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BALANCED USE OF NUTRIENTS FOR HIGH CROP YIELD AND QUALITY OF RICE IN CENTRAL UTTAR PRADESH

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***Abstract*— The field experiment on rice crop was conducted at research farm of C.S.A. University Of Agriculture & Technology Kanpur, during Kharif season 2013. The doses of experiment were 50% NPK , 50% NPK+ S40, 50% NPK + S40 + Zn5, 50% NPK +Zn5, 100% NPK, 100% NPK + S40, 100% NPK + Zn5 and 100% NPK + S40 + Zn5. The results showed that the grain yield varied from 29.5 to 45.50q ha-1 and straw yield from 60.50 to 98.50q ha-1. The N content in grains ranged from 1.42 to 1.50%, P from 0.32 to 0.38 % , K from 1.24 to 1.32%, S from 0.20 to 0.25% and Zn from13.0 to 18.0 mg kg-1. The N content in rice straw ranged from 0.22 to 0.28%, P from 0.17 to 0.24%, K from 0.35 to 0.44%,S from 0.10 to 0.14% and Zn from 27.0 to 40.0 mg kg-1. It was noted the N uptake varied from 55.21 to 105.82 kg ha-1, P from 19.72 to 40.92 kgha-1, K from 85.34 to 150.04 kg ha-1, S from 11.95 to 25.16 kg ha-1 and Zn from 201.65 to 473.15 g ha-1.The starch content varied from 65 to 70%, amylose from 28 to 34% and amylopectin from 66 to 72%. The dose of 100% NPK+S40+Zn5 were found most suitable in respect of crop yield, nutrient content uptake of nutrient and quality of rice.**

I. INTRODUCTION

Rice (Oryza sativa L.) is one of the most important and stable crop in tropical and sub-tropical area of our country. Rice is grown over an area of 40 million to 41 million ha in the country. Today, the total rice production in Kharif season (2010-11) is 95 million tonnes (Agriculture Survey 2011). Andhra Pradesh, Bihar, Uttar Pradesh, Madhya Pradesh and West Bengal are the leading states of rice production. The average yield per ha is highest in Punjab (3346 kg/ha-1). Besides the ideal ratio of N.P.K is 4 : 2 : 1 for cereal crops. Indiscriminate use of fertilizer adversely affect the physico-chemical properties of the soil resulting in poor rice production. Rice is a high carbohydrate containing food. The protein content of milled rice is usually 6-7 percent.

Nitrogen is major structural constituent of the cell. It helps in building up vegetative growth. In the absence of nitrogen the crop growth is greatly retarded foliage turns yellowish, cause shrivelling of grain and lower crop yield. Chlorophyll and carbohydrates assimilation are greatly diminished. Phosphorus is second important major plant nutrient for crop production. It has been called as the "Bottleneck of World Hunger". Phosphorus is a structural component of cell membranes, chloroplast and mitochondria, It is necessary for photosynthesis, development of plant cell as well as fat and carbohydrate. Potassium is the third major element and plays very important role in photosynthesis and translocation of nutrients from leaves to the seed. It affects both carbohydrate metabolism and also regulates their proportion in the plants.

Sulphur is one of the nature's super nutrients. It is now recognized as the fourth major nutrient in addition to nitrogen, phosphorus and potassium. It influences plants growth in two ways firstly acting as a nutrient and secondly by improving the soil conditions. Zinc is involved in carbohydrate and protein metabolism through several enzyme systems. Zinc is also involved in the synthesis of some growth promoting hormones.

II. MATERIALS AND METHOD

The experiment was conducted at research farm Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during the Kharif season 2013. The rice verity NDR 359 were taken for study with 9 treatment and 3 replication. The initial characteristics of soil were analyse to know the nutrient status of soil. The soil of experimental field is low in organic carbon, available nitrogen and available Zn, but medium in case of available P K and available S. The pH and EC was soil in normal range. The pH EC and organic carbon are analyse by the method described by Jackson (1967), available N2 was determine by Alkaline permanganate method as described by Subbiah and Asija (1956). Available phosphorus was extracted with 0.5 M NaHCO3 Olsen et al. (1954). The P was determine in extract by vandomolybdate yellow colour method Jackson (1967). The available K was determined by flame photometer. Available sulphur was determined by Chesnin and Yien (1950). Available zinc was estimated by atomic absorption spectrophotometer. The plant samples were also analyse for N P K, S and Zn. Nitrogen was determined by Kjeldal's method (Jackson 1967). Phosphorus was determined calorimetrically (Chapman and Pratt, 1961). Potassium was determined by flame photometric method. Sulphur was determined by Chesnin and Yien (1956).Zinc was

determined by atomic absorption spectrophotometer. For quality characteristics the amylose and amylopectin was also determined by the method described by Mc Cready and Hassid (1943) in rice grain.

Table-1 Yield % increased over control

S. No.	Treatment	Grain yield (q ha^{-1})	% Increase over control	Straw yield (q ha^{-1})	% Increase over control
1	T_1	29.50		60.50	
2	T_2	34.00	13.23	70.00	13.57
3	T_3	36.00	18.05	75.00	19.33
4	T_4	38.50	23.37	80.50	24.84
5	T_5	37.00	20.27	76.50	20.91
6	T_6	40.50	27.16	85.50	29.23
7	T_7	42.00	29.76	90.00	32.77
8	T_8	43.00	31.39	94.00	35.63
9	T_9	45.50	35.16	98.50	38.57
	SE m ±	**1.135**		**0.915**	
	CD (P=0.05)	**2.407**		**1.940**	

Table-2 Effect of different treatments on total uptake of N P K S and Zn

S No.	Treatment	Uptake values				
		N($kgha^{-1}$)	P($kgha^{-1}$)	K($kgha^{-1}$)	S($kgha^{-1}$)	Zn(gha^{-1})
1	T_1	55.21	19.72	85.34	11.94	201.64
2	T_2	65.06	24.15	100.07	14.83	250.61
3	T_3	70.18	27.59	108.18	18.27	286.46
4	T_4	77.12	31.16	117.25	19.70	339.16
5	T_5	75.03	30.15	112.71	18.05	311.65
6	T_6	82.59	34.63	128.16	20.09	355.48
7	T_7	85.56	34.90	133.73	20.44	386.89
8	T_8	89.44	37.52	141.61	22.53	430.34
9	T_9	105.82	40.92	150.04	25.15	473.14
	SE m ±	**3.697**	**1.951**	**5.433**	**1.730**	**11.532**
	CD (P=0.05)	**7.839**	**4.138**	**11.520**	**3.669**	**24.449**

Table-3 Effect of different treatments on starch, amylose and amylopectin content (%)

S.N.	Treatments	Starch (%)	Amylose (%)	Amylopeptin (%)
1.	T_1	65.00	34.00	68.00
2.	T_2	67.00	31.00	69.00
3.	T_3	66.00	33.00	67.00
4.	T_4	68.00	30.00	70.00
5.	T_5	67.00	29.00	71.00
6.	T_6	66.00	28.00	72.00
7.	T_7	67.00	32.00	68.00
8.	T_8	68.00	33.00	67.00
9.	T_9	70.00	28.00	66.00
	SE	**2.356**	**0.942**	**1.904**
	SE m ±	**N.S**	**1.998**	**N.S**
	CD (P=0.05)			

III. Result and Discussion

Fertilizers are play very important role in the yield of economy of the crop. Fertilizer alone contributed 55 to 60% to achieve the biological yield of a crop. In inceptisols five most limiting nutrients have been identified i.e. N,P,K,S and Zn. The element S and Zn are the recent additions in this list. The several side nutrient specific trails conducted at different locations both on farm and off farm established the need of sulphur and zinc along with NPK for yield maximization. The results of present study are discussed as under:-

Grain yield:- The grain yield varied from 29.50 to 45.50 q ha-1 . The 100% NPK +S40 + Zn5 dose gave the highest grain yield. About 35.16% yield increases with the addition of N,P,K,S and Zn in comparison to control. The result are also clearly indicated that addition of S and Zn increases the about 5.5% grain yield in comparison to non sulphur +zinc containing treatment. Several other scientists reported the results in conformity with the results of present study. Reddy et al.(2010), Zea et al. (2007) and Singh and Tripathi (2008).

Straw yield:- The straw yield varied from 60.50 to 98.50 q ha-1. The dose of 100% NPK + S40+Zn5 gave the maximum straw yield. The results are statistically significant and all the treatment gave superior than control. Increased straw due to addition of N,P,K,S and Zn containing fertilizers has been reported by many workers Darde & Bankar (2009) Shekhara et. al. (2010), Muthu Kumarraja et al. (2010). The results of present investigation are in agreement with these workers.

Nutrient content:- The N content in grain varied from 1.42 to 1.50%. P from 0.32 to 0.38%, K from 1.24 to 1.32%, S from 0.20 to 0.25% and Zn from 13.0 mg kg-1 to 18.0 mg kg-1 . The minimum and maximum concentration of nutrient was observed in control and dose of 100%NPK+S40+Zn5 respectively. The variation in the concentration of different nutrients was small but significant. The N content in straw varied from 0.22 to 0.28%, P from 0.17 to 0.24%, K from 0.35 to 0.44%, S from 0.10 to 0.14% and Zn from 27.0 to 40.0 mg kg-1 . The trends of variation in the results were similar to those describe for grain content. The concentration of these nutrients increases with increasing levels of nutrients has been also reported by Tripathi and Tripathi (2004) and Islam et al. (2006).

Uptake- The uptake values of nutrients in grain and straw increased due to concentration of these nutrients and biological yield of grain and straw. It was recorded that N uptake varied from 55.21 to 105.82 kgha-1, P from 19.72 to 40.92 kg ha-1, K from 85.34 to 150.04 kg ha-1, S from 11.95 to 25.16 kg ha-1 and Zn from 201.65 to 473.15 g ha-1 . The uptake values indicate the appropriate quantity of nutrients required for optimum yield in present investigation. The uptake value in indicated that the yield level of normal rice upto 45 to 48 q ha-1 can be harvested from combined use of 120 kg N + 60 kg P2O5 + 60kg K2O + 40 kg S+ 5 kg Zn for one ha. area. Any reduction in above dose level cause declying in yield of rice crop. Similar kind of results has been reported by Ravichandran et al. (2006) and Jana et al. (2009).

Crop quality- The maximum starch content in rice grain was observed in T9 (100% NPK + S40 +Zn5) treatment and lowest in control. In case of amylose content the highest value was recorded in control and lowest in T9 treatment combination. Thus there is a negative relationship appeared in between starch and amylose content. The increase in amlopectin contain at the cost of amylose. The data of current

study are in agreement with several workers (Upadhyay and Pathak-1981, Alvardo and Lobes- 1986.

Conclusion- The dose of 100% NPK+S40+Zn5 was the best dose amongst all in terms of grain yield, straw yield, nutrient content, uptake values and crop quality. So it is concluded that application of Sulphur and Zinc along with the combination of NPK gave best results to the farmers.

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