Original Research Article

Effect of nano urea and foliar spray of urea on growth and yield of wheat (Triticum aestivum L.)

ABSTRACT

(In abstract, give in short location, year, methodology and objective of the experiment. Then in short mention the gist of your research.)

The high yields of today's modern wheat cultivars require of the high input which leads to both higher production costs and a greater risk of environmental pollution; considering this; nitrogen management field experiment was carried out during *rabi* seasons of 2022 at Crop Research Farm in the Department of agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj Uttar Pradesh on topic "Effect of nitrogen management using nano urea and foliar spray of urea on growth and yield of wheat (Triticum aestivum L.)**"** The experiment was conducted in Randomized Block Design (RBD) with 10 treatments and three replications. The experiment include three levels of **Nitrogen** (50 % ,75 % ,100%) and **Foliar Spray** (2ml/L nano urea, 4 ml/L nano urea, 2% urea). Result revealed that increasing nitrogen levels on addition with 4ml/L foliar spray of nano urea had a significant effect on Growth, yield and yield parameters. Treatment-6 possesses significantly higher plant height (106.51 cm), dry weight (26.27 g) number of tillers/running row (104.66), number of effective tillers/m^2 (422.83), number of grains/spike (52.19), test weight (50.77 g) and grain yield (6.04 t/ha)

Keywords: Wheat, Nitrogen, Nano Urea, foliar spray, growth and yield.

1. Introduction (Give the Introduction in brief include world status of wheat with application nano urea)

Wheat (*Triticum aestivum* L.) is one of the chief sources of diet by providing half of the dietary protein and more than half of the calories to the rising population of India. As a consequence, scientists are always focusing to produce higher yields to feed the nation **(Khan *et al.* 2015).** Wheat ranks first among the world food crops, in terms of cultivated area (223.813 m ha) or production (733.144 m t) and with productivity of (3280 kg/ha) (USDA 2016). In India, Uttar Pradesh state ranks first in both area (9.67 m ha) and production (27.52 m t), but the average productivity is much lower (2846 kg/ha) than Punjab (4307 kg/ha) and Haryana (4213 kg/ha), respectively.

Rapid economic and income growth, urbanization, and globalization are leading to dramatic dietary shifts, especially in Asia as consumers are increasing their consumption of wheat products (**Pingali, 2007**). Wheat production needs to increase to meet the combined growing population and expanding demand by the middle of this century (**Tilman *et al*., 2011**). Currently, wheat yield gains are estimated to be 0.9% per year, much less than the 1.5% per year, which is required to meet the projected 60% increase in global production needed by 2050.At the current rate, the global production of wheat may only increase by 38%, which is far short of the projected demand. Additionally, the effect of climate change, such as less favorable growing conditions, may even further reduce wheat production (**Gammans et al., 2017**). Up to 6% yield declines are projected in wheat for each degree Celsius temperature increase if adaptive measures such as improved germplasm are not realized (**Zhao et al., 2017**).

Nitrogen occupies a conspicuous place in plant metabolism. All vital processes in plant are associated with protein, of which nitrogen is an essential constituent. Consequently to get more crop production, nitrogen application is essential in the form of chemical fertilizer. Nitrogen fertilizer is known to affect the number of tillers/m^2, number of spikelet's/spike , number of Grains/spike , spike length and 1000- grain weight (**Ali *et al* 2000**). Nitrogen is an essential nutrient, and often the most yield-limiting, for wheat production. It serves to promote tillering, enable photosynthesis, and build protein in the grain.

To ensure global food security for rapidly growing population, wheat production needs to be doubled by 2050 (**Hunter *et al.* 2017**).To achieve each of these goals, nitrogen availability needs to be regulated carefully over the growth stages of wheat by managing the timing, rate, form, and placement of nitrogen fertilizer applications.Nano urea makes this more feasible to accomplish.

In India, there is a little scope of bringing in more area under cultivation; therefore, growth in food grain production has to come largely through productivity enhancement. Enhancing nutrient use efficiency (NUE) with minimal threat to environment has become critical for our agriculture food production systems (FPS) to sustain the burgeoning population. Nanotechnology with nanoscale inputs for production of nano agri-inputs (NAIPs) has emerged as an innovative solution for addressing issue of low or declining nutrient use efficiency (NUE) with minimal environment footprint. Nanotechnology is a promising field of research which has the potential to offer sustainable solutions to ever pressing challenges confronting our modern intensive agriculture. Nano Urea is a nanotechnology based revolutionary Agri-input which provides nitrogen to plants (**Sheoran *et al*. 2016**) Nano Urea is a sustainable option for farmers towards smart agriculture and combat climate change. These fulfill the plant nutrient requirement as a fertilizer. Nano urea is bio available to plants because of its desirable particle size about 20-50 nm.

Granular urea is not environment friendly and degrade soil quality over times if use continuously. These common urea when urea applied to crops, it gets vulnerable to losses from volatilization, nitrous emission, leaching, denitrificatication and water eutrophication. Urea is the most widely used fertilizer globally because of its high nitrogen content (46%), low cost, and ease of application (**Zheng *et al*. 2009**). The nutrient demand of the plant cannot be properly managed by above losses.

The use efficiency of nutrients of traditional fertilizers is abysmally low. It has been reported that around 40–70 % of nitrogen, 80–90 % of phosphorus, and 50–90 % of potassium content of applied fertilizers are lost in the environment and could not reach the plant which causes significant economic losses (**Trenkel 2010; Saigusa 2000; Solanki et al. 2015**). These problems seem to intensify fiercely by 2050 when we have to feed the population of over 9 billion. Agriculture as a source of food, feed and fiber has always been increasingly important in a world of diminishing resources and with an ever increasing global population (**Brennan 2012**). To counteract this scenario, the agriculture dependent countries have to adopt more advanced technologies, labor-saving practices, and methods. Nanotechnology is a promising tool and has the potential to foster a new era of precise farming techniques and therefore may emerge as a possible solution for these problems. Nanotechnology may increase agricultural potential to harvest higher yields in an eco-friendly way even in the challenging environments (**Sugunan and Dutta 2008**).

Nano urea; when sprayed on leaves initially it gets absorbed easily and also enters through stomata and other pores.It is translocated & metabolically assimilated as proteins, amino acids etc. as per the plant's need.. Nano urea treated plot have more number of tillers and results indicate that 25 -50 % nitrogen fertilizer reduction in wheat is possible with 2 sprays of Nano Urea.

2. MATERIALS AND METHODS

The experiment was laid out during the *Rabi* season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The crop research farm is situated at 250 39" 42" N latitude, 810 67" 56" E longitude and at an altitude of 98 m above mean sea level. The experiment was laid out in Randomized Block Design (RBD) consisting of ten treatments with treatment T1 50% nitrogen + foliar spray of 2ml/ L nano urea, T2 75% nitrogen + foliar spray of 2ml/ L nano urea T3 100% nitrogen + foliar spray of 2ml/ L nano urea, T450% nitrogen + foliar spray of 4ml/ L nano urea, T5 75% nitrogen + foliar spray of 4ml/ L nano urea, T6 100% nitrogen + foliar spray of 4ml/ L nano urea, T7 50% nitrogen + foliar spray of 2% urea, T8 75% nitrogen + foliar spray of 2% urea, T9 100% nitrogen + foliar spray of 2% urea, T10 Control RDF 120:60:40 NPK kg/ha. Experiment was laid out in factorial randomized block design with three replications. The recommended dose of phosphorus (60kg/ha), potassium (40 kg/ha) were applied at the time of sowing as a basal dose The sources of phosphorus and potassium were SSP and MOP, respectively. Nitrogen was applied through urea as per treatments in split does during the crop period. Additionally nitrogen sources i.e. Nano urea and foliar spray of urea was given twice during the crop period.. Sowing of healthy seed was done with spacing of 22.5cm x 10cm. All cultural operations were performed as per recommendations. Observations were recorded from five random healthy plants of each treatment on growth, yield, and its attributes. Data recorded on different aspects of crop, viz., growth, yield and yield parameters.

Sr. No	**Treatment Combinations**

2.1 Details for Treatment Combinations

1	50% nitrogen + foliar spray of 2ml/ L nano urea
2	75% nitrogen + foliar spray of 2ml/ L nano urea
3	100% nitrogen + foliar spray of 2ml/ L nano urea
4	50% nitrogen + foliar spray of 4ml/ L nano urea
5	75% nitrogen + foliar spray of 4ml/ L nano urea
6	100% nitrogen + foliar spray of 4ml/ L nano urea
7	50% nitrogen + foliar spray of 2% urea
8	75% nitrogen + foliar spray of 2% urea
9	100% nitrogen + foliar spray of 2% urea
10	Control (RDF) 120-60-40 NPK kg/ha.

3. RESULT AND DISCUSSION:

3.1 Effect on Growth parameters

3.1.1 Plant height (cm)

Height of the plant rise as crop growth progressed, as shown in (table 1). Significant and maximum plant height (106.91) measured for treatment 6 (100% nitrogen + foliar spray of 4ml/L nano urea). While T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6. (**Guo *et al.* 2019**) nitrogen is an essential nutrient for crops, and its application can be effective for increasing crop yield. As large number of previous studies have demonstrated that application of nitrogen can increase the height of the crop, (**Zhang *et. al* 2018**). Similar findings were confirmed by **(Rawat *et al.* 2000)** and (**Iqtidar *et al.* 2006**). The levels of nitrogen influenced plant height significantly.

3.1.2 Plant dry weight (g/plant)

Weight of plant dry matter increased with crop growth (table 1).Significant and maximum dry weight (26.27g) was observed in T6 (100% nitrogen + foliar spray of 4ml/ L nano urea). While

T5 (75% nitrogen + foliar spray of 4ml/ L nano urea), T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6. Effect of increasing nitrogen level with foliar application of urea on total dry matter production revealed significant difference. It might be due to increased photosynthetic rate and higher leaf area that increased total dry matter production. The finding of **(Rahman *et al.* 2014)** is in similar pattern of the present study.

3.1.3 Number of tillers/running row

Maximum number of tillers/running row (104.66) were found in T6 (100% nitrogen + foliar spray of 4ml/ L nano urea), While T3 (100 % nitrogen + foliar spray of 2ml/ L nano urea) and T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6. Number of tillers increased with increase in nitrogen level along with nano urea similar finding was observed by (**Rawate *et al*. 2022**)

3.2 Yield and yield attributes

3.2.1 Number of effective tillers/m^2

Significant and maximum tillers/m^2 (422.83) was observed in treatment T6 (100% nitrogen + foliar spray of 4ml/ L nano urea); (table 2); while T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6.

3.2.2 Number of grains/ spike

Significant and higher (52.19) grains/spike was observed in treatment T6 (100% nitrogen + foliar spray of 4ml/ L nano urea) while T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6. (**Hawkesford *et. al* 2014)** Wheat grain was found to have a positive quadratic relationship with the N application rate.

3.2.3 Test weight

The data showed that highest test weight (50.77) was recorded in treatment 6 (100% nitrogen + foliar spray of 4ml/ L nano urea) where as T9 (100% nitrogen + foliar spray of 2% urea) was found to be statically at par with T6

3.2.4 Grain yied (t/ha) (Check the spelling)

Significant and higher (6.04t/ha) grain yield s was observed in treatment T6 (100% nitrogen + foliar spray of 4ml/ L nano urea) where as lowest yield (5.03 t/ha) was observed in T1 (50% nitrogen + foliar spray of 2ml/ L nano urea) .The integrated management of nitrogen has significant effect on the grain yield.(**Benzon et al. 2015)** reported synergistic effect of the nano-fertilizers on the efficacy of conventional fertilizer for better nutrient absorption by plant cells resulting to optimal growth plant parts and metabolic process such as photosynthesis leads to higher photosynthates accumulation and translocation to the economic parts of the plant, thus resulting in high yield which may be attributed to increased source (leaves) and sink (economic part) strength (**Taiz and *et al.* 2006).** Foliar application of Nano-fertilizers significantly increase the crop yield (**Tarafdar *et al*. 2012)**. As mentioned earlier, nanofertilizers may have affected these processes through its nutrient transportation capability in terms of penetration and movement of a wide range of nutrients, from roots uptake to foliage penetration and movements within the plant.

Table 1. **Effect of nitrogen management using nano urea and foliar spray of on growth parameters of wheat**

S. No.	Treatment combinations	Plant height (cm)	Plant dry weight (g)	Number of tillers/ running row meter
1	50% nitrogen + foliar spray of 2ml/ L nano urea	93.65	20.61	95.06
2	75% nitrogen + foliar spray of 2ml/ L nano urea	101.45	22.95	100.27
3	100% nitrogen + foliar spray of 2ml/ L nano urea	103.64	24.44	102.01
4	50% nitrogen + foliar spray of 4ml/ L nano urea	98.68	21.64	96.96
5	75% nitrogen + foliar spray of 4ml/ L nano urea	102.90	24.32	101.43
6	100% nitrogen + foliar spray of 4ml/ L nano urea	106.51	26.27	104.66
7	50% nitrogen + foliar spray of 2% urea	97.30	21.18	96.40
8	75% nitrogen + foliar spray of 2% urea	102.26	23.74	101.17
9	100% nitrogen + foliar spray of 2% urea	105.00	24.82	103.95
10	Control RDF (120:60:40 NPK kg/ha.)	95.33	20.92	95.45
	F test	S	S	S
	SEm(+)	1.33	0.66	0.93
	CD (p= 0.05)	3.96	1.97	2.75

Table 2 Effect of nitrogen management using nano urea and foliar spray of urea on yield attributes of wheat

S. No.	Treatment combinations	Number of effective tillers/m^2	Number of grains/ spike	Test weight (g)	Grain yield (t/ha)
1	50% nitrogen + foliar spray of 2ml/ L nano urea	361.23	40.16	38.91	5.03
2	75% nitrogen + foliar spray of 2ml/ L nano urea	394.06	45.01	43.09	5.42
3	100% nitrogen + foliar spray of 2ml/ L nano urea	408.04	48.09	47.58	5.88
4	50% nitrogen + foliar spray of 4ml/ L nano urea	377.17	43.22	42.07	5.33
5	75% nitrogen + foliar spray of 4ml/ L nano urea	404.71	47.94	46.00	5.71
6	100% nitrogen + foliar spray of 4ml/ L nano urea	422.83	52.19	50.77	6.04
7	50% nitrogen + foliar spray of 2% urea	371.14	42.26	40.46	5.21
8	75% nitrogen + foliar spray of 2% urea	401.64	45.36	44.14	5.56
9	100% nitrogen + foliar spray of 2% urea	418.92	50.47	49.90	5.96
10	Control RDF (120:60:40 NPK kg/ha.)	365.57	40.49	39.34	5.12
	F test	S	S	S	S
	SEm(+)	3.67	0.44	0.42	0.01
	CD (p= 0.05)	10.90	1.29	1.24	0.03

4. CONCLUSION

Based on the above findings it is concluded that with the application of Nitrogen 100 % along with foliar spray of 4ml/ L nano urea performs positively and improves the growth parameters, yield attributes of Wheat. Since the results are based on a single season, further trails could be needed for additional confirmation.

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