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Effect of nitrogen management on growth and yield of maize (*Zea mays* L.)

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Abstract
The experiment was carried out at Raj Mohini Devi College of Agriculture and Research Station Ambikapur (C.G.) during the *Kharif* 2022-23 season. The experimental laid out in randomized block design with three replication and twelve treatments. Among the different nitrogen management practices, application of 100% RDN (3 split N application) had higher growth as well as yield attributes. Results revealed the 100% RDN (3 split N application) significantly increased all the growth attributes *viz.* plant height, dry matter accumulation, crop growth rate and the yield attributes viz., cob length, cob girth, number of grain rows cob^{-1}, number of grains row^{-1}, number of cobs. The highest cob yield (8961.2 kg ha^{-1}) and grain yield (7188.8 kg ha^{-1}) were also achieved under T_2: 100% RDN (3 split N application) followed by T_6: T_3 (75% RDN) + Nano urea two spray**.** T_1 (Control) was recorded lowest in term of growth attributes, yield attributes and yield. The highest net return and B:C ratio were also recorded under 100% RDN (3 split N application).

Keywords: Crop residue, nutrient management, *Trichoderma viride*, soil health and organic matter

Introduction
One of the most significant food crops in the world, maize provides >5% of the daily recommended energy. The relevance of maize may be seen in its wider adaptability, high yield potential, and use as a crop for food, feed, and forage. Although it is grown throughout the year, more than 80% of it is in the rainy or kharif season (July to October). Maize is referred to as the "Queen of Cereals" internationally. Maize production in India significantly increased from just 1.73 million tons in 1950–51 to 27.8 million tons in 2018 –19, an increase of more than 16 times. With a typical output of 2.56 tons/hectare, it currently occupies 9.23 million hectares. Domestically, maize is used for food, starch production, feed for chickens and cows, as well as numerous industrial uses. In Chhattisgarh maize occupies 206.63 thousands hectare area with the productivity of 2789 Kg/ha in Kharif 2020-21. Among the crops of agronomic interest, maize express nutritional dependence, especially of nitrogen. Studies conducted by Taiz and Zeiger (2009) [7] show a direct dependence of maize on mineral nutrients, as large quantities applied reflect positively on grain yield. There are many sources of nitrogenous fertilizer available, however, in India the most used is urea. The urea [CO(NH2)2] has a high nitrogen concentration, high solubility, and lower cost/unit of nutrient, but higher volatilization. From the standpoint of manufacturing, transportation, and direct application, urea has the advantage over other solid nitrogen materials of being cheaper to manufacture and having a higher content of total nitrogen.

Recently, IFFCO (Indian Farmers Fertilizer Co-operative) launched the nano Urea fertilizers in India for experiment as well as demonstration purpose. 500 ml of liquid nano Urea fertilizer contain same quantity of N received from 50 kg of Urea fertilizer. Nano fertilizer is an important tool in agriculture to improve crop growth, yield and quality parameters with increased nutrient use efficiency. Nano-fertilizers are applied either to soil and/ or leaves. Foliar application can be done during favourable soil and weather conditions. In addition to this, it promotes the direct entry of nutrients into the plant system, thus reduce the wastage of fertilizer. However, published literatures regarding the use of nano-fertilizer (nano Urea) on growth and yield of crops are rare.

Materials and Methods

The present experiment entitled "Effect of nitrogen management on growth and yield of maize (*Zea mays* L.)" was conducted during *kharif* 2022-23 at Research- cum-instructional farm of RMD College of Agriculture and Research Station, Ambikapur, Chhattisgarh. Geographically, Ambikapur is situated in the north of Chhattisgarh and lies between 23°10' North latitude and 83º15' East longitude having an altitude of 623 meter above mean sea level. The maximum rainfall during July to September. The crop received total 1519.0 mm rainfall during entire growth period and the maximum rainfall of 210.4 mm. was recorded during 4th week of august. The soil of the experimental field was slightly acidic in nature having pH 5.81 Available nitrogen phosphorus and potash was 220, 7.0 and 280 kg ha^{-1}, respectively.

The experiment was layout in a random block design with three replication and twelve treatments. Maize variety NK30 was sown with spacing 75 x 20 cm, seed rate 18 kg ha^{-1}. Nitrogen was applied in split doses, the first at basal, second 25-30 DAS and third 40-45 DAS. Nitrogen was applied as urea, nano urea and foliar spray of urea. Recommended dose of nitrogen (urea) 150 kg ha^{-1} was applied in different percent level and with or without foliar spray of urea and nano urea. Different activities of cultural integration such as irrigation, cultivation, pest control and so on are performed as required.

Results and Discussion

Among the different nitrogen management practices, application of 100% RDN (3 split N application) had higher growth as well as yield attributes. Results revealed the 100% RDN (3 split N application) was significantly superior on growth attributes viz., plant height (221.8 cm), dry matter accumulation (315 g plant-1), crop growth rate, and was also superior on yield attributes viz., cob length (17.5 cm), cob girth (16.7 cm), number of grain rows cob-1 (13.5), number of grains row-1 (39.3), and number of cobs (64.6 thousand ha^{-1}). The highest cob yield (8961.2 kg ha^{-1}) and grain yield (7188.8 kg ha^{-1}) were also achieved under T_2: 100% RDN (3 split N application) followed by T_6: T_3 (75% RDN) + Nano urea two spray. T_1 (Control) was recorded lowest in term of growth attributes, yield attributes and yield.

Table 1: Growth attributes as influenced by different nitrogen management practices.

	Treatments	Plant height (cm) at harvest	Dry matter accumulation (g plant-1) at harvest	CGR(g m^{-2} day^{-1}) 90- at harvest
T_1	Control (only PK)	194.33	134.76	4.94
T_2	RDN 100 % (3 split N application)	221.8	315	14
T_3	75% RDN (3 split N application)	213	256.62	10.36
T_4	50% RDN (3 split N application)	203.07	205.46	8.1
T_5	T_3 + Nano urea one spray	215.33	290	12.88
T_6	T_3 + Nano urea two spray	218.6	297.75	13.23
T_7	T_4 + Nano urea one spray	205.4	213.28	8.45
T_8	T_4 + Nano urea two spray	207.07	246.36	9.12
T_9	1/3rd RDN basal + Nano urea two spray	196.4	155.08	6.68
T_{10}	2/3rd RDN + Nano urea one spray	206.97	184.53	9.45
T_{11}	1/3rd RDN basal + 2% urea two foliar spray	201.73	188.84	7.36
T_{12}	2/3rd RDN basal + 2% urea one foliar spray	209.87	213.85	10.96
	SEm±	1.7	4.26	0.32
	CD (at 5%)	4.99	12.49	0.95

Table 2: Yield attributes as influenced by different nitrogen management practices.

	Treatments	Cob length (cm)	Cob girth (cm)	100 seeds weight(g)
T_1	Control (only PK)	14.9	14.7	34
T_2	RDN 100 % (3 split N application)	17.5	16.7	39.72
T_3	75% RDN (3 split N application)	16.3	15.1	38.03
T_4	50% RDN (3 split N application)	15.4	14.9	35.05
T_5	T_3 + Nano urea one spray	16.4	15.2	38.45
T_6	T_3 + Nano urea two spray	16.9	15.4	38.7
T_7	T_4 + Nano urea one spray	15.5	14.9	36.2
T_8	T_4 + Nano urea two spray	16	15.1	36.36
T_9	1/3rd RDN basal + Nano urea two spray	15.3	14	34.33
T_{10}	2/3rd RDN + Nano urea one spray	16.1	15.1	36.55
T_{11}	1/3rd RDN basal + 2% urea two foliar spray	15.4	14.7	34.75
T_{12}	2/3rd RDN basal + 2% urea one foliar spray	16.3	15.1	37.3
	SEm±	0.48	0.33	1.17
	CD (at 5%)	1.42	0.99	3.43

Table 3: Yields and economics of maize as influenced by different nitrogen management practices.

	Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)	Net return (Rs.ha^{-1})	B:C ratio
T_1	Control (only PK)	4277.7	7611.1	35.9	47894.5	1.27
T_2	RDN 100 % (3 split N application)	7188.8	10770.8	40	109731.3	3.22
T_3	75% RDN (3 split N application)	6288.8	9115.5	40.7	92232.7	2.75
T_4	50% RDN (3 split N application)	5405.5	8192	39.6	75067.4	2.27
T_5	T_3 + Nano urea one spray	6305.5	9126.6	40.8	91366.1	2.63
T_6	T_3 + Nano urea two spray	6650	9350	41.5	97655	2.76
T_7	T_4 + Nano urea one spray	5611.1	8586.1	39.5	77978.5	2.41
T_8	T_4 + Nano urea two spray	5638.8	8638.8	39.4	77934	2.24
T_9	1/3rd RDN basal + Nano urea two spray	5011.1	7638.8	39.7	65712.7	1.9
T_{10}	2/3rd RDN + Nano urea one spray	5744.4	8705.5	39.6	80610.8	2.35
T_{11}	1/3rd RDN basal + 2% urea two foliar spray	5316.6	7861.1	40.3	72900.8	2.18
T_{12}	2/3rd RDN basal + 2% urea one foliar spray	5755.5	8844.4	39.4	81359.3	2.41
	SEm±	293.25	384.9	1.36	5865.16	0.17
	CD (at 5%)	860.09	1128.89	NS	17201.93	0.5

Conclusion

From the result, it is concluded that among nitrogen management practices 100% RDN (3 split N application) found effective in enhancing grain (kernel) yield and net return and superior over the rest of the treatments.

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