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Effect of Different Levels of Nitrogen on Growth and Yield of Rice

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Abstract: *The results indicated that significantly higher plant height of 48.27cm, 89.93cm and 110.68 cm was observed in the STCR approach at tillering, panicle initiation and harvest stages of crop growth compare to control, The highest number of tillers was recorded in the treatment which received nutrient based on STCR approach (23.73 tillers per hill at harvest stage) which was superior among all the treatment. The lowest number of tillers per hill was recorded at harvest stage (12.27) in control. The maximum yield was recorded in the treatment receiving nutrients based STCR approach (5414 kg ha-1) which was significantly higher than other treatments.*

1. INTRODUCTION

Nitrogen plays an important role in increasing the agricultural production and being a constituent of protein, it increases food value. Nitrogen is an important component of several structural, genetic and metabolic compounds in plant cells. It is a major component of chlorophyll and amino acids. Some proteins act as structural units in plant cells while others act as enzymes, making possible many of the biochemical reactions, on which, life is based. Nitrogen is a component of energy-transfer compounds, such as ATP which allows cells to conserve and use the energy released in metabolism. Nitrogen is an important component of nucleic acids (DNA), the genetic material that allows cells (eventually whole plants) to grow and reproduce.

Existing fertilizer recommendations for rice often consist of one predetermined rate of nitrogen (N), phosphorus (P) and potassium (K) for vast areas of rice production. Such recommendations assume that the need of nutrients for rice crop is constant over time and over large areas. But the growth and needs of a rice crop for supplementing nutrients can vary greatly among fields, seasons, and years as a result of differences in crop-growing conditions, crop and soil management, and climate. Hence, the management of nutrients for rice requires a new approach, which enables adjustments in applying N, P, and K to accommodate the field-specific needs of the rice crop for supplementing nutrients. Nitrogen (N) has been and will continue to be the key input in augmenting India's food grain production, particularly rice. By the year 2020, India will need about 300 million metric tonnes food grain per year, which can be achieved only if the present consumption of 11 million metric tonnes of N per year is more than doubled to an extent of 22 to 25 million metric tonnes. In contrast to these high demands of N, Indian soils are very poor in total N. For most soils of the country, Nitrogen Use Efficiency (NUE) for rice is 30 to 40 per cent. About one-third of applied N is lost by different processes of N losses [1]. Research efforts made so far in the past revealed that NUE is predominantly affected by N fertilizer, rate, method, time of application and soil type. The value of soil tests prior to planting to evaluate fertilizer N requirement for rice is not well-understood. The soil test or leaf analysis is expensive and time consuming. In addition, tissue testing is a destructive method, which limits its use as a diagnostic tool for NUE in rice. Matching crop N demand with flexible, split applications may have economic and environmental advantages than supplying fixed rate at fixed growth stages. Blanket fertilizer recommendations over large areas are not efficient because indigenous nutrient supply varies widely among rice field. Rice crops require different amount of nutrients, depending on native nutrient supply and demand. Farmer may benefit significantly if they can adjust N inputs to actual crop condition and nutrient requirements. In this regard STCR approach of nutrient management is one of the promising tools developed in recent years for need-based N management in rice crops.

In order to increase the nitrogen availability, there are several practices like UAS (B) package and STCR approach of nutrient management were also followed in rice growing regions of Karnataka

2. MATERIAL AND METHODS

A field experiment was conducted at Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bangalore during *Kharif*2011. The treatments were as fallows control,100% RDF only (no FYM), 100% RDN through FYM, UAS (B) package (100:50:50+10ton FYM) + 20 kg Zn So_4/ha, STCR

approach (154:64:72+10ton FYM)/ha, 50%N +100% P K (basal) + balance N through Leaf Colour Chart, 50% RDN +25% N through GLM + 25% N through FYM, 100% P&K (basal) + 50% RDF + 50% Nitrogen through FYM, 50%RDF +50% Nitrogen through Green leaf manure. The FYM, green leaf manure, were applied one month prior to sowing as per the treatment combinations. The observations were taken at tillering stage, panicle initiation stage, and at the time of harvest of the crop

3. Results and Discussion

The data given in Table -1 indicated that significantly higher plant height of 48.27cm, 89.93cm and 110.68 cm was observed in the STCR approach at tillering, panicle initiation and harvest stages of cop growth, which was superior over among all the treatments, whereas lowest plant height of 25.60 cm, 47.53 cm and 60.20 cm at tillering, panicle initiation and harvest stages of rice, respectively was noticed in control. Among all the stages, highest plant height was recorded at harvest stage. This might be due to efficient utilization of the applied nutrients by the rice crop. Target yield fertilizer application ensures an optimum supply of all essential nutrients same results were reported by [5].A significant difference in the number of tillers per hill was noticedamong the treatments. The highest number of tillers was recorded in the treatment which received nutrient based on STCR approach (23.73 tillers per hill at harvest stage) which was superior among all the treatment. The lowest number of tillers per hill was recorded at harvest stage (12.27) in control. This may be due to combined use of farmyard manure, fertilizers and bio inoculants. Increased nutrient availability with conjunctive use of organic and inorganic nutrient sources was responsible for better growth the results are similar with [2].

A significant difference in the number of leaves per hill was noticed among the treatments. The highest number of leaves per hill was recorded in treatment which received nutrients based on STCR approach (114.87 leaves per hill at harvest stage). The lowest number of leaves per hill was recorded at harvest stage (55.33) in control (T_1). Higher nutrition might have helped in higher dry matter production in a given canopy and in turn might have helped other synthetic process during development sequence by[7].

The table -2 indicates Highest number of grains per panicle was recorded in the treatment that received nutrient based on STCR approach (138.03), which was on par with UAS (B) package (136.28). The lowest number of grains per panicle (92.30) was noticed in control because this was attributed to the fact that there was a buildup of organic matter which might have enhanced the productivity and efficiency of nutrients for optimum plant growth[4]. Significantly higher 1000 grain weight (24.25 g) was recorded in treatment receiving nutrients based on STCR approach, which was superior over the other treatments. The lowest 1000 grain weight was recorded in control (17.60 g) this is due to incorporation of GLM along with applied fertilizer nitrogen might have increased the availability of N throughout the growth period increasing the growth and yield attributes of rice crop. This is in agreement with the findings of [6].A significant difference in the number of panicles m^{-2} was noticed among the treatments. The highest number of panicles m^{-2} was recorded in treatment receiving nutrients based on STCR approach (335) which was superior over all the treatments.

Table 1: Effect of nitrogen management practices on plant height, number of tillers per hill and number of leaves per hillat different growth stages of rice

Treatments	Plant height(cm)			No. of Tillers hill-1			No. of Leaves hill-1		
	Tillering	Panicle initiation	Harvest	Tillering	Panicle initiation	Harvest	Tillering	Panicle initiation	Harvest
T	25.6	47.5	60.2	5.9	8.6	12.3	27.9	54.3	55.3
T2	41.9	76.7	80.3	13.7	15.8	16.5	46.6	92.9	94.6
T3	37.3	59.1	64.4	12.5	15.0	15.3	39.4	74.1	75.1
T4	47.5	86.1	104.1	20.7	23.0	23.7	56.7	108.3	110.9
T5	48.3	89.9	110.7	21.4	24.1	23.7	57.5	112.5	114.9
T6	41.3	79.5	98.8	15.1	20.7	20.5	50.3	95.5	97.9
T7	41.7	69.1	84.8	15.4	19.1	19.8	46.3	85.1	87.1
T8	41.2	66.1	84.3	16.6	19.5	20.2	48.1	82.3	84.3
T9	45.5	66.4	88.3	15.3	19.0	19.7	47.9	86.9	88.9
SEm±	0.8	2.1	3.2	0.5	0.6	0.4	1.2	1.6	1.6
CD @ 5%	2.4	6.3	9..538	1.4	1.9	1.3	3.5	4.8	4.8

Note: RDF=Recommended dose of fertilizer; FYM= Farm yard manure; RDN=Recommended dose of nitrogen;GLM= Green leaf manure; STCR=Soil test crop response; LCC=Leaf colour chart;

Table 2: Effect of nitrogen management practices on Yield attributes in rice

Treatments	No Grains panicle-1	1000 grain weight (g)	No. Panicles m-2
T1: Control	92.30	17.60	184.67
T2: 100% RDF (No FYM)	112.67	19.57	273.33
T3: 100% RDN (FYM)	106.37	18.40	233.33
T4: UAS(B) Package	136.28	23.09	328.33
T5: STCR Approach	138.03	24.25	335.00
T6: 50% N + 50% N (LCC)	132.33	23.04	300.67
T7: 50% RDN + 25 % N (GLM) + 25 % N (FYM)	127.00	22.76	298.67

T8: 50% RDF + 50 % N (FYM)	126.62	21.34	290.33
T9: 50% RDF + 50 % N (GLM)	128.84	22.83	295.00
SEm±	1.492	0.612	5.570
CD @ 5%	4.473	1.836	17.239

Note: RDF=Recommended dose of fertilizer; FYM= Farm yard manure; RDN=Recommended dose of nitrogen;GLM= Green leaf manure; STCR=Soil test crop response; LCC=Leaf colour chart;

The lowest number of panicles m^{-2} was noticed in control (184.67) due to combined use of farmyard manure, fertilizers and bio inoculants. Increased nutrient availability with conjunctive use of organic and inorganic nutrient sources was responsible for better growth.

In table -3 The maximum yield was recorded in the treatment receiving nutrients based STCR approach (5414 kg ha^{-1})which was significantly higher than other treatments. Whereas lowest grain yield was recorded in control (1811 kg ha^{-1}) and lowest straw yield was (2172 kg ha^{-1}) due to the incorporation of FYM was attributed to improved physico-chemical environment of soil especially the supply of additional plant nutrients and enhanced supply of both native and applied N, P and K. Therefore targeting treatments in the presence of FYM gave more significantly higher amount of grain as well as straw

Table-4 indicates that the nitrogen content ranged from 0.79 per cent in control to 1.02 per cent in STCR approach and it was superior over other treatments. It might be due to favourable soil condition, which enhanced nutrient uptake and will results in better growth. STCR approach of nutrient applied recorded the highest N content in grain. This might be due to mineralization of organic matter which leads to the release of considerable quantity of ammonium ion, which is important constituent of available nitrogen [3].

Table 3: Effect of nitrogen management practices on grain and straw yield of rice.

Treatments	Grain yield (kg ha-1)	Straw yield (kg ha-1)
T1: Control	1811.67	2171.67
T2: 100% RDF (No FYM)	3607.33	4407.00
T3: 100% RDN (FYM)	2616.33	3240.00
T4: UAS(B) Package	5256.67	6472.00
T5: STCR Approach	5414.33	6634.67
T6: 50% N + 50% N (LCC)	5138.33	6092.33
T7: 50% RDN + 25 % N (GLM) + 25 % N (FYM)	5058.67	6311.00
T8: 50% RDF + 50 % N (FYM)	5040.33	5998.00
T9: 50% RDF + 50 % N (GLM)	5077.33	6246.00
SEm±	6.960	8.56
CD @ 5%	20.867	25.69

Note: RDF=Recommended dose of fertilizer; FYM= Farm yard manure; RDN=Recommended dose of nitrogen;GLM= Green leaf manure; STCR=Soil test crop response; LCC=Leaf colour chart;

Highest phosphorus content was recorded in STCR treatment, which was superior over 100% N and control due to when single super phosphate (SSP) was applied along with organic manures than application of SSP alone.

The potassium content also followed the same trend with highest K concentration in STCR treatment compared to control. Concentration of K was higher in straw than in grain. The application of FYM increased the supply of easily assimilated major nutrients to plants, besides mobilizing unavailable nutrients into available form.

Table- 5 shows that Treatment which received STCR approach has recorded maximum gross return over 100 per cent N and control. Due to the combined application of organic manures along with reduced dose of NPK fertilizers had improved the soil fertility. Consequently, yield of rice increased, which ultimately helped in gaining the higher gross returns compared to use of only chemical fertilizers.

Table 4: Effect of nitrogen management practices on percent nutrient concentration (%) in rice grain and straw.

Treatments	Grain			Straw		
	N(%)	P2O5(%)	K2O(%)	N(%)	P2O5(%)	K2O(%)
T	0.79	0.29	0.30	0.57	0.22	0.27
T2	0.84	0.33	0.48	0.58	0.24	0.43
T3	0.96	0.32	0.40	0.54	0.20	0.35
T4	0.94	0.41	0.55	0.62	0.29	0.45
T5	1.02	0.44	0.56	0.66	0.30	0.44
T6	0.90	0.37	0.46	0.62	0.28	0.39
T7	0.82	0.35	0.50	0.58	0.27	0.42
T8	0.92	0.39	0.49	0.65	0.26	0.38
T9	0.89	0.37	0.51	0.65	0.28	0.42
SEm±	0.028	0.021	0.030	0.025	0.015	0.019
CD @ 5%	0.083	0.064	0.091	0.075	0.046	0.056

Table 5: Economics of rice production due to nitrogen management practices on soil properties and growth and yield of rice.

Treatments	Grain yield (kg ha-1)	Straw yield (kg ha-1)	Cost of cultivation (Rs ha-1)	Gross return (Rs ha-1)	B:CRatio
T	1810.67	2171.67	17062	22994.38	1.35
T2	3607.33	4407.00	23601	45891.3	1.94
T3	2616.33	3240.00	24662	33327.8	1.35
T4	5256.67	6472.00	27401	66923.71	2.44
T5	5414.33	6634.67	29062	68899.47	2.37
T6	5138.33	6092.33	27400	65183.13	2.38
T7	5058.67	6311.00	27587	64485.71	2.34
T8	5040.33	5998.00	28062	63961.8	2.28
T9	5077.33	6246.00	27062	64635.3	2.39

Note: RDF=Recommended dose of fertilizer; FYM= Farm yard manure; RDN=Recommended dose of nitrogen;GLM= Green leaf manure; STCR=Soil test crop response; LCC=Leaf colour chart;

3. CONCLUSION

It is essential that the results of soil tests be calibrated against crop responses from applications of the plant nutrients in question as it is the ultimate measure of a fertilization program. An accurate soil test interpretation requires knowledge of the relationship between the amount of a nutrient extracted by a given soil test and the amount of plant nutrients that should be added to achieve optimum yield for each crop. Calibrations are specific for each crop.

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