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DIFFERENT INTEGRATED TARGETED YIELD NUTRIENT PRESCRIPTION MANAGEMENT OF RICE-BLACKGRAM SEQUENCE

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ABSTRACT
A field experiment was conducted at the Agricultural College farm, Bapatla, during *kharif and rabi* 2017-18 and 2018-19. The experiment was conducted with variety BPT-5204 in a Randomized Block Design with ten treatments and three replications. The Seed yield, Grain yield of rice- blackgram crops, system productivity of rice-blackgram sequence and economics of rice-blackgram were recorded with soil test based fertilizer recommendation with 10 t ha^{-1} FYM application which was at par with soil test based fertilizer recommendation alone and 7.5 tha^{-1} targeted yield recommendation along with FYM (T_5 and T_{10}) and RDF with FYM (T_6). Seed yield of blackgram was significantly higher with soil test based fertilizer recommendation with 10 t ha^{-1} FYM application which was statistically at par with soil test based fertilizer recommendation alone (T_2) and 7.5 t ha^{-1} targeted yield fertilizer recommendation with FYM (T_{10}) compared to the rest of the treatments.

INTRODUCTION

Rice is a staple food crop not only in India but also in entire South Asia. Of the total rice (*Oryza sativa* L.) production in the world, more than 90% is in Asia. Rice is cultivated in 111 countries of all continents, except Antarctica. India and China are the leading producers as well as consumers of rice. In India, it is grown in an area of 43.9 m ha with a production of 99.24 m t and productivity of 2494 kg ha^{-1}. In Andhra Pradesh, it is grown in an area of 2.152 m ha with a production of 8.05 m t and productivity of 3741 kg ha^{-1}. (Anon., 2018). Blackgram (*Vigna mungo L. Hepper*) is one of the most important pulse crops among the various grain legumes. It is a rich protein food, contains about 26% protein, 1.2% fat and 56.6% carbohydrates on dry weight basis. It fits well in rice based cropping sequence in coastal Andhra Pradesh. India with largest area under pulses in the world (190.4 lakh ha.) produce about 124.0 lakh tonnes with an average yield of 651.2 kg ha^{-1} (Amruta *et al.*, 2015). Among the pluses, blackgram (Urdbean) contributes 16.28% of the total area and 11.48% of the total production with an average productivity of 451.6 kg ha^{-1}. Nutrient management is an important aspect in increasing the productivity of pulses. It is closely related to availability of nutrients to plants.

For enhancing rice productivity from the existing rice growing areas, which have been under rice cultivation over decades, soil fertility monitoring and management need to be strengthened. During the last two decades, due to crop intensification and increased availability of chemical fertilizers at subsidized prices and decreased availability of organic sources of nutrients resulted in substantially declined use of organic manures such as farm yard manure. In recent years, however, with the increasing pressure to produce high yields of crops and concern for sustainable soil productivity, the researchers, interest has been renewed towards usage of organic manures in addition to major nutrients. The organic manures improve the physico-chemical properties of soil and also act as chelating compounds on decomposition and help in increasing the availability and retention of nutrients (Singh *et al.*, 2009). Organic manures also enhance fertilizer use efficiency when applied in conjunction with inorganic fertilizers (Baskar, 2003 and Arun Kumar *et al.*, 2014). Hence, the paper deals with maintaining higher residual fertility through the credible use of chemical fertilizers and organic manures in previous rice crop are very important in enhancing the productivity of rice – blackgram sequence.

MATERIALS AND METHODS

A field experiment was conducted at the Agricultural College farm, Bapatla, during *kharif and rabi* 2017-18 and 2018-19. The experiment was conducted with variety BPT-5204 in a Randomized Block Design with ten treatments and three replications. The treatments comprised of, Recommended Dose of Fertilizer (T_1), Soil test based fertilizer recommendation(T_2); Targeted yield fertilizer recommendations for 5.5 tons ha^{-1} (T_3) , 6.5 t ha^{-1} (T_4) and 7.5 t ha^{-1} (T_5) ; Treatment T_1 + FYM @ 10 t ha^{-1} (T_6); Treatment T_2

+ FYM @ 10 t ha^{-1} (T_7); Treatment T_3 + FYM @ 10 t ha^{-1} (T_8); Treatment T_4 + FYM @ 10 t ha^{-1} (T_9); and Treatment T_5 + FYM @ 10 t ha^{-1} (T_{10}). The experimental soil was clay loam in texture, slightly alkaline in reaction, non saline, low in available nitrogen, low in organic carbon, high available phosphorus and potassium. The application of nutrients was done following the soil test based fertilizer recommendations as per the treatment. Target yield fertilizer recommendations were based on using the target yield equations developed for Krishna Godavari agro ecological region.

By using formulae Targeted yield (qha^{-1}) equation for *kharif*- Rice (Anon., 2007)

*FN = 2.30 × T 0.32 × SN	SN = Soil Nitrogen
*FP_2O_5 = 1.91 × T - 1.90 x SP	SP = Soil Phosphorous
*FK = 2.27 × T - 0.27 × SK	SK = Soil Potassium

Fertilizer schedule during *kharif* rice- during 2017and 2018 (As Per Initial soil analysis data)

Treatments	2017-18N-P-K (kg ha^{-1})	2018-19N-P-K (kg ha^{-1})
T_1	120-60-40	120-60-40
T_2	156-42-28	156-42-28
T_3	80-30-30	70-30-28
T_4	102-30-52	98-30-50
T_5	125-30-75	123-30-73
T_6	T_1 + FYM@10 t ha^{-1}	T_1 + FYM@10 t ha^{-1}
T_7	T_2 + FYM@10 t ha^{-1}	T_2 + FYM@10 t ha^{-1}
T_8	T_3 + FYM@10 t ha^{-1}	T_3 + FYM@10 t ha^{-1}
T_9	T_4 + FYM@10 t ha^{-1}	T_4 + FYM@10 t ha^{-1}
T_{10}	T_5 + FYM@10 t ha^{-1}	T_5 + FYM@10 t ha^{-1}

RESULTS AND DISCUSSION

System productivity of rice-blackgram sequence under the influence of nitrogen, phosphorus and potassium through STFR could be assessed by summing up the performance of individual crops in each year so as to compare all factors (Table 1).

Maximum rice equivalent yield of blackgram as well as system productivity of rice-blackgram sequence *i.e.*, total yield in terms of rice equivalent was observed with soil test based fertilizer recommendation with FYM @10 t ha^{-1} (T_7) which was closely followed by soil test based fertilizer recommendation alone (T_2). Effect of various types of fertilizer recommendation of NPK given to preceding rice showed an increasing trend towards yield. Treatment with 7.5 t with FYM @ 10 t ha^{-1} targeted yield fertilizer application (T_{10}) recorded higher system productivity followed by RDF (T_5) in rice-blackgram sequence.

This indicated that residual effect of nitrogen, phosphorus and potassium through STFR with FYM @ 10 t ha^{-1} can reduce the fertility requirement of rice- blackgram sequence. Similar results were also reported by Biswas *et al.* (2006), Ramesh Babu (2012) and Samant (2015).

Physical and physico-chemical properties of the experimental soil

S. No.	Properties	2017-18	2018-19	Method of analysis
I	**Physical properties**			
	Sand (%)	42.0	40.0	Bouyoucos hydrometer method (Piper, 1960)
	Silt (%)	20.0	21.0	
	Clay (%)	38.0	39.0	
	Textural class	Clay loam	Clay loam	
II	**Physico-chemical properties**			
	pH (1:2.5)	7.60	7.40	Glass electrode method (Jackson, 1973)
	EC (dS m^{-1} at 25^{0}C)	0.26	0.30	Digital conductivity meter (Jackson, 1973)
III	**Chemical properties**			
	Organic carbon (%)	0.41	0.43	Modified walky and black method (Walky and Black, 1934)
	Available N (kg ha^{-1})	146.0	163.0	Alkaline permanganate method(Subbiah and Asija, 1956)
	Available P_2O_5 (kg ha^{-1})	76.0	78.0	Olsen's method(Olsen *et al.*, 1954)
	Available K_2O (kg ha^{-1})	352.0	358.0	Neutral normal ammonium acetate method (Muhr *et al.*, 1965)

Table 1: System productivity (kg ha^{-1}) of rice-blackgram sequence as influenced by site specific nutrient management during 2017-18 and 2018-19

Treatments	2017-18				2018-19			
	Rice grain yield	Blackgram yield	Rice eq. yield	Total REY	Rice grain yield	Blackgram yield	Rice eq. yield	Total REY
T_1- Recommended dose of fertilizer 120-60-40 kg ha^{-1}	4450	755	7079	11529	5236	765	7684	12921
T_2- Soil test based fertilizer recommendation	5099	857	8085	13184	5805	884	8634	14439
T_3- Targeted yield fertilizer recommendation for 5.5t ha^{-1}	4234	642	6470	10704	4800	681	6980	11780
T_4- Targeted yield fertilizer recommendation for 6.5t ha^{-1}	4370	734	6928	11298	5163	746	7551	12715
T_5- Targeted yield fertilizer recommendation for 7.5t ha^{-1}	4831	794	7599	12429	5540	882	8363	13904
T_6- T_1 + FYM @ 10 t ha^{-1}	4667	760	7316	11983	5346	784	7856	13203
T_7- T_2 + FYM @ 10 t ha^{-1}	5117	876	8168	13285	6023	905	8921	14945
T_8- T_3 + FYM @ 10 t ha^{-1}	4358	697	6788	11146	4870	719	7172	12042
T_9- T_4 + FYM @ 10 t ha^{-1}	4396	746	6996	11391	5226	755	7642	12868
T_{10}-T_5 + FYM @ 10t ha^{-1}	4876	831	7770	12646	5614	855	8350	13964
SEm ±	141.2	40.89	230.84	355.13	157.1	44.87	229.9	366.7
CD (P = 0.05)	419.2	121.48	685.8	1055.1	466.9	133.31	683.1	1089.7
CV (%)	5.2	9.2	5.4	5.1	5.0	9.7	5.0	4.7

Rice MSP (2017-18) - Rs. 15.5 kg^{-1} , Rice MSP (2018-19) - Rs. 17.5 kg^{-1} , Blackgram MSP (2017-18) - Rs. 54.0 kg^{-1}, Blackgram MSP (2018-19) - Rs. 56.0 kg^{-1}

Table 2: Economics of rice-blackgram sequence as influenced by site specific nutrient management during 2017-18 and 2018-19

Treatments	2017-18			2018-19		
	GR(Rs.)	NR(Rs.)	Return per Rs. invested	GR(Rs.)	NR(Rs.)	Return per Rs. invested
T_1- Recommended dose of fertilizer (RDF) 120-60-40 kg ha^{-1}	178704	116000	1.85	226116	161361	2.49
T_2- Soil test based fertilizer recommendation (STFR)	204350	141976	2.28	252690	188266	2.92
T_3- Targeted yield fertilizer recommendation for 5.5 t ha^{-1} (TYFR)	165910	103872	1.67	206145	142157	2.22
T_4- Targeted yield fertilizer recommendation for 6.5 t ha^{-1} (TYFR)	175113	112527	1.80	222509	157873	2.44
T_5- Targeted yield fertilizer recommendation for 7.5 t ha^{-1} (TYFR)	192657	129497	2.05	243316	178106	2.73
T_6- T_1 + FYM @ 10 t ha^{-1}	185738	115033	1.63	231050	156496	2.10
T_7- T_2 + FYM @ 10 t ha^{-1}	205917	135543	1.93	261537	187313	2.52
T_8- T_3 + FYM @ 10 t ha^{-1}	172758	102720	1.47	210741	136853	1.85
T_9- T_4 + FYM @ 10 t ha^{-1}	176567	105981	1.50	225195	150759	2.03
T_{10}-T_5 + FYM @ 10t ha^{-1}	196017	124857	1.75	244369	169359	2.26
SEm $\pm$	5504.4	5504.4	0.09	6418.4	6418.4	0.09
CD (P = 0.05)	16354.5	16354.5	0.25	19070.2	19070.2	0.28
CV (%)	5.14	8.03	8.21	4.78	6.83	6.91

Gross returns, net returns and return per rupee invested for entire crop sequence taking into consideration all the inputs used in *kharif* and *rabi* seasons during both the years of study are presented in Table 2.

Though the maximum gross returns were realized with STFR with FYM (T_7) the net returns and return per rupee invested were higher with the application of STFR alone (T_2) during both the years of study and it was found at par with the aplication of 7.5 t targeted yield fertilizers recommendation @ 7.5 t ha^{-1} (T_5). Finally from all factors of production in rice-blackgram sequence, soil test based fertilizer recommendation alone (T_2) showed the better response than other treatment combinations in relevance to return per rupee invested. This was mainly due to higher yields relatively less cost of cultivation and market price of both rice and blackgram with low input requirement particularly in blackgram. These results are in accordance with that of Sudha Jacob *et al.* (2016) and Uma Reddy and Sathish (2017).

CONCLUSIONS

Thus based on the Soil test based fertilizer recommendation with FYM followed by soil test based fertilizer recommendation alone and 7.5 t ha^{-1} target yield recommendation with and without FYM, imposed in rice had significant positive residual effect on increasing yield of succeeding blackgram . Though the maximum system productivity and gross returns were realized with STFR application with FYM (T_7), the net returns and return per rupee invested were higher with the application of STFR alone (T_2) in rice-blackgram system as a whole experimentation study.

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