Vol.12 No. 1, Page No. 64–67 (2023)

Received: January, 2023; Accepted: March, 2023

Effect of Nano Fertilizers on Yield, Nutrients Uptake and Quality Parameters in Rice Under Rice-Wheat Cropping System

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Abstract

A field experiment was conducted during 2019 to 2021 at Fertilizer Research Farm Uttaripura in the jurisdiction of C. S. Azad University of Agriculture and Technology, Kanpur using high yielding variety of rice CSR-36.The value of plant height (16.7 %), panicle length (24.1 %), spikelet/panicle 20.1 %), effective tillers/m^2 (15.2 %), test weight 13.2 %), grain yield (17.4 %), straw yield (18.0 %) and biomass (17.6 %) was recorded with the application of RDF (-) 100%N+2 spray of nano N nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) higher in comparison to RDF (recommended dose of fertilizer) treatment. The application of nano zinc is more beneficial than nano copper application. The application of RDF (-) 100%N+2 spray of nano N (8 ml/lit) and RDF (-) 100%N+2 spray of nano N and nano Cu (8 ml/2 ml/lit) treatment were at par in case of yield and yield attribute characters of rice crop. The maximum quality parameters of rice was recorded with the application of RDF (-) 100%N+2 spray of nanoN nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) followed by RDF (-) 100%N+2 spray of nano N and nano Zn (8 ml/2 ml/lit) treatments and minimum was recorded with the application of RDF (Recommended dose of fertilizer) treatment.Themaximum uptake of N, P, K, Cu and Zn nutrients was recorded 33.7 %, 45.4 %, 42.4 %, 34.5 % and 37.1 % in grain and 32.6 %, 41.8 %, 49.2 %, 36.6 % and 38.0 % in straw respectively over RDF (recommended dose of fertilizer) treatment.

Keywords : Nano fertilizers, Rice, Yield, Nutrient uptake, quality parameters.

Introduction

Among most recent technical improvements in the field of agriculture, nanotechnology holds an eminent position in remodeling agriculture and food production to fulfill the demands in an efficient and cost-effective way.[1]. Nanotechnology is a promising tool and has the potential to foster a new era of precise farming technologies and therefore, may emerge as a possible solution for these problems. The use of nano fertilizers not only causes increased use efficiency through ultrahigh absorption of the nutrients, increase in photosynthesis caused by expansion in surface area of the leaves but also reduces the toxicity generated due to over application in the soil as well as reduces the split application of fertilizers. Therefore, the present study was undertaken to effect of nano nitrogen, zinc and copper on yield, nutrients uptake and soil fertility in rice under rice- wheat cropping system.

Materials and Methods

A field experiment was conducted during 2019 to 2021 at Fertilizer Research Farm Uttaripura in the jurisdiction of C. S. Azad University of Agriculture and Technology, Kanpur using high yielding variety of rice CSR-36 in rice-wheat cropping system. The initial physico-chemical properties of soil were pH 8.1, EC 0.65 dSm^{-1}, organic carbon 4.5 g kg^{-1}. The soil was sandy loam in texture having

available N 232.5 kg ha^{-1}, available P_2O_5 19.5 kg ha^{-1} and available K_2O 210.7 kg ha^{-1}. The experiment was laid out under randomize block design with four replications. The experiment consist of five treatments viz. T_1- RDF, T_2- RDF (-) 50%N+2 spray of nano N(4 ml/lit), T_3- RDF (-) 50%N+2 spray of nano N and nano Zn (4 ml/2 ml/lit), T_4- RDF (-) 50%N+2 spray of nano Zn and nano Cu (4 ml/2 ml/2 ml/lit), T_5-RDF (-) 100%N+2 spray of nano N(8 ml/lit), T_6- RDF (-) 100%N+2 spray of nano N and nano Zn (8 ml/2 ml/lit), T_7- RDF (-) 100%N+2 spray of nano N and nano Cu (8 ml/2 ml/lit) and T_8- RDF (-) 100%N+2 spray of nano Zn and nano Cu (8 ml/2 ml/2 ml/lit). About 25 days old seedling was uprooted carefully from the seedbed and it's transplanted in well prepared field in the first week of July. The nano fertilizers namely nano-nitrogen, copper and zinc had nutrient concentrations of 25000, 5000 and 2000 ppm, respectively Four ml of these liquid fertilizers were added in one litre of water and for one acre 500 ml of nano fertilizers were added to 125 litre of water and sprayed as per treatments. The first spray was done at 14 DAT and second 35 DAT in the rice crop. The agronomical practices were applied as per requirement of crops. The crops were harvested at full maturity and the yield data were recorded from the net plot area harvested. The soil samples were analysis by adopting standard procedures The results are in accordance with [3]. The data obtained from consecutive three years were statistically analyzed as per procedure given by [2].

Results and Discussion

Yield and growth parameters of rice

The yield and growth parameters of rice were significantly influenced with the application of different treatments in rice under rice-wheat cropping system (Table-1). The plant height varied from 87.2 to 104.7 cm with the mean value of 95.1 cm, panicle length 19.2 to 25.3 cm with the mean value of 22.5 cm, spikelet/panicle 54.5 to 68.2 with the mean value of 61.4, effective tillers/m^2 126.2to 148.8 with the mean value of 138.8, test weight 23.7 to 27.3 gram with the mean value of 25.5 gram, grain yield 45.2 to 54.7 q/ha with the mean value of 50.3 q/ha, straw yield 60.97 to 74.28 q/ha with the mean value of 68.5 q/ha and biomass from 106.14 to 128.96 q/ha with the mean value of 118.7 q/ha in rice with the application of different treatments. The maximum yield and growth parameters of rice was recorded with the application of RDF (-) 100%N+2 spray of nanoN nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) followed by RDF (-) 100%N+2 spray of nano N and nano Zn (8 ml/2 ml/lit) treatments and minimum yield and growth parameters was recorded with the application of RDF (Recommended dose of fertilizer) treatment. The highest value of plant height (16.7 %),panicle length (24.1 %), spikelet/panicle 20.1 %), effective tillers/m^2 (15.2 %), test weight 13.2 %), grain yield (17.4 %),straw yield (18.0 %) and biomass (17.6 %)was recorded with the application of RDF (-) 100% N+2 spray of nano N nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) over RDF (recommended dose of fertilizer) treatment. The application of nano zinc is more beneficial than nano copper application. The application of RDF (-) 100%N+2 spray of nano N(8 ml/lit) and RDF (-) 100% N+2 spray of nano N and nano Cu (8 ml/2 ml/lit) treatment were at par in case of yield and yield attribute characters of rice crop. The similar results were reported by The results are in accordance with [4].

Quality parameters of rice

The quality parameters of rice were significantly influenced with the application of different treatments in rice-wheat cropping system (Table-1). The protein content varied from 7.82 to 10.35 % with the mean value of 9.26 % and protein yield from 383.3 to 402.7 kg/ha with the mean value of 347.3 kg/ha in rice with the application of different treatments. The maximum quality parameters of rice was recorded with the application of RDF (-) 100%N+2 spray of nano N nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) followed by RDF (-) 100%N+2 spray of nano N and nano Zn (8 ml/2 ml/lit) treatments and minimum was recorded with the application of RDF (Recommended dose of fertilizer) treatment. The highest value of the protein content(24.7 %) and protein yield (29.6 %) was recorded with the application of RDF (-) 100% N+2 spray of nano N nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) over RDF (recommended dose of fertilizer) treatment. The application of RDF (-) 100% N+2 spray of nano N (8 ml/lit) and RDF (-) 100% N+2 spray of nano N and nano Cu (8 ml/2 ml/lit) treatment were at par in case of quality parameters of rice crop.

Table 1 Effect of different Nano fertilizers on yield and growth parameters of rice. (mean of three years)

Treatments	Plant height (cm)	Panicle length (cm)	Spiklets/penicle	Effective tillers/m^2	Test wt. (gm)	Grain (q/ha)	Straw (q/ha)	Biomass (q/ha)	Protein content (%)	Protein yield (q/ha)
T_1	87.2	19.25	54.5	106.14	23.7	45.17	60.97	106.14	7.82	283.3
T_2	89.4	19.78	56.4	109.69	24.1	46.88	62.81	109.69	8.15	305.7
T_3	91.7	20.23	58.2	116.23	24.6	49.25	66.98	116.23	8.77	325.2
T_4	93.3	20.85	60.7	118.72	25.2	50.16	68.56	118.72	9.17	342.4
T_5	96.8	21.17	63.4	121.50	25.8	51.27	70.23	121.50	9.75	361.3
T_6	99.6	21.68	65.3	126.23	26.9	53.15	73.08	126.23	10.17	382.4
T_7	97.5	21.45	64.8	123.05	26.4	51.92	71.13	123.05	9.87	375.2
T_8	104.7	22.34	68.2	128.96	27.3	54.68	74.28	128.96	10.35	402.7
CD=0.05	2.23	1.37	1.86	16.22	0.97	2.12	2.24	--	0.48	2.27

Uptake of nutrients

The uptake of nutrients by grain and straw of rice were significantly influenced with the application of different treatments (Table-2). The nutrients uptake of N, P, K, Cu and Zn varied from 43.2 to 65.2 kg ha^{-1}, 17.3 to 31.7 kg ha^{-1}, 20.0 to 34.7 kg ha^{-1}, 25.2 to 38.4 mg kg^{-1} and 80.4 to 127.8 mg kg^{-1} in grain and from 46.3 to 68.7 kg ha^{-1}, 20.2 to 34.4 kg ha^{-1}, 35.2 to 69.3 kg ha^{-1}, 22.3 to 35.2 mg kg^{-1} and 76.5 to 123.4 mg kg^{-1}in straw with the mean value of 53.9 kg ha^{-1}, 24.4 kg ha^{-1}, 9.57 kg ha^{-1}, 30.5 mg kg^{-1} and 99.7 mg kg^{-1} in grain and 57.2 kg ha^{-1}, 27.5 kg ha^{-1}, 52.1 kg ha^{-1},28.7, mg kg^{-1} and 95.5 mg kg^{-1} in straw of rice respectively with the application of different treatments. The maximum uptake of N, P, K, Cu and Zn nutrients was recorded 65.2 kg ha^{-1}, 31.7 kg ha^{-1}, 34.7 kg ha^{-1}, 38.4 mg kg^{-1} and 127.8 mg kg^{-1} in grain and 68.7 kg ha^{-1}, 34.4 kg ha^{-1}, 69.3 kg ha^{-1}, 35.2 mg kg^{-1} and 123.4 mg kg^{-1}in straw respectively with the application of RDF (-) 100% N+2 spray of nano N nano Zn and nano Cu (8 ml/2 ml/2 ml/lit) due to foliar application of nano N, P, K, Cu and Zn nutrients and minimum uptake of nutrients was recorded

in recommended dose of fertilizer treatment.The application of RDF (-) 100% N+2 spray of nano N and nano Cu (8 ml/2 ml/lit) and RDF (-) 100% N+2 spray of nano N (8 ml/lit) treatments were at par in the case of nutrients uptake.The results are in accordance with [5,6]. The uptake of N, P, K, Cu and Zn nutrients was recorded 33.7 %, 45.4 %, 42.4 %, 34.5 % and 37.1 % in grain and 32.6 %, 41.8 %, 49.2 %, 36.6 % and 38.0 % in straw respectively over RDF (recommended dose of fertilizer) treatment.

Table 2 Effect of treatments on nutrient uptake by grain and straw of rice (mean of three years)

Treatments	Grain					Straw				
	N	P	K	Cu	Zn	N	P	K	Cu	Zn
	(kg ha^{-1})			(mg kg^{-1})		(kg ha^{-1})			(mg kg^{-1})	
T_1	43.2	17.3	20.0	25.2	80.4	46.3	20.2	35.2	22.3	76.5
T_2	46.5	19.5	22.8	26.1	84.7	49.5	22.5	39.5	23.5	80.8
T_3	49.1	21.7	24.7	27.4	97.4	52.3	24.4	44.3	25.6	93.6
T_4	52.3	23.3	26.2	33.5	108.8	55.4	26.5	49.2	27.7	103.8
T_5	55.2	25.1	28.5	28.3	88.5	58.5	28.7	54.6	29.6	84.5
T_6	58.6	27.2	30.6	29.6	117.6	61.2	30.5	59.8	31.8	112.6
T_7	61.1	29.3	32.4	35.7	92.2	64.4	32.4	64.7	33.5	88.6
T_8	65.2	31.7	34.7	38.4	127.8	68.7	34.4	69.3	35.2	123.4
CD=0.05	1.68	1.59	1.47	2.14	2.53	1.72	1.64	1.52	2.19	2.57

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