International Journal for Research in Applied Sciences and Biotechnology

ISSN: 2349-8889
Volume-6, Issue-4 (July 2019)

www.ijrasb.com

https://doi.org/10.31033/ijrasb.6.4.3

Response of Chemical Fertilization on Some Nitrogenous Biomolecules in Grains of a Popular Rice Cultivar

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ABSTRACT

Agronomical field study was conducted to study the effect of different levels of NPK fertilization on crude protein, total nitrogen, nitrate and nitrite nitrogen, non protein nitrogen and total free amino acids in the rice grains of well known variety Pant-4. T.N. and C.P. content was found to increase with the increase in fertilizer doses whereas the nitrate nitrogen content decreased. Nitrite nitrogen and non protein nitrogen showed an irregular trend with respect to control. However the quantity of total amino acid was found optimum at $N_{80}P_{40}K_{30}$ dose..

Keywords-- Rice, Crude Protein, Total free Aminoacids

I. INTRODUCTION

Nitrogen, phosphorus and potassium are the essential elements required for the plant growth and its development. Nitrogen is an integral part of plant and is present in various important fractions such as chlorophyll, proteins, alkaloids, RNA and DNA, whereas phosphorus is a vital structural component of nucleoprotein, phospholipids, sugar phosphate, ATP and NADP and is absorbed in the form of phosphate ions. Its deficiency decreases the rate of protein synthesis and general chlorosis on leaf tips (Dobermann and Fairshurst, 2000). It is also essential for the formation of sugar, starch and their translocation throughout the plant system (Webster, 1954). Potassium is also an important nutrient which exists in the form of metal complexes in the protoplasm and supposed to maintain the colloidal structure inside plant body. It is involved in the synthesis of chlorophyll, carbohydrates and as a catalyst required by DNA polymerase. Khandagle et al. (2019) revealed that nitrogen fraction in grains decreased with increase in depth of soil. Even Hasanuzzaman et al. (2010) studied a comparative performance of difference organic manures and inorganic fertilizers on transplanted rice in agronomy fields of Sher-e-Bangla agricultural university, Dhaka. Nayak et al. (2013) observed different nitrogen fractions and their relationship with available nitrogen yield and nutrient uptake in safflower. Chauhan et al. (2017) discussed the status of nutrient management in rice with high production levels and mineral loss. Keeping in view the importance, an attempt has been made to study the impact of different doses of NPK chemical fertilization in association over crude protein, total nitrogen (TN), albuminoid nitrogen (Al. N), non protein nitrogen (NPN), nitrate and nitrite nitrogen (NO_3 N and NO_2 N)) as well as total free amino acid (TFAA) content of rice grains of Pant-4 variety.

II. MATERIAL AND METHODS

The field study was conducted at Nawabganj Agricultural Research Station in Kharif season of 2017. A block of land was divided into 12 plots each of size 8x6 sq.mt. Six NPK rates ($N_0P_0K_0$; $N_{60}P_{30}K_{20}$; $N_{80}P_{40}K_{30}$; $N_{100}P_{50}K_{40}$; $N_{120}P_{60}K_{50}$; $N_{140}P_{70}K_{60}$;kg/ha) were chosen. Experiment was performed in replication. N, P and K were given in the form of ammonium sulphate, superphosphate and muriate of potash respectively. Grains of the harvested crop were properly numbered and preserved safely for chemical analysis. Crude protein was determined by multiplying the total nitrogen value estimated by Microkjeldhal method as outlined by Jackson (1973) with a factor (6.25) while nitrate and nitrite nitrogen were determined spectrophotometrically (Tirvedi and Goel, 1986) using respective standard procedures. NPN was determine by difference method while Al N was determined using microkjeldhal method after deproteinization. Total free amino acids and all above parameters were analysed according to method given by A.O.A.C. (1985). All the results so obtained were subjected to statistical analysis to drive conclusions.

The representative soil samples from the experimental field were collected before sowing and were analyzed for the major parameters as follows.

Available N (Kg/ha)	=	179
Available P (Kg/ha)	=	45
Available K (Kg/ha)	=	210
Soil pH	=	7.3
Climate	=	Relatively humid.

III. RESULTS

Results are shown in Table A and Fig. 1, 2, 3 indicating that a dose of $N_{100}P_{50}K_{40}$ was found to give the highest CP content (9.81%) as compared to the control (7.43%) value. Further addition of NPK caused decline in crude protein and total nitrogen content to a value of 8.88% at highest level of $N_{140}P_{70}K_{60}$ which is even higher than control value (7.43). Nitrate nitrogen decreased significantly with an increase in chemical fertilization

doses. Even nitrite nitrogen in grains decreased below the control level for all the increased doses of fertilization but with an irregular trend. Like wise non protein nitrogen also increased in significantly upto $N_{100}P_{50}K_{40}$ and then decreased thereafter.

Total free amino acid content increased to maximum i.e. 0.145% with a dose of $N_{80}P_{40}K_{30}$ and it suddenly decreased to a value of 0.095% next higher dose of $N_{100}P_{50}K_{40.}$ However, it again increased with next higher doses and then again decreased with highest dose of $N_{140}P_{70}K_{60}$. But these values are higher in comparison to control (0.0630). Therefore, the content of free amino acid showed no definite trend.

IV. DISCUSSION

Anand and Krishnappa (1988) found very similar results to our observations. They reported 8.96% crude protein content at $N_{120}P_{100}K_{50}$ dose which is approximately equal to our results i.e. 9.33%. The content value is also almost similar. They found CP value 7.35% which is 7.43% during present study. Pacv and Steve (1989) also found that with increase in the level of NPK fertilization grain CP content increased. They gave NPK is sufficiently higher doses of 0-240 kg N, 0-240 kg P and 0-160 kg K/ha and found CP content increased from 12.7% to 16.7%. They have further reported that low rates of NPK (30-60 kg, N, 30-60kg P and 40-60 kg K/ha) and insignificant effect on grains.

Similar observations have also been reported by Peric (1980), Stulin et al. (1982), Sinirhova (1988) and Efremova et al. (1990).

Kosilova and Presnyakov (1982) found an increase in the level of free amino acid content at very low rate of NPK (30, 60, 60 kg/ha). However, Nazarova (1982) reported that P have no importance in increasing free amino acid content. Lanky (1982) and Naishoim and Ericsson (1990) also determined the positive effect of NPK content in increasing the content of free amino acid. Results of present study were also in agreement with the above observations, however, after $N_{80}P_{40}K_{30}$ dose no definite trend of free amino acid content was noticed.

Percentage of nitrate nitrogen decrease with the increase of NPK levels. At control level where no fertilizer supplementation was made nitrate nitrogen content was 1.00% which was decreased to 0.69% at the highest dose of NPK fertilizers.

Chohan and Ali (1990) determined the impact of fertilizers on three commonly grown vegetables i.e. Spinach, turnip and cauliflowers. Fertilizers given in the form of NH_4NO_3 and KNO_3 markedly increased nitrate nitrogen content in vegetable and suggested that it could pose a health hazard. Nyazin et al. (1991) also reported an increase in nitrate nitrogen with the application of NPK fertilizer. However, Nowicka (1988) found that both irrigation and high NPK levels decreased nitrate nitrogen content in sugar beet. During present study, nitrogen was given in the form of $(NH_4)_2SO_4$ and this may be reason for the decrease in nitrate and nitrite nitrogen content in the rice grains of Pant-4 variety.

V. CONCLUSION

It could be concluded from the results obtained that optimal doses of NPK chemical fertilizer combination for rice cultivar chosen was $N_{100}P_{50}K_{40}$ Kg/ha for maintaining the nutritive value in grains in regards to consumption by masses in North India.

ACKNOWLEDGEMENT

The author is highly grateful to the Head, Department of Chemistry, Bareilly College, Bareilly for providing all facilities.

Table A. Content of all nitrogenous fractions estimated in the grain of rice variety Pant-4 as affected by different levels of NPK fertilization.

N+P+K (kg/ha) levels		T.N.	Crude Protein	Al N	Nitrate Nitrogen	Nitrite nitrogen	NPN	Total free amino acid
1.	Control	1.1890	7.431	1.1190	1.002	0.864	0.0700	0.0630
2.	60 N+30P+20K	1.2480	7.799	1.1750	0.942	0.759	0.0730	0.1415
3.	80N+40P+30K	1.3630	8.521	1.2570	0.919	0.763	0.1060	0.1455
4.	100N+50P+40K	1.5710	9.818	1.3570	0.855	0.779	0.2140	0.0955
5.	120N+60P+50K	1.4940	9.337	1.3220	0.776	0.751	0.1720	0.1385
6.	140N+70P+60K	1.4220	8.887	1.3110	0.697	0.722	0.1110	0.1100
Variance Ratio 'F'		185.77**	189.09**	47.54*	57.79*	57.79*	13.94	25.20
Critical difference (C.D.)*		0.0292	0.1813	0.0369	0.040	0.040	0.0421	0.017

*Significant at 5% level.
**Significant at 1% level.
% on dry matter basis.

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www.ijrasb.com https://doi.org/10.31033/ijrasb.6.4.3

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