RESEARCH ARTICLE

BALANCE FERTILIZATION FOR HIGH SUSTAINABLE RICE (*ORYZA SATIVA* L.) YIELD AND QUALITY IN CENTRAL ALLUVIAL SOILS OF UTTAR PRADESH

Kautilya Chaudhary[1], Puspendra Kumar[2], H.C. Tripathi[1] and Pardeep Kumar*[3]

[1]Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture & Technology, Kanpur-208002 (U.P.)
[2] Department of Agronomy, C. S. Azad University of Agriculture & Technology, Kanpur-208002 (U.P.)
[3]Department of Soil Science, S.V.P. University of Agriculture & Technology, Meerut-250110 (U.P.)
Email: sehravat@gmail.com

Received-04.01.2017, Revised-15.01.2017

Abstract: The pot experiment was conducted at soil science laboratory of C. S. Azad University of Agriculture & Technology, Kanpur with 150kg N+ 75kg P2O5+ 75kg K2O ha-1 in rice crop during kharif 2011 . The other treatments included the 125% increased doses of above and sulphur (60 kg ha^{-1}) and zinc (5 kg ha^{-1}) were added since the experimental soil was deficient in these two nutrients. Mustard was grown after rice on the residual nutrients of the same treatments with application of 80 kg N ha^{-1} uniformly. The results revealed that rice yields varied from 49.0 to 73.0 q ha^{-1} and NPK raised by 125% with 60 kg S ha^{-1} and 5kg Zn ha^{-1} gave the highest yields. The starch content varied from 65 to 71%, amylose from 27 to 34% and amylopectin from 66 to 73%. The treatment T_8 (187.5N + 93.75 P_2O_5 + 93.75 K_2O + 60 S + 20 Zn Kg ha^{-1}) gave the best result in terms of yield and crop quality.

Keywords: Balanced fertitilization, Rice yield, Starch, Amylose, Amylopectin

INTRODUCTION

Paddy rice is one of the most important food crops of the world and so also of India. At the national level, it occupies about 45 million hectares of land and share about 43% of total food production. In face of rising population, rice requirement will be about 120-130 million tones. In spite of our best efforts, the rice yields have reached a plateau and there is a dire need of increasing the productivity of rice (Subbaiah et al;2006). Use of high fertilizer responsive varieties and applying high levels of fertilizers in a balanced proportion appears to be a feasible approach for the scale up of rice-productivity to a considerable extent. However, the possibility of residual nutrients in soil, particularly at comparatively higher rates of nutrients cannot be ruled out. Under the circumstance it appears worthwhile to exploit the residual nutrients per se in a succeeding crop of different rooting habit.

For optimum plant growth, nutrients must be available in sufficient and balanced quantities. Soils contain natural reserves of plant nutrients, but these reserves are largely in forms unavailable to plants, and only a minor portion is released each year through biological activity or chemical processes. This release is too slow to compensate for the removal of nutrients by agricultural production and to meet crop requirements. Therefore, fertilizers are designed to supplement the nutrients already present in the soil. The use of chemical fertilizer, organic fertilizer or biofertilizer has its advantages and disadvantages in the context of nutrient supply, crop growth and environmental quality. The advantages need to be integrated in order to make optimum use of each type of fertilizer and achieve balanced nutrient management for crop growth.

With the above objective in view, the present study was planned to examine the effect of direct fertilization of rice by rising the RDF by 125% and 150% and addition of required doses of sulphur and zinc. The sulphur and zinc hold the key to the balanced nutrition of rice.

MATERIAL AND METHOD

The physicochemical properties of soil revealed that it belonged to loam textural class with pH 8.1, EC-2.6 dSm, organic carbon 0.47%, available N 250 kg ha^{-1}, available P 15 kg ha^{-1}, available K 138 kg ha^{-1}, available S- 8.2 kg ha^{-1} and available Zn 0.30 ppm.

The experiment was conducted in cemented ground pots of 10 kg capacity having 30 cm diameter at the top and 26 cm depth with 9 treatments four replications under randomized block design. Each pot was filled with 10 kg well pulverized homogeneous soil. In kharif season of 2011 using rice variety PHB-78 was transplanted on 8th July 2011. The crop was harvested on 26th October 2011. Fertilizer treatments were T_1. Control, T_2. 60 kg S+5 kg Zn ha^{-1}, T_3. 150 kg N+ 75 kg P_2O_5+75 kg K_2O ha^{-1}, T_4. 187.5 N+93.75 kg P_2O_5+ 93.75 kg K_2O ha^{-1}, T_5. 150 kg N+ 75 kg P_2O_5+75 kg K_2O ha^{-1}+ 60 kg S ha^{-1}, T_6. 150 kg N+ 75 kg P_2O_5+ 75 kg K_2O+60 kg S+ 20 kg Zn ha^{-1}, T_7. 187.5 kg N+93.75 kg P_2O_5+75 kg K_20+ 60 kg S ha^{-1}, T_8. 187.5 kg N+93.75 kg P_2O_5+93.75 kg K_2O+60 kg S+20 kg Zn ha^{-1}, T_9. 225 kg N+112.5 kg P_2O_5+112.5 kg K_2O+60 kg S+20 kg Zn ha^{-1}.

*Corresponding Author

The fertilizers applied for above nutrients were urea, DAP, Muriate of Potash, elemental sulphur and zinc sulphate. Total amounts of phosphorus potash, sulphur and zinc were applied in the soil before transplanting however nitrogen was applied half as basal and rest half top dressed after 30 days of transporting.The observations were recorded on grain and straw yield, concentration and uptake of NPK, S and Zn in rice and yield.

The standard analytical procedures were adopted for soil and plant analysis. Mechanical analysis of soil was done by international pipette method (Piper, 1966), pH in 1:2:5 soil water ratio, EC was analyzed in above supervision (Jackson, 1973), organic carbon by rapid titration method (Walkley and Black's 1934) , Available N was estimated by alkaline permaganate method of (Subbiah and Asija1956), available P by Olsen's method (Olsen, et al. 1954), available K ammonium acetate extraction method (Jackson 1973), available S by turbidimetric method (Chesnin and Yien 1951) and available Zn was extracted with DTPA and determined using AAS as described by Lindsay and Norvell (1978).

Table 1. Effect of balanced fertilization on grain and straw yields of rice (q ha^{-1})

Treatments	Grain	Straw
T_1	49.0	62.0
T_2	52.0	66.0
T_3	66.5	85.5
T_4	70.0	89.0
T_5	62.0	75.5
T_6	69.0	88.0
T_7	71.0	90.0
T_8	73.0	94.0
T_9	70.0	91.0
SEm ±	0.95	0.833
C.D (at 5%)	1.949	1.710

Table 2. Effect of balanced fertilization on crop quality

Treatments	Starch (%)	Amylose (%)	Amylopectin (%)
T_1	65	34	66
T_2	66	32	68
T_3	67	33	67
T_4	68	33	67
T_5	66	31	69
T_6	69	28	72
T_7	70	29	71
T_8	71	28	72
T_9	68	27	73
SEm ±	2.18	0.98	2.10
C.D (at 5%)	NS	NS	NS

RESULT AND DISCUSSION

Grain and straw yield

The experimental data of grain yield of rice are presented in table 1. The grain yield varied from 49.0 – 73.0 qha^{-1}. The treatment T_8 (187.5 kg N + 93.75 kg P_20_5 + 93.75 K_20 + 60 kg S + 20 kg Zn) gave the highest grain yield in present investigation. The data clearly shows that all the treatment gave significantly higher yield in comparison to control. The grain yield of rice increased by increasing the nutrient dose but the yield was slightly decreased at T_9 (225 Kg N + 112.5 kg P_20_5 + 112.5 Kg K_20 + 60 kg S + 20 kg Zn) in comparison to T_8 treatment. The data of study clearly indicated that the addition of S and Zn gave only marginal response aver NPK combination in respect of grain yield. It was suggested that the pot soil was poor in nitrogen, phosphorus of added nutrients in terms of straw yield were more or less similar to those of grain yield. The straw yield ranged from 62.0 to 94.0 qha^{-1} and the treatment T_8 was once again found best fertilizer combination. Increased grain straw yield due to addition of nutrients in the form of fertilizers in balanced manner has been reported by several workers Pandey et al. (2004), Darde and Banker (2009), Reddy et al. (2010)

Crop Quality- The maximum starch content in rice grain was observed at T_8(187.5 Kg N + 93.75 Kg P_2O_5 + 93.75 Kg K_2O + 60Kg S + 20Kg Zn) treatment and lowest value was recorded at control. In case of amylose content the highest value was recorded in control treatment and lowest at T_8 treatment. Thus there a negative relationship appeared in between starch and amylose content. However, due to increased yield, the harvest of

amylopectin should also be higher in high nutrient treatment. The increase in amylopectin content at the cost of amylost. It ranged from 27 to 34%. The data of present study are in agreement with the findings (Tripathi *et al.* 1997, and Dwevedi et.al.2006)

REFERENCES

Chesnin, L. and Yien (1951). C.H. : Turbidimetric determination of available sulphur. *Proc. Soil Sci. Soc. Amer.*, 14 : 149-151.

Darade, A. B. and Banker, K. B. (2009). Yield attributes and yield of hybrid rice as affuled by placement of urea, DAP briquettes and Zn levels. *Agriculture Update 9(3/4): 226-228.*

Dwivedi, A.P.; Dixit, R.S. and Singh, G.R. (2006). Effect of nitrogen, phosphorus and potassium levels on growth, yield and quality of hybrid rice (*Oryza sativa* L.). *Oryza*, **43** (1) : 64-66.

Jackson, M. L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal 42, 421-428*.

Olsen, S.R.; Cole, C.V.; Watanable, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soil by extraction with sodium bicarbonate. *Circ U.S. Deptt. Agric.*, 939.

Pandey, S. B., Pandey, I. P. and Singh, R. S. (2004). Effect of potassium and magnesium on growth yield an uptake of nutrients in wheat. *Annals Plant Soil Res., 3(1):7-78.*

Piper, C.S. (1966). Soil and plant analysis, International Science Publisher University of Adelaide, Australia.

Reddy, B. C. M., Manjunatha, H., Patil, V. C. and Patil, S. N. (2010). Response of transplanted rice to N, P and K levels effect on growth, grin yield and economics. *Asian J. of Soil Science 4(2):298-303.*

Subbaiah, S.V.; Singh, S.P.; Mahendra Kumar, R.; Viraktamath, B.C. and Ilyas Ahmed, M. (2006). *Agrotechniques for hybrid rice cultivation and seed production.* Directorate of Rice Research.

Subhiah, B.V. and Asija, G.L. (1956). A rapid procedure for the estimation of available nitrogen in Soil. *Curr. Sci.*, 25 : 259-260.

Tripathi, H.C.; Singh, R.S. and Mishra, S.K. (1997). Effect of S and Zn nutrition on yield and quality of chickpea. *J. Indian Soc. Soil Sci.*, **45** (1) : 123-126.

Walkley, A.J. and Black, I.A. (1934). Estimation of soil organic carbon by chromic acid titration method. *Soil Sci. 37 : 29-38.*