020), Bayan *et al.* (2021) and Neeruggi *et al.* (2024)<sup>[2, 9, 14, 3, 16]</sup>

### Conclusion

On the basis of one year experiment, it is concluded that application of 100 % recommended dose of fertilizer with (100:50:50; N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O kg ha<sup>-1</sup>) was recorded significantly highest in growth, yield and yield attributing character, nutrient uptake and availability and economics of chilli.

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