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Residual effect of fertilizer recommendations and organic manures imposed in *kharif* rice on succeeding *rabi* blackgram

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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 maximum plant height and drymatter production and seed yield 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 7.5tha^{-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.

Keywords: Blackgram, targeted yield fertilizer recommendation, yield and growth parameters, STFR

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) [3]. 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}. 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. Integrated nutrient management, which entails the maintenance / adjustment of soil fertility to an optimum level for crop productivity to obtain the maximum benefit from all possible sources of plant nutrients. To get more and more yield, farmers inclined to the excess use of chemical fertilizer, but the decision on fertilizer use requires knowledge of the expected crop yield response to nutrient application, which is a function of crop nutrient needs, supply of nutrients from indigenous sources, and the short and long term fate of fertilizer applied. Application of fertilizers by the farmers in the fields without information on soil fertility status and nutrient requirement by the crop causes adverse effects in soil and crop regarding both nutrient toxicity and deficiency either by over use or inadequate use.

Rice–blackgram (cereal–legume) sequence is an age old and the best cropping sequence followed in the Krishna Agro-climatic Zone of Andhra Pradesh, India. The potential for increasing the productivity of both of these crops *i.e.*, rice and blackgram in sequence with sustainable nutrient management practices. Farmers in this region grow blackgram crop only on residual soil fertility.

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Hence, maintaining higher residual fertility through the credible use of chemical fertilizers and organic manures in previous rice crop is 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) [2].

*FN= 2.30 x T 0.32 x SN	SN= Soil Nitrogen
*FP$_2$O$_5$=1.91 x T - 1.90 x SP	SP= Soil Phosphorous
*FK=2.27 x T - 0.27 x SK	SK= Soil Potassium

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

Treatments	2017-18 N-P-K (kg ha^{-1})	2018-19 N-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

Plant height of blackgram at different growth stages *viz.,* at 30, 60 days after sowing and at maturity (Table 1) was affected significantly by residual effect of fertilizer recommendations imposed in rice.

Soil test fertilizer recommendation along with 10 FYM (T_7) followed by T_2, T_{10}, T_5 treatments significantly influenced the plant height of blackgram compared to other treatments. Similarly 5.5 t targeted yield fertilizer recommendation to rice observed with significantly lower height plant height over other treatments and it was found to be on par with the treatments T_8, T_4 and T_9. Application of organics like FYM in combination of other treatments to rice increased plant height significantly compared with the treatments without FYM.

Almost similar trend was observed during 2019 also where, application of FYM along with STFR application and 7.5 t targeted yield fertilizer recommendation to rice produced significantly taller plants along with the treatments T_2 and T_5 over other treatments given to rice. A significant decrease in plant height of blackgram with 5.5 t targeted yield fertilizer recommendation followed by T_8 and T_4 compared with other treatments at all the growth stages of blackgram during the year 2019.

Per cent plant height increase with soil test recommendation with FYM (T_7) and without FYM (T_2) was 38.0%, 27.5%, 23.3%, 31.2% and 17.42%,, 35.3%, 24.4%, 20.0% higher compared to the treatments T_3, T_4, T_9, and T_8 respectively (pooled data).

In a cropping sequence the effect of nutrients applied to the preceding crops is beneficially influencing the productivity of succeeding crop. The carryover effect of organic sources is more than inorganic sources. The residual effect of inorganic sources is more pronounced in T_2 among treatments without FYM and T_5 among the treatments with FYM. Similar views are reflected from the observations of Senthilvalavan and Ravichandran (2016) [9] and Saha and Moharana (2008) [8].

Drymatter accumulation is one of the important factors influencing the partitioning of assimilates among different plant parts. Drymatter accumulation of blackgram at different growth stages *viz.,* at 30, 60 days after sowing and at maturity presented in (Table 2).

Drymatter production of blackgram was significantly the highest with application of 10 t FYM along with STFR application (T_7) to preceding rice compared to rest of the treatments at 30, 60, 90 DAS and pooled data. However, it was found on par with STFR application alone (T_2) and targeted yield (7.5 t ha^{-1}) fertilizer recommendation (T_{10}). The lowest drymatter production observed with targeted yield (5.5 t ha^{-1}) fertilizer recommendation (T_3) over all other treatments and it was on par with treatments T_8 and T_4 at 30 DAS and T_9 and T_1 as well at 60 and 90 DAS during year 2018 and 2019.

Similar trend as that of 2018 was also observed in 2019 also where, treatments T_7 followed by T_2, T_{10} and T_5 were observed with higher drymatter production over that of the remaining treatments. Similarly, the treatments T_3 followed by T_8 and T_4 produced lower drymatter at 30 DAS. However, the differences among the treatments T_3, T_8, T_4, T_9 and T_1 were not significant at 60, 90 DAS and in pooled data and in the year 2019.

Drymatter production increase with soil test recommendation with FYM (T_7) and without FYM (T_2) was 15.0%, 12.9%, 11.9% and 13.5% & 13%, 10.8%, 9.8% and 11.4% higher compared to the treatments T_3, T_4, T_9, and T_8 respectively (pooled data).

The superiority of residual effect of organic manures treatments was attributed to its slow decomposition, that might have released the nutrients slowly as compared to that of without FYM. Increased dry matter accumulation with increased fertilizer doses and with organic manures was reported by many researchers (Alagappan and Venkitaswamy, 2016; Senthilvalavan and Ravichandran, 2016; Anu Lavanya and Ganapathy, 2010) [1, 9, 4].

Data pertaining to seed yield presented in (table 3) indicated that the highest seed yield of blackgram was recorded with STFR application with 10 t FYM (T_7) to rice and was significantly superior to other treatments. Whereas, the differences in yield obtained among the treatments T_7, T_2, T_{10}, T_5 and T_6 were not significant during 2018 and 2019.

The lowest seed yield of blackgram observed with targeted yield (5.5 tha^{-1}) fertilizer recommendation (T_3) was significantly inferior compared to the treatments T_7, T_2, T_{10} and T_5 during both the years of study and pooled data.

Seed yield increase with soil test recommendation with FYM (T_7) and without FYM (T_2) was 25.8%, 16.9%, 15.8% and

20.5% & 14.4%, 4.1%, 2.8% and 8.3%, higher compared to the treatments T_3, T_4, T_9, and T_8 respectively.

Seed yields of blackgram after rice increased significantly with the increasing level of nutrient (156-42-28 kg ha⁻¹ NPK) application in T_7 along with FYM compared with other treatments in the rice- blackgram sequence. Similarly, addition of FYM to rice crop showed significant residual effect on the seed yield of blackgram. These results are in confirmity with the observations of Aruna and Shaik Mohammad (2005) [5], Bhoite (2005) [6] and Ombir Singh *et al*. (2012) [7].

Residual effect of STFR based integrated plant nutrient management along with FYM and biofertilizers imposed by preceding rice crop on blackgram seed yield was reported by Senthilvalavan and Ravichandran (2016) [9] and Saha and Moharana (2008) [8].

Table 1: Plant height (cm) at different stages on residual effect of *rabi* blackgram as influenced by site - specific nutrient management in rice-blackgram sequence during *rabi* 2017-18, 2018-19 and pooled data

Treatments	2017-18			2018-19			Pooled data		
	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity
T_1- Recommended dose of fertilizer (RDF) 120-60-40 kg ha⁻¹	23.49	50.00	54.15	25.18	54.00	65.14	24.33	52.00	59.64
T_2- Soil test based fertilizer recommendation (STFR)	28.10	55.58	68.16	31.72	60.00	72.93	29.91	57.79	70.55
T_3- Targeted yield fertilizer recommendation for 5.5 t ha⁻¹ (TYFR)	18.48	41.67	42.34	21.30	42.33	48.96	19.89	42.00	45.65
T_4- Targeted yield fertilizer recommendation for 6.5 t ha⁻¹ (TYFR)	21.95	48.30	48.62	23.45	51.67	58.16	22.70	49.98	53.39
T_5- Targeted yield fertilizer recommendation for 7.5 t ha⁻¹ (TYFR)	25.54	54.67	61.51	29.14	57.91	72.09	27.34	56.29	66.80
T_6- T_1+FYM @ 10 t ha⁻¹	24.29	53.54	57.40	25.67	56.64	67.38	24.98	55.09	62.39
T_7- T_2+FYM @ 10 t ha⁻¹	30.19	57.91	69.70	32.14	63.27	77.43	31.17	60.59	73.56
T_8- T_3+FYM @ 10 t ha⁻¹	20.44	43.67	47.37	22.46	45.67	53.83	21.45	44.67	50.60
T_9- T_4+FYM @ 10 t ha⁻¹	22.61	49.33	52.88	24.41	52.67	60.05	23.51	51.00	56.46
T_{10}- T_5+FYM @ 10 t ha⁻¹	26.90	55.31	65.29	29.06	58.00	76.81	27.98	56.65	71.05
SEm±	1.58	3.08	4.14	1.95	2.30	5.07	1.37	2.46	3.57
CD (p = 0.05)	4.70	9.16	12.31	5.80	6.83	15.06	4.07	7.30	10.61
CV (%)	11.33	10.47	12.65	12.79	7.34	13.45	9.36	8.09	10.14

Table 2: Drymatter production (kg ha⁻¹) at different stages on residual effect of *rabi* blackgram as influenced by site - specific nutrient management in rice-blackgram sequence during *rabi* 2017-18, 2018-19 and pooled data

Treatments	2017-18			2018-19			Pooled data		
	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity
T_1-Recommended dose of fertilizer (RDF) 120-60-40 kg ha⁻¹	573	1223	2188	583	1274	2240	578	1249	2214
T_2- Soil test based fertilizer recommendation (STFR)	648	1348	2426	662	1425	2437	655	1386	2431
T_3- Targeted yield fertilizer recommendation for 5.5 t ha⁻¹ (TYFR)	403	1104	2096	427	1223	2132	415	1164	2114
T_4- Targeted yield fertilizer recommendation for 6.5 t ha⁻¹ (TYFR)	491	1199	2113	495	1244	2223	493	1222	2168
T_5- Targeted yield fertilizer recommendation for 7.5 t ha⁻¹ (TYFR)	594	1287	2269	609	1364	2375	602	1326	2322
T_6- T_1+FYM @ 10 t ha⁻¹	586	1245	2215	596	1359	2246	591	1302	2231
T_7- T_2+FYM @ 10 t ha⁻¹	658	1360	2483	676	1442	2493	667	1401	2488
T_8- T_3+FYM @ 10 t ha⁻¹	467	1170	2109	479	1235	2198	473	1203	2153
T_9- T_4+FYM @ 10 t ha⁻¹	520	1210	2157	560	1266	2227	540	1238	2192
T_{10}- T_5+FYM @ 10 t ha⁻¹	614	1303	2372	643	1377	2408	629	1340	2390
SEm±	18.61	36.58	70.07	17.50	40.01	67.63	12.93	32.40	46.49
CD (p = 0.05)	55.30	108.68	208.18	51.98	118.89	200.93	38.42	96.27	138.13
CV (%)	5.80	5.0	5.41	5.29	5.20	5.10	3.97	4.37	3.55

Table 3: Seed yield (kg ha⁻¹) of *rabi* blackgram as influenced by site - specific nutrient management in rice-blackgram sequence during *rabi* 2017-18, 2018-19 and pooled data

Treatments	2017-18	2018-19	Pooled data
T_1-Recommended dose of fertilizer (RDF) 120-60-40 kg ha⁻¹)	755	765	760
T_2- Soil test based fertilizer recommendation (STFR)	857	884	871
T_3-Targeted yield fertilizer recommendation for 5.5 t ha⁻¹ (TYFR)	642	681	661
T_4- Targeted yield fertilizer recommendation for 6.5 t ha⁻¹ (TYFR)	734	746	740
T_5- Targeted yield fertilizer recommendation for 7.5 t ha⁻¹ (TYFR)	794	882	838
T_6-T_1+FYM @ 10 t ha⁻¹	760	784	772
T_7- T_2+FYM @ 10 t ha⁻¹	876	905	891
T_8-T_3+FYM @ 10 t ha⁻¹	697	719	708
T_9- T_4+FYM @ 10 t ha⁻¹	746	755	750
T_{10}-T_5+FYM @ 10t ha⁻¹	831	855	843
SEm±	40.89	44.87	31.64
CD (p = 0.05)	121.48	133.31	94.02
CV (%)	9.2	9.7	7.0

Conclusions

Thus based on the plant height and drymatter production and seed yield it can be recommended to go for up to soil test based fertilizer recommendation with 10 t ha⁻¹ FYM application (156-42-28 kg NPK ha⁻¹), applied. Among the treatments 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 t ha⁻¹ targeted yield recommendation along with FYM (T_5 and T_{10}) and RDF with FYM (T_6). Whereas targeted yield recommendation 5.5 and 6.5 t ha⁻¹ (T_3 and T_4) found with significantly lower plant height and drymatter production and seed yield compared to the rest of treatments during both the years of study.

References

1. Alagappan S, Venkitaswamy R. Performance of different sources of organic manures in comparison with RDF and INM on nutrient uptake, nutrient balance and soil properties in Rice-green gram cropping sequence. International Journal of Agricultural Sciences. 2016; 12(2):326-334.

2. Anonymous. Soil test based fertilizer application. All India Coordinated Research Project for Investigations on Soil Test Crop Response Correlation (AICRP) Hyderabad Centre, Indian council of Agricultural Research, New Delhi, ANGRAU, Hyderabad and Department of Agriculture, A.P. 2007, 60.

3. Anonymous. Report on area, production and productivity of rice. Ministry of Agriculture, Govt of India, 2018.

4. Anu Lavanya G, Ganapathy M. Yield maximization of blackgram in rice fallow blackgram through organic sources of nutrient management practices in cauvery deltaic areas. Legume Research. 2010; 33(4):291-294.

5. Aruna E, Shaik Mahammad. Influence of conjunctive use of organic and inorganic source of nutrients in rice (*Oryza sativa*) on crop growth, yield components, yield and soil fertility in rice-sunflower (*Helianthus annus*) sequence. Indian Journal of Agronomy. 2005; 50(4):265-268.

6. Bhoite SV. Integrated nutrient management in basmati rice (*Oryza sativa*) - wheat (*Triticum aestivum*) cropping system. Indian Journal of Agronomy. 2005; 50(2):98-101.

7. Ombir Singh, Sandeep Kumar, Awanish. Productivity and profitability of rice (*Oryza sativa*) as influenced by high fertility levels and their residual effect on wheat (*Triticum aestivum*). Indian Journal of Agronomy. 2012; 57(2):143-147

8. Saha S, Moharana M. Effect of different nutrient management practices in rice (*Oryza sativa* L.) – blackgram sequence (*Vigna mungo* L.) utera cropping sequence. *Oryza*. 2008; 45(1):79-81.

9. Senthivalavan P, Ravichandran M. Residual effect of nutrient management practices on the yield, NPK uptake and profitability of rice fallow balckgram. Asian Journal of Science and Technology. 2016; 7(1):2305-2310.