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## **EffectofNanoUreaandzincongrowthandyieldofKharif maize**

## ABSTRACT

A field experiment was conducted with the objective to evaluate the Effect of Nano Urea and zinc on growth and yield of Kharif maize during kharif ( Monsoon ) season of 2023 at Crop Research Farm Department of Agronomy. The treatments consisted of 3 levels of Nano urea ( 3,4,5 ml/l ) and 3 level Zinc (0.3%,0.5%,0.7%) along with recommended doses of nitrogen and potash and a control (120-60-40kg N-P-K/ha). The experiment was laid out in a Randomized Block Design with 10 treatments and replication thrice. Application of Nano urea at 4ml/l at 0.5% Zinc (Treatment 5) recorded highest plant height (226.71cm), no. of leaves (14.18), dry weight (104.67 g) and crop growth rate (5.926 g/m<sup>2</sup>/day), yield attributes and yield viz ., No. of cobs/plant (1.33), No. of grains / row (23.56), No. of rows / cob (13.900), seed index (23.10g), grain yield (6.05t/ha) and stover yield (8.99t/ha) compared to control.

**Keywords:** *Maize, Nano urea, Zinc, yield attributes*

## Introduction

Maize is one of the most important cereal crop after rice and wheat and occupies a prominent place in global agriculture. It ranks third after rice and wheat in India. Maize (*Zea mays* L.) also called as corn, is one of the most crucial and strategic crops in the world. Its origin is in Mexico (Central America). It is called as queen of cereal due to its great importance in human, animal diet and high yielding ability. It efficiently utilizes solar energy and has immense potential for higher yield, so called as "Miracle Crop". The nutritional composition of maize (per 100 g) is as follows protein 4 g, 30 g carbohydrate, 3.5 g dietary fiber, 1.5 g fat, 3.6 g sugar, 4 mg calcium, 0.72 mg zinc etc. (Dragana *et al.*, 2015). Every part of the maize plant has economic value (the grain, leaves, stalk, tassel, and cob) and all are used to produce a large variety of food and non-food products also there is a concept which focuses on government of India goes behind i.e. corn to ethanol. Presently, USA is the major exporter of maize and shifted 30% of its maize grain towards bio-fuel production to meet society's prospective hidden requirements. Corn is the most economical source of starch, comprising about 68-72% of kernel weight, which is easily converted into glucose and fermented into ethanol (ICAR)

Nano urea has high nitrogen use efficiency and also it is environment friendly. This fertilizer is popularly known as "smart fertilizer" because it reduces the emission of nitrous oxide which is primarily responsible for contaminating soil, air and water bodies and also helps in reduction of global warming. Liquid nano fertilizer which is currently the best alternative to urea fertilizer. One bottle of nano urea (500 ml) is equivalent to a bag of urea fertilizer (45 kg), 10% lower than a bag of conventional urea. It can bring down the import of urea fertilizer. One nano urea liquid particle is 30 nano meters in diameter, with 10,000 times higher surface area to volume size than normal granular urea. Foliar application of nano urea liquid at critical crop growth stages of a plant effectively fulfills its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea. (Sahu *et al.* 2022).

Zinc (Zn) is an essential micronutrient for plant growth, Zn input has received much less attention than nitrogen (N), phosphorus (P), or irrigation during the Green Revolution (Tilman *et al.*, 2002; Mueller *et al.*, 2012). Maize attainable yield reduction resulting from the lack of Zn application was assessed by these authors at the level of 10%. As well documented by plant physiologists, zinc exerts a great influence on basic plant life processes, such as (i) nitrogen metabolism – uptake of nitrogen and protein quality; (ii) photosynthesis chlorophyll synthesis, carbon anhydrase activity; (iii) resistance to abiotic and biotic stresses – protection against oxidative damage (Alloway 2004, Cakmak 2008). Most research on soil and foliar application of zinc focused on alleviating its deficiencies, particularly on wheat and rice cultivated in semi-arid or arid regions of the world (Alloway 2004, Cakmak 2008). Maize was recognized by farmers for a long time as a crop of high response to zinc supply.

## MATERIALS AND METHODS:

The experiment was conducted during *Kharif* season of 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH - 6.9), organic carbon (0.870%), available N (270.81 kg/ha), available P (11.5 kg/ha) and available K (215.9 kg/ha). The treatment consists of T<sub>1</sub>: Nano Urea 3 ml/l + Zinc 0.3 %, T<sub>2</sub>: Nano Urea 3 ml/l + Zinc 0.5 %, T<sub>3</sub>: Nano Urea 3 ml/l + Zinc 0.7 %, T<sub>4</sub>: Nano Urea 4 ml/l + Zinc 0.3 %, T<sub>5</sub>: Nano Urea 4 ml/l + Zinc 0.5 %, T<sub>6</sub>: Nano Urea 4 ml/l + Zinc 0.7 %, T<sub>7</sub>: Nano Urea 5 ml/l + Zinc 0.3 %, T<sub>8</sub>: Nano Urea 5 ml/l + Zinc 0.5 %, T<sub>9</sub>: Nano Urea 5 ml/l + Zinc 0.7 %, T<sub>10</sub>: Control (RDF-N-P-K-120-60-40 kg/ha).

The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice. One of the primary benefits of RBD in agriculture is its ability to increase the precision of treatment effect estimates. By accounting for variability among blocks that might otherwise confound the results, RBD allows researchers to isolate the effect of the treatment more effectively. The observations were recorded for plant height, plant dry weight, No. of cobs per plant, Number of rows/cob, Number of grains/row, Seed index (g), Grain yield (t/ha), Stover Yield (t/ha), Harvest Index (%).

The collected data was subjected to statistical analysis by analysis of variance method. *Kharif* maize, were selected for sowing. Seeds are sowed of spacing (60 x 25 cm).

## RESULTS AND DISCUSSION

### GROWTH PARAMETERS

#### Plant height (cm):

The data revealed that significantly higher plant height (226.71 cm) was recorded with application of Nano Urea 4 ml/l + Zinc 0.5 %. However, treatment 2 and 8 (211.83 cm, 214.40 cm respectively) were statistically at par with application of Nano Urea 4 ml/l + Zinc 0.5 %.

Foliar spray of Nano Urea at knee stage and tasselling stage could be an ideal technological alternative to achieve sustainability in irrigated maize (Samui et al., 2021) and significantly increased the plant height. Foliar nitrogen application through Nano - N resulted in notably greater plant heights in Oats (Rajesh et al., 2021). Zinc helps in synthesis of tryptophan which is a precursor of IAA, it also has an active role in the production of auxin, an essential growth hormone. Hence the plant height is maximum with optimum application

of micronutrient and Nano urea. Similar result reported by Shahzad *et al.*, (2012), Tahir *etal.*,(2012), Samuiet *al.*,(2021),Rajesh *et al.*,(2021).

**Plant dry weight(g/plant):**

Significantly highest plant dry weight (104.67 g) was observed with application of Nano Urea 4 ml/l + Zinc 0.5 %, whereas treatment 8 (97.33 g) which was found to be statistically at par with Nano Urea 4 ml/l + Zinc 0.5 %.

Nitrogen and phosphorus application through RDF and foliar spray of urea and nano urea treatments increase plant height, stem girth, leaf: stem ratio which ultimately increase fodder yield of maize. The results are in corroboration with the finding of Tariq *et al.*, Singh *et al.* and Meena *et al.*. The highest forage yield obtained with nano urea foliar spray rates were in conformity with the findings of Abdel. Tariq *et al.*, (2014) where there is foliar applied Zn increases the photosynthesis and chlorophyll production that ultimately increases the dry weight.

**Crop growth rate(g/m<sup>2</sup>/day):**

The significantly maximum CGR (5.926 g/m<sup>2</sup>/day) was recorded with application of Nano urea 4ml/l + Zinc 0.5% which was found to be statistically at par to all treatments.

The application of Nano urea 4ml/l + Zinc 0.5% resulted in higher crop growth rate, this might be due to increased chlorophyll production and photosynthesis which leads to higher biomass production. Hence ultimately increasing in crop growth rate. Similar finding was also reported by Kumar *et al.*, (2019)

**Relative growth rate(g/g/day):**

The maximum relative growth rate (0.0115 g/g/day) was recorded with application of Nano Urea 4 ml/l + Zinc 0.5 % which was found to be statistically at par to all treatments.

**YIELD PARAMETER:****Number of cobs/plant**

Application of ( Nano Urea 4 ml/l + Zinc 0.5% ) was recorded significantly higher number of cobs per plant (1.33). However, treatment no. 2, 3, 4, 5, 6, 7, 8, 9 (1.27, 1.20, 1.13, 1.33, 1.27, 1.27, 1.27, 1.20) was found to be statistically at par with the highest.

**Number of rows/cob**

Treatment-5 (Nano Urea 4ml/l + Zinc 0.5%) was recorded significantly maximum

Number of rows/cob (13.900). However, treatment no. 1 , 2, 8 (12.800, 13.700,13.233)wasfoundtobestatisticallyatparwith highest.

### **Numberofgrains/row**

Treatment-5 (Nano Urea 4 ml/l + Zinc 0.5%) was recorded significantly maximumNumberofgrains/row((23.56)whichwassuperioroverallothertreatments.However, treatment no. 1 , 2, 8 (12.800, 13.700, 13.233) was found to be statisticallyatparwith highest.

### **Seedindex(g)**

Treatment-5 (Nano Urea 4 ml/l + Zinc 0.5%) was recorded significantlymaximumseedindex(23.10g)whichwassuperioroverallothertreatments.However,treatments treatment 2, 3, 4, 5, 6, 7, 8, 9 (22.90g , 22.64g , 22.89g, 22.53g, 21.74g,23.04g, 22.61g) was found to be statistically at par with Treatment-5( Nano Urea 4ml/l +Zinc 0.5%).

**Sharma et al.:** investigated the effect of nitrogen levels on maize growth and yield inIndia . Found that increasing nitrogen application significantly increased grain yieldand biomass production of maize. While the study did not specifically focus on seedindex, thepositiveimpactofnitrogenon overall yield suggeststhe potentialfor anindirect effectonseedcharacteristics.Nanoureahasthepotential toimprovepollination andfertilizationprocesses inmaize .Itcanenhancepollen viability,germination , and pollen tube growth, leading to efficient fertilization and potentiallyresultingin improved seed set and seed index.

### **Grainyield(t/ha):**

Treatment-5 (Nano Urea 4 ml/l + Zinc 0.5%) was recorded significantly maximum grainyield (6.05 t/ha) whichwassuperior over all other treatments. However, treatments 2 ,6, 7, 8 (5.92 , 5.62 , 5.21 , 5.73t/ha respectively) was found to be statistically at par withTreatment-5(Nano Urea 4 ml/l +Zinc 0.5%).

Zinc availability may have increased meristematic cell activity and cell elongation,which in turn improved vegetative growth and eventually helped produce more drymatter . This improved dry matter production was further reflected in yield-attributingcharacteristics, and as a result, the yield of the crop under the current treatment wassignificantlyhigher.Similar resultwasreportedby Imsonget al.(2022)

**Stover yield (t/ha):**

Treatment-5 (Nano Urea 4 ml/l + Zinc 0.5%) was recorded significantly maximum stover yield (8.99 t/ha) which was superior over all other treatments. However, all treatments were found to be statistically at par with Treatment-5 (Nano Urea 4 ml/l + Zinc 0.5%).

The experiment was done on kharif maize the treatment combination of Zinc (15 kg/ha) along with nitrogen (150 kg/ha) recorded significantly higher stover yield (11.20 t/ha) (Marngarand Dawson, 2017)

**Harvest index (%)**

Highest harvest index (40.11%) was recorded with the application of Treatment No.- 5 (Nano Urea 4 ml/l + Zinc 0.5%) whereas treatment 2, 3, 4, 5, 6, 7, 8 and 9 (39.92%, 36.73%, 35.83%, 40.11%, 38.89%, 39.44%, 39.87%, 36.34%) were found to be statistically at par to all

**treatment. ECONOMICS**

The data on the economics of different treatments presented showed that the maximum gross return (₹138980 / ha) and net return (₹93490 / ha) was recorded with application of Nano Urea 4 ml/l + Zinc 0.5% (treatment 5). However, maximum benefit-cost ratio was obtained in treatment 5 (2.06) due to low cost of cultivation. Minimum was observed in control (₹90994 / ha) and net return (₹46594 / ha) was observed with application of Nano Urea 3 ml/l + Zinc 0.3% (treatment 1) and lowest benefit-cost ratio (1.29) was recorded in treatment 1 (Nano Urea 3 ml/l + Zinc 0.3%).

**Table 1. Effect of Nano urea and Zinc on growth attributes of Kharif maize.**

S/No.	Treatments	Plant	80DAS Dry	60-80DAS	
		height (cm)	Weight (cm)	C.G.R(g/m <sup>2</sup> /day)	RGR(g/g/day)
1	NanoUrea 3ml/l + Zinc 0.3 %	209.23	68.23	1.232	0.0033
2	NanoUrea 3 ml/l+ Zinc 0.5 %	211.83	90.51	5.194	0.0115
3	NanoUrea 3 ml/l+ Zinc 0.7 %	199.00	86.73	5.203	0.0107
4	NanoUrea 4 ml/l+ Zinc 0.3 %	208.60	86.77	4.657	0.0107
5	NanoUrea 4 ml/l+ Zinc 0.5 %	226.71	104.67	5.926	0.0115
6	NanoUrea 4 ml/l+ Zinc 0.7 %	204.03	87.59	4.553	0.0103
7	NanoUrea 5 ml/l+ Zinc 0.3 %	203.83	88.71	5.232	0.0117
8	NanoUrea 5 ml/l+ Zinc 0.5 %	214.40	97.33	4.352	0.0088
9	NanoUrea 5 ml/l+ Zinc 0.7 %	204.50	90.08	4.468	0.0099
10	Control-120-60- 40kgNPK/ha(Farmer'sPr actice)	195.67	79.76	4.667	0.0080
	S.Em(+)	5.28	2.55	0.73	0.001
	CD(P=0.05)	15.71	7.58	2.19	-

**Table 2. Effect of Nano urea and Zinc on yield attributes of maize.**

No	Treatments	No. of cobs/plant	No. of grains/cob	No. of rows/cob	Seed index (g)	Grain yield (t/ha)	Yield Stover (t/ha)	Harvest index (%)
1	NanoUrea 3ml/l + Zinc0.3 %	1.00	20.40	12.800	20.95	3.96	8.03	33.12
2	NanoUrea 3ml/l + Zinc0.5 %	1.27	22.67	13.700	22.90	5.92	8.89	39.92
3	NanoUrea 3ml/l + Zinc0.7 %	1.20	21.91	12.433	22.64	4.87	8.40	36.73
4	NanoUrea 4ml/l + Zinc0.3 %	1.13	22.13	12.467	22.89	4.74	8.44	35.83
5	NanoUrea 4ml/l + Zinc0.5 %	1.33	23.56	13.900	23.10	6.05	8.99	40.11
6	NanoUrea 4ml/l + Zinc0.7 %	1.27	23.54	12.700	22.53	5.62	8.86	38.89
7	NanoUrea 5ml/l + Zinc0.3 %	1.27	23.47	12.200	21.74	5.21	7.95	39.44
8	NanoUrea 5ml/l + Zinc0.5 %	1.27	23.51	13.233	23.04	5.73	8.63	39.87
9	NanoUrea 5ml/l + Zinc0.7 %	1.20	21.90	12.733	22.61	4.91	8.65	36.34
10	Control-120-60-40kgNPK/ha (Farmer's Practice)	1.00	20.34	12.200	19.91	3.28	7.07	31.60
	S.Em(+)	0.06	0.82	0.37	0.64	0.33	0.35	1.83
	CD(P=0.05)	0.20	2.45	1.10	1.91	1.00	1.06	5.46

**Table3. Effect of Nano urea and zinc on economic of maize**

<b>S.No.</b>	<b>Treatments</b>	<b>Cost of cultivation (₹/ha)</b>	<b>Gross returns (₹/ha)</b>	<b>Net returns (₹/ha)</b>	<b>Benefit Cost Ratio (B:C)</b>
1.	NanoUrea 3 ml/l+Zinc 0.3 %	45189	103290	58101	1.29
2.	NanoUrea 3 ml/l+Zinc 0.5 %	45265	136180	90915	2.01
3.	NanoUrea 3 ml/l+Zinc 0.7 %	45341	114200	68859	1.52
4.	NanoUrea 4 ml/l+Zinc 0.3 %	45414	111680	66266	1.46
5.	NanoUrea 4 ml/l+Zinc 0.5 %	45490	138980	93490	2.06
6.	NanoUrea 4 ml/l +Zinc 0.7 %	45566	130120	84554	1.86
7.	NanoUrea 5 ml/l +Zinc 0.3 %	45639	120100	74461	1.63
8.	NanoUrea 5 ml/l+Zinc 0.5 %	45715	131860	86145	1.88
9.	NanoUrea 5 ml/l+Zinc 0.7 %	45791	115500	69709	1.52
10.	Control-120-60-40kgNPK/ha(Farmer's Practice)	44400	90994	46594	1.05

## CONCLUSION

Maize was recognized by farmers for a long time as a crop of high response to zinc supply. On the basis of one season experimentation, we can conclude that the cultivation of maize with Foliarspray of Nano Urea 4ml/l + Zinc 0.5 % 30 DAS and 45 DAS was more desirable in terms of growth, yield and economics.

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