Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 17 (1) : 70-72 (January-2022), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Study on Application of Organic Nano Zinc and Chemical Fertilizers in Rice-Wheat Cropping System

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Abstract

A field experiment was conducted during 2019 to 2020 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 and wheat K-1007 in rice-wheat cropping system. The grain, straw and biological yield of rice ranged from 35.10-53.18, 27.98-63.59 and 50.61-97.88 q ha^{-1} respectively (Table-1). The maximum grain yield was received from 100% RDF+ Zinc monohydrate (application through Soil) and minimum 50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT. The maximum uptake of N 74.9, P 23.4 and K 22.8 kg ha^{-1} in grain and N 28.8, P 3.75 and K 96.7 kg ha^{-1} in straw of rice and N 69.6, P 21.7 and K 20.8 kg ha^{-1} in grain and N 28.4, P 3.04 and K 96.4 kg ha^{-1} in straw of wheat with the application of 100% RDF+ Zinc monohydrate (application through Soil).. The maximum changes in physico-chemical properties of soil with the application of 100% RDF+ Zinc monohydrate (application through Soil) followed by 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT and 100% RDF whereas not remarkable changes in 50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT treatment.

Key words : *Soil properties, nutrients uptake and organic nano zinc and chemical fertilizers.*

Introduction

World agricultural cropping system are intensively using large amount of fertilizers, pesticides and herbicides to achieve more production per unit area per unit time but using more doses than optimum of these chemicals and fertilizers leads to several problems like environment pollution, low input use efficiency, decreased quality of food products, increasing problems of pests, less income from the production, soil degradation, increasing incidence of multi-nutrient deficiencies in soil and plants, decreasing of population of beneficial organisms in the soil and on the whole soil health problems. Although, various tools such as Leaf color chart (LCC) is a suitable tool to optimize the use of N, can be used for reducing the load of chemical fertilizers in soil (1). 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. 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 (2). The use of nanofertilizers 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 (3, 4).Therefore, the present study was undertaken to effect of nano-nitrogen, potassium and zinc on enhancing nutrient use efficiency, crop productivity and economic returns in rice-wheat cropping system.

Materials and Methods

A field experiment was conducted during 2019 to 2020 as a fixed layout 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 and wheat K-1007 in rice-wheat cropping system. The initial physico-chemical properties of soil were pH 8.2, EC 0.62 dSm^{-1}, organic carbon 2.8 g kg^{-1}. The soil was sandy loam in texture having available N 185.7 kg ha^{-1}, available P_2O_5 22.5 kg ha^{-1} and available K_2O 235.4 kg ha^{-1}. The experiment was laid out under randomize block design with three replications. The experiment consist of six treatments viz., T_1-Farmer Practice (FP), T_2-100% RDF, T_3- 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT, T_4- 75% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT, T_5-50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT and T_6- 100% RDF+ Zinc monohydrate (application through Soil). About 21 days old seedling was uprooted carefully from the seedbed and its transplanted in well prepared field in the month of June and sowing of wheat in the month of November. Recommended doges of fertilizers were applied through urea, DAP and muriate of potash, respectively. The half doge of N and full doges of P_2O_5 and K_2O were applied as basal and rest N applied in two equal splits at the time of tillering and ear emergence

Received : September-2021; Revised : September-2021; Accepted : October-2021

Table-1 : Effect of treatments on grain, straw and biological yield of rice and wheat q/ha (mean of twoyears).

Treatments	Rice			Wheat		
	Grain	Straw	Biological	Grain	Straw	Biological
T_1	38.25	51.63	89.88	34.82	48.74	83.56
T_2	45.68	61.66	107.34	41.55	58.17	99.72
T_3	50.43	68.08	118.51	45.85	64.19	110.04
T_4	44.86	60.56	105.42	40.53	56.74	97.27
T_5	35.10	47.38	82.48	31.94	44.72	76.66
T_6	53.18	71.79	124.97	48.35	67.69	116.04
CD=0.05	2.12	3.24	-	2.04	3.16	-

Table-2 : Effect of treatments on nutrients uptake kg ha^{-1} in rice and wheat (mean of twoyears).

Treatments	Rice						Wheat					
	Grain			Straw			Grain			Straw		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1	51.9	16.3	14.9	18.5	2.28	67.1	48.7	14.6	13.6	19.2	1.85	65.8
T_2	63.2	19.6	18.5	24.7	3.07	81.4	59.4	18.7	17.0	24.5	2.44	78.9
T_3	70.1	21.9	21.2	27.9	3.50	89.9	65.9	20.2	19.2	26.3	2.76	89.5
T_4	62.4	19.1	18.0	25.4	3.01	79.3	58.7	17.4	16.2	23.2	2.28	78.3
T_5	49.2	15.2	13.1	18.0	2.16	60.6	45.4	13.8	12.8	18.3	1.73	58.2
T_6	74.9	23.4	22.8	28.8	3.75	96.7	69.6	21.7	20.8	28.4	3.04	96.4
CD=0.05	3.12	0.27	2.24	3.26	0.31	2.35	2.42	0.23	2.14	2.46	0.38	2.47

Table-3 : Effect of treatments on physico-chemical properties of experimental soil after two years.

Treatments	pH	EC dSm^{-1}	OC g kg^{-1}	N kg ha^{-1}	P kg ha^{-1}	K kg ha^{-1}
T_1	8.1	0.61	2.9	187.9	22.6	236.3
T_2	7.9	0.56	3.0	190.1	23.0	238.0
T_3	7.8	0.55	3.1	195.3	23.2	240.1
T_4	8.0	0.58	2.9	188.4	22.7	236.4
T_5	8.2	0.59	2.8	184.9	22.6	235.2
T_6	7.7	0.53	3.2	198.5	23.6	243.5
Initial values	8.2	0.62	2.8	185.7	22.5	235.4

in both crop. Agronomical operations will be applied as par requirement of crop. The estimation of physico-chemical properties of soil were estimated by standard procedures (5).

Results and Discussion

Yield of crops : The yield and yield attributing characters of rice were significantly influenced with the application of different treatments in rice-wheat cropping system (Table-1). The yield of grain ranged from 35.10 to 53.18 q ha^{-1} with the mean value of 44.58 q ha^{-1}, straw from 47.38 to 71.79 q ha^{-1} with the mean value of 60.18 q ha^{-1} and biological from 82.48 to 124.97 q ha^{-1} with the mean value of 104.76 q ha^{-1} in rice and grain from 31.94 to 48.35 q ha^{-1} with mean value of 40.51 q ha^{-1}, straw from 44.72 to 67.69 q ha^{-1} with mean value of 56.71 q ha^{-1} and biological from 76.66 to 116.04 q ha^{-1} with mean value of 97.22q ha^{-1} in wheat in rice wheat cropping system. The maximum yield of grain 53.18 q ha^{-1}, straw 71.79 q ha^{-1} and biological 124.97 q ha^{-1} in rice and grain 48.35 q ha^{-1}, straw 67.69 q ha^{-1} and biological 116.04 q ha^{-1} in wheat was received from 100% RDF+ Zinc monohydrate (application through Soil) followed by 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT and minimum yield of grain 35.10 q ha^{-1}, straw 47.38 q ha^{-1} and biological 82.48 q ha^{-1} in rice and grain 31.94 q ha^{-1}, straw 44.72 q ha^{-1} and biological 76.66 q ha^{-1} in wheat with50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT. The increasing trend of grain yield were 33.99, 28.07, 15.64, 14.10 and 5.17 % in rice and 33.94, 27.98, 16.17, 14.06 and 5.17 % in wheat with the application of 100% RDF+ Zinc monohydrate (application through Soil), 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT, 100% RDF, 75% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT,Farmer Practice (FP), Over 50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT. The same increasing trend of straw and biological yield was recorded also in both rice and wheat crop. Similar results was reported by (6 and 7).

Uptake of nutrients : The nutrients uptake by grain and straw of rice and wheat were significantly influenced with the application of different treatments in rice-wheat

cropping system (Table-2). The uptake of N varied from 49.2 to 74.9 kg ha^{-1} with mean value of 61.7 kg ha^{-1}, P from 15.2 to 23.4 kg ha^{-1} with mean value of 19.3 kg ha^{-1} and K from 13.1 to 22.8 kg ha^{-1} with mean value of 18.1 kg ha^{-1} in grain and N from 18.0 to 28.8 kg ha^{-1} with mean value of 23.8 kg ha^{-1}, P from 2.16 to3.75 kg ha^{-1} with mean value of 2.96 kg ha^{-1} and K from 60.6 to 96.7 kg ha^{-1} with mean value of 79.2 kg ha^{-1} in straw in rice and N from 45.4 to 69.6 kg ha^{-1} with mean value of 57.9 kg ha^{-1}, P from 13.8 to 21.7 kg ha^{-1} with mean value of 17.7 kg ha^{-1} and K from 12.8 to 20.8 kg ha^{-1} with mean value of 16.6 kg ha^{-1} in grain and N from 18.3 to 28.4 kg ha^{-1} with mean value of 23.3 kg ha^{-1}, P from 1.73 to 3.04 kg ha^{-1} with mean value of 2.35 kg ha^{-1} and K from 58.2 to 96.4 kg ha^{-1} with mean value of 77.8 kg ha^{-1} in straw in wheat in rice-wheat cropping system with the application of different treatments. The maximum uptake of N 74.9, P 23.4 and K 22.8 kg ha^{-1} in grain and N 28.8, P 3.75 and K 96.7 kg ha^{-1} in straw of rice and N 69.6, P 21.7 and K 20.8 kg ha^{-1} in grain and N 28.4, P 3.04 and K 96.4 kg ha^{-1} in straw of wheat with the application of 100% RDF+ Zinc monohydrate (application through Soil) followed by 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT. Similar results was reported by (8). The minimum uptake in both grain and straw of rice and wheat was recorded from the treatment of 50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT.

Physico-chemical properties of soil : The considerable changes in physico-chemical properties of experimental soil after three year with the application of different treatments (Table-3). The maximum changes in soil pH from 8.2 to 7.7, EC from 0.62 to 0.53 dSm^{-1}, organic carbon from 2.8 to 3.2 g kg^{-1}, available N from 185.7 to 198.5 kg ha^{-1}, available P from 22.5 to 23.6 kg ha^{-1} and available K from 235.4 to 243.5 kg ha^{-1} with the application of 100% RDF + Zinc monohydrate (application through Soil)treatment. The maximum changes in physico-chemical properties of soil with the application of 100% RDF+ Zinc monohydrate (application through Soil) followed by 100% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT and 100% RDFwhereas not remarkable changes in 50% RDF+ Foliar application of Organic Nano Zinc 20 ml/liter at 21 DAT treatment. Similar expects reported by (9).

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