

Field Validation of on STCR Based Fertilizer Recommendations in Paddy on Alfisols of Nagarkurnool District, Telangana State

Ramakrishna K., Prabhakar Reddy T. *, Rajashekhar M., Rajashekhar B.,
Adi Shankar and Afifa Jahan

Krishi Vigyan Kendra, Palem

Professor Jayashankar Telangana State Agricultural University, Telangana

*Corresponding Author E-mail: soilprabhakar@gmail.com

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ABSTRACT

On farm trails were conducted at six different locations across three villages in Nagarkurnool district of Telangana during Rabi 2017 and 2018 to evaluate the soil test crop response (STCR) based fertilizer prescription for paddy on Alfisols. The treatments include farmers fertiliser practice, recommended dose of fertilizers (RDF) and STCR based fertilizer recommendations for an yield target of 70 q ha⁻¹. The N, P and K fertilizers for yield target was calculated based on the initial soil test values of the respective locations. The results showed that, against the paddy yield target of 70 q ha⁻¹, the grain yield at six locations varied from 69.08 to 72.49 q ha⁻¹ with a mean of 71.15 q ha⁻¹. With respect to farmers practice of fertiliser recommendations, the yield at ten locations varied from 66.18 to 69.82 q ha⁻¹ with a mean yield of 67.92 q ha⁻¹. The grain yield recorded with STCR recommendations were higher in producing grain yield as compared to RDF and farmers practice of fertiliser recommendations. Adoption of STCR based fertilizer recommendations for paddy was useful to the farmers for saving of P fertilizers from current recommended dose by 25 kg P₂O₅ ha⁻¹ (42 % of RDP) and saving of cost of P fertilizers applied per hectare to the extent of Rs.1250/-. The treatment of targeted yield found most economic treatment as compare to farmer practices and general recommendation.

Keywords: STCR equation, Validation, Paddy, Follow up trails.

INTRODUCTION

Rice the staple food of more than half of the population of the world, is an important target to provide food security and livelihoods for millions. Fertilizer is one of the costliest inputs in agriculture and the use of the right amount

of fertilizer is fundamental for farm profitability and environmental protection (Kimetu et al., 2004). Soil test based fertilizer prescription eliminates over or under usage of fertilizer inputs there by increasing the fertilizer use efficiency and yield of crops.

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The fertilizer prescription equations developed by the AICRP centre of the project on STCR for different crops of different agro-ecological situations in different states. Substitution of soil test values and target yield in the prescription equations gives us that particular fertilizer nutrient recommendation which need to be converted in to fertilizer quantity to be applied. These fertilizer target yield equations will not only help in saving of fertilizers and improving the economy but also help in improvement of soil health.

The treatment with N application based STCR realized the target yield (Ramesh & Chandrashekar, 2007). Srinivasan and Angayarkanni (2008) reported that application of fertilizers based on STCR equation will result in buildup of nutrients in the soil. Soil test based application of plant nutrients helps to realize higher response ratio and benefit: cost ratio as the nutrients are applied in proportion to the magnitude of the deficiency of a particular nutrient and the correction of

the nutrients imbalance in soil helps to harness the synergistic effects of balanced fertilization (Rao & Srivastava, 2000). Hence the present investigation was undertaken where STCR approach of fertilizer application was compared with farmers practice and recommended dose of fertilizers application. In this contest, STCR based target yield approach will help to provide the required amount of nutrient to the crop and increases the crop uptake and in turn higher yield can be expected.

MATERIALS AND METHODS

On farm trails were conducted at six different locations across three villages in Nagarkurnool district of Telangana during Rabi 2017 and 2018 to evaluate the soil test crop response (STCR) based fertilizer prescription for paddy on Alfisols. The fertilizer prescription equation developed for desired yield target of paddy ($T = 70 \text{ q ha}^{-1}$) for Southern Telangana soil series are furnished here.

$$FN=3.23T-0.46SN \quad FP_2O_5=1.51T-1.80SP \quad FK_2O=1.65T-0.26SK$$

Where, FN, FP_2O_5 and FK_2O are fertilizer N, P_2O and K_2O in kg ha^{-1} respectively. T is the yield targeted in q ha^{-1} ; SN, SP and SK are soil available N, P and K in kg ha^{-1} respectively. The treatments include T1: Farmers Fertilizer Practice, T2: Recommended Dose of Fertilizers (RDF) and T3: Soil Test Crop Response (STCR) based fertilizer dose for an yield target of 70 q ha^{-1} . The test crop paddy variety Telangana Sona (RNR 15048). BCR (B: C ratio) was worked out based on the standard procedure (Gittinger, 1982). The cultivation practices were carried out periodically and the grain and straw yield was recorded at harvest.

Initial available soil nutrient status

Initial soil samples were collected in each location and analysed for alkaline $KMnO_4$ -N (Subbiah & Asija, 1956), Olsen-P (Olsen et al., 1954) and NH_4OAc -K (Hanway & Heidal, 1952). Initial soil samples were collected in each location and analyzed for available status of nutrients. The soils across 6 locations were neutral in reaction to non-saline in nature. Available N, P and K were low, high and medium to high in status ranging from 188 to 232, 31 to 46 and 279 to 348 kg ha^{-1} , respectively (Table 1).

Table 1: Initial available soil nutrient status of selected locations

S.No.	pH	EC (dSm^{-1})	Available soil nutrient status (kg ha^{-1})		
			SN	SP	SK
1.	7.56	0.314	201.6	39.63	286
2.	7.93	0.146	192.4	30.63	297
3.	7.41	0.251	225.8	39.28	320
4.	7.88	0.198	212.9	44.80	348
5.	7.92	0.324	188.2	34.49	279
6.	8.01	0.285	232.8	46.41	308
Mean	7.79	0.254	209	38	306

The available status of nutrients was used to compute fertiliser doses for paddy through adjustment equations using basic data that had earlier been generated from fertility gradient field experiments for paddy. The detailed procedure has been described by Valayutham et al (1985). The range of N, P₂O₅ and K₂O application rates under different treatments across 6 locations indicated that, N, P₂O₅ and K₂O recommendations by farmers practice were lower than STCR recommendations.

Across all sites, farmers practice of N, P₂O₅ and K₂O recommendations ranged from 123.8 to 148.5, 97.5 to 137.5 and 75 to 95 with a mean of 137, 109 and 79, respectively where as STCR practice of N, P₂O₅ and K₂O recommendations ranged from 119 to 140, 22 to 51 and 25 to 43 kg ha⁻¹ with a mean of 130, 35 and 36 kg ha⁻¹, respectively (Table 2 & Fig.1). Recommended dose of fertilizer application for paddy in Telangana region is 100-50-40 kg N- P₂O₅-K₂O ha⁻¹.

Table 2: Fertilizer recommendations for rice in different treatments

S.No	T1: Farmers Fertiliser Practice (kg ha ⁻¹)			T3: Targeted yield with chemical fertilizers (kg ha ⁻¹)		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
1	138.8	137.5	77.5	133	34	41
2	131.3	115	75.0	138	51	38
3	148.5	97.5	95.0	122	35	32
4	123.8	97.5	57.5	128	25	25
5	148.5	97.5	95.0	140	44	43
6	130	107.5	75.0	119	22	35
Mean	137	109	79	130	35	36

Recommended Dose: 100-50-40 kg N- P₂O₅ - K₂O ha⁻¹

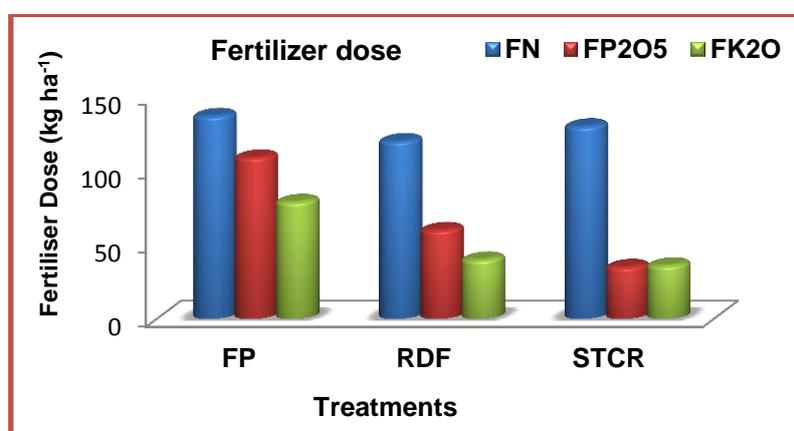


Fig.1: Fertilizer recommendations for rice in different treatments

RESULTS AND DISCUSSION

The fertilizer application as per the STCR equation with yield target 70 q ha⁻¹ to paddy crop for validation were achieved the desired targeted yield (Table 2). The yield level that could be achievable with 100 % recommended dose (120-60-40 kg N-P₂O₅-K₂O ha⁻¹) to paddy crop can be obtained with a lower dose of 130-35-36 kg N-P₂O₅-K₂O ha⁻¹ to the same crop and thus saving 25 kg cost of P input without sacrificing the yield of rice crop. The grain yield under STCR recommendations at

six locations varied from 69.08 to 72.49 kg ha⁻¹ with a mean of 71.15 q ha⁻¹. The variation in yield obtained from the targeted ones ranged from -1.31 to +1.64. The fertiliser application as per the STCR equation with yield target 70 q ha⁻¹ to paddy crop for validation were achieved the targeted yield. With respect to farmers practice of fertilizer recommendations, the yield at ten locations varied from 66.18 to 69.82 q ha⁻¹ with a mean yield of 67.92 q ha⁻¹. The grain yield recorded with STCR recommendations were higher in producing

grain yield as compared farmers practice of fertilizer recommendations (Table 3).

Singh et al. (2014) reported that targeted yield of rice was achieved by using the plant nutrients on the basis of targeted yield concept (soil test crop response technology). The present results were in accordance with the study conducted by Singh et al. (2017) and revealed that among the treatments, STCR recorded relatively higher yield, benefit: cost ratio and per cent achievement. Suresh and Santhi (2018) validated STCR equation for hybrid maize and reported that, STCR based fertilizer recommendations with the targeted yield has been achieved within +/- 10 per cent variation proving the validity of the equations. The results of the validation experiment on paddy

clearly indicated that the per cent achievement was below 10 per cent variation at all the locations for validation was achieved the targeted yield of paddy crop.

The benefit cost ratio of the treatments was estimated using the cost of input and value of output. Economics of fertilizer application based on targeted concept gave benefit cost ratio varying from 2.27 to 2.36 with a mean value of 2.31. The corresponding value for farmers fertilizer practice ranged from 1.96 to 2.02 with a mean value of 2.00 (Table 3). The results are confirming that, the treatment of targeted yield found most economic treatment as compare to farmer practices and general recommendation. Similar results were reported by Singh et al. (2015).

Table 3: Grain yield and benefit cost ratio of rice under different treatments

S.No	Grain Yield (q ha ⁻¹)			Benefit- Cost Ratio		
	T1	T2	T3	T1	T2	T3
1	69.82	68.50	71.83	2.00	2.17	2.33
2	68.94	69.25	72.08	2.02	2.19	2.30
3	66.72	70.75	72.49	1.96	2.24	2.36
4	66.18	68.24	69.08	2.00	2.16	2.28
5	68.02	68.56	71.16	2.00	2.17	2.27
6	67.82	71.75	70.24	2.01	2.27	2.32
Mean	67.92	69.51	71.15	2.01	2.20	2.31

T1: Farmers Fertilizer Practice; T2: RDF; T3: STCR based fertilizer dose

The gross and net returns in T1 were Rs. 1,07,988/- and Rs.53,952/-, respectively (Table 4) where as in T3 the higher gross and net returns were obtained (Rs.1,13,123/- and

Rs.64,160, respectively). Chaubey et al. (2015) reported that the net returns from the improved practice (STCR technology) were substantially higher than the farmers' practice (GRD).

Table 4: Economics of rice under different treatments

S.No	Cost of Cultivation			Gross Returns			Net Returns		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	55,449	50,205	49,104	111014	108915	114210	55565	58710	65106
2	54,152	50,205	49,928	109615	110108	114607	55463	59902	64679
3	54,100	50,205	48,741	106085	112493	115259	51985	62287	66518
4	52,654	50,205	48,109	105226	108502	109837	52572	58296	61728
5	54,100	50,205	49,754	108152	109010	113144	54052	58805	63390
6	53,760	50,205	48,142	107834	114083	111682	54074	63877	63539
Mean	54,036	50,205	48,963	1,07,988	1,10,518	1,13,123	53,952	60,313	64,160



Soil sampling



Soil health card distribution



Demonstration



Evaluation

CONCLUSION

Adoption of STCR based fertilizer recommendations for rice was useful to the farmers for saving of P fertilizers from current recommended dose by 25 kg P₂O₅ ha⁻¹ (42 % of RDP) and saving of cost of P fertilizers applied per hectare to the extent of Rs.1250/-. The cultivable area of rice in Telangana state is 2.0 lakh hectares. Out of this, an average 30 percent of the rice growing area (60,000 hectares) found to have P accumulation. Hence, adoption of this technology can be useful to save Rs.4.5 crores on P fertilizer application.

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