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Effect of Integrated Nutrient Management Practices of *Kharif* Rice on Seed Yield, Haulm Yield and Uptake of Nutrients of *Rabi* Black gram

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ABSTRACT

A field experiment was conducted during 2014-15 with rice in Kharif, black gram in Rabi season, atfarmer's field, Devaryamjal village, near Hakimpet, Rangareddy district, Telangana. The experiment was laid out in randomized block design (RBD) with 11 treatments, each replicated 3 times. The treatments consisted of control (T_1), 100% RDFN (T_2), 75% RDFN + 25% N through VC, PM and FYM (T_3, T_6, T_9), 50% RDFN + 50% N through VC, PM and FYM (T_4, T_7, T_{10}), 100% RDN through VC, PM and FYM (T_5, T_8, T_{11}). Rice (BPT 5204) was test crop grown during *Kharif* season with RDF applied as N : P_2O_5: K_2O @ 120 : 60 : 40 kg ha^{-1}. A uniform dose of 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O was applied as basal to all the plots. In the *Rabi* season blackgram (LBG-20) was taken up in same plots. Each treatmental plot of *Kharif* crop was divided into two equal halves. In one half recommended dose of fertilizers to blackgram @ 30 : 60 : 40 kg ha^{-1} (N : P_2O_5 : K_2O) were applied to study the cumulative effects. In the other half no fertilizers were applied to study the residual effects. The results revealed that seed and haulm yields, uptake of N, P and Kof all the treatments were higher under cumulative effects than their respective residual effects. Among cumulative effects higher seed yield, haulm yield and uptake of N, P and K were recorded with the treatment T_5 i.e., 100% recommended dose of nitrogen (RDN) through VC during rice crop coupled with application of recommended dose of fertilizer during *Rabi* to black gram crop.Similar trends were observed in residual effects.

Keywords: Black gram, INM, Yield, Uptake of N, P and K

INTRODUCTION

Black gram (*Vigna mungo L.*) is one of the important pulse crop grown through out the country. This being a leguminous crop is admired for it's capacity to fix the atmospheric nitrogen. Black gram consists of proteins (25 to 26%), carbohydrates (60%), Fat (1.5%), minerals, amino acids and vitamins.Total black gram production in India is 2.89 million tonnes from an area of 3.56 million hectares (Ministry of Agriculture and Farmers' welfare annual report, 2016-17).The reasons for low yield of black gram in our country are cultivation under low fertile soils, under moisture stress conditions, non-availability of quality seed.Although, chemical fertilizers play a crucial role to meet the nutrient requirement of the crop, persistent nutrient depletion pose a great threat to the sustainable agriculture. Therefore it is necessary to reduce the use of chemical fertilizers and in turn increase the use of organic manures to maintain the soil health. Organic manures not only increase the nutrient status of the soil but also improve various physical, chemical and biological properties leading to better soil quality and increased fertilizer use efficiency (Dick and Gregorich, 2004). Use of organic manures alone does not result in significant increase in crop yield. Therefore the aforesaid consequences have paved the way to cultivate pulses like black gram. In this context integrated use of both organic manures and inorganic fertilizers have been quite promising not only to maintain higher productivity, soil health but also to provide maximum stability to crop production. The existing blanket recommendation for crops does not ensure efficient and economic use of fertilizers, as it does not take into account fertility variations resulting in imbalanced use of fertilizer nutrients.Thus integrated nutrient management (INM) system envisages use of inorganic fertilizers, organic manures, crop residues, green manures, bio fertilizers taking into account the fertility status of soils.Organic manures such as farm yard manure, poultry manure and vermicompost are some of the important manures used as components of INM. Hene the present investigation was carried out to study the effect of integrated nutrient management practices on yield and nutrient uptake in *Rabi* black gram.

MATERIALS & METHODS

The present investigation entitled "Effect of Integrated Nutrient Practices of *Kharif* Rice on Growth and Yield of *Rabi* Black gram" was conducted at farmer's field, Devaryamjal village, near Hakimpet, Rangareddy district, Telangana during 2014-15 with rice in *Kharif* and black gram in *Rabi* season. It is situated at an altitude of 536 m above mean sea level, $17^0 23^{'}$ N latitude and $78^0 28^{'}$ E longitude. It is classified as Southern Telangana agro-climatic zone of Telangana State.*Kharif* rice was laid out in randomized block design (RBD) with 11 treatments, each replicated 3 times. The treatments consisted of control (T_1), 100% RDFN (T_2), 75% RDFN + 25% N through VC, PM and FYM (T_3, T_6, T_9), 50% RDFN + 50% N through VC, PM and FYM (T_4, T_7, T_{10}), 100% RDN through VC, PM and FYM (T_5, T_8, T_{11}). Soil of the experimental field is a sandy clay loam (ultisol), slightly alkaline in reaction (pH : 7.60), non saline (EC : 0.39 dS m^{-1}), medium in organic carbon (0.51%), low in available N (235 kg ha^{-1}), medium in available P_2O_5 (23 kg ha^{-1}) and high in available K_2O (304 kg ha^{-1}). Rice (BPT 5204) was test crop grown during *Kharif* season with RDF applied as N : P_2O_5: K_2O @ 120 : 60 : 40 kg ha^{-1}. A uniform dose of 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O was applied as basal to all the plots. In the *Rabi* season blackgram (LBG-20) was taken up in same plots. Each treatmental plot of *Kharif* crop was divided into two equal halves. In one half recommended dose of fertilizers to blackgram @ 30 : 60 : 40 kg ha^{-1}(N : P_2O_5 : K_2O) were applied to study the cumulative effects. In the other half no fertilizers were applied to study the residual effects.The plant samples of black gram were collected at 30, 60 DAS and at harvest. After recording dry weights the samples were ground in a willey mill and analyzed for the concentrations of N, P and K by adopting standard procedures.The nitrogen content in the dried plant samples was determined by micro kjeldahl digestion and distillation method after destroying the organic matter using H_2SO_4 and H_2O_2 and expressed as % (Piper 1966). The phosphorus content in the tri acid digest was determined by developing vanadomolybdo phosphoric yellow colour method with Barton's reagent.The intensity of yellow colour was determined by using UV visible spectrophotometer at 420 nm, GBC-(906) and expressed as % (Piper 1966). Thepotassium content in the tri acid digest was determined by using ELICO flame photometer and expressed as % (Piper, 1966).

The uptake of N,P and K were computed using the following formula:

$$\text{Uptake of nutrient (kg ha}^{-1}\text{)} = \frac{\text{Nutrient concentration (\%) x dry matter Production (kg ha}^{-1}\text{)}}{100}$$

Seed yield and haulm yield were recorded treatment wise and yields were expressed in kg ha^{-1}. The data obtained from the experiment was analysed statistically as per the procedures outlined by Panse and Sukhatme, 1985.

RESULTS AND DISCUSSION

Seed Yield

The data on seed yields of blackgram due to cumulative and residual effects of INM treatments are presented in Table 1. All the treatments meant for cumulative effects recorded higher seed yields than their respective treatments for residual effects. Among cumulative and residual effects, seed yields of blackgram ranged from 1172 to 1355 kg ha^{-1} and 682 to 812 kg ha^{-1} with mean values of 1287 and 761 kg ha^{-1}, respectively. The difference in mean seed yields between cumulative and residual effects was 526 kg ha^{-1}.

Haulm Yield

The data on haulm yields of blackgram due to cumulative and residual effects of INM treatments were presented in Table 1. All the cumulative treatments recorded higher haulm yields than their corresponding residual treatments. Among cumulative and residual effects, haulm yields of blackgram ranged from 2274 to 2791 kg ha^{-1} and 1462 to 1930 kg ha^{-1}, with mean values of 2577 and 1741 kg ha^{-1}, respectively. The difference in mean haulm yields between cumulative and residual effects was 836 kg ha^{-1}.

Uptake Of Nutrients

Uptake Of Nitrogen

The differences in uptake of nitrogen by blackgram due to cumulative and residual effects of INM treatments were conspicuous from the data presented in the Table 2. Increased uptake of nitrogen was observed in all the treatments in both cumulative and residual effects with progressive increase in the age of crop. Between cumulative and residual effects, all the cumulative treatments showed higher values of nitrogen uptake than their corresponding residual treatments.

At 30 DAS the difference in mean uptake values between cumulative and residual effects was 6.1 kg ha^{-1}.At 30 DAS, among the cumulative effects, the nitrogen uptake by blackgram ranged from 10.1 to 14.9 kg ha^{-1} with a mean value of 13.1 kg ha^{-1}. Among the residual treatments nitrogen uptake by blackgram ranged from 5.2 (T_1) to 8.1 kg ha^{-1} (T_5) with a mean value of 7.0 kg ha^{-1}. Similar trend in uptake of nitrogen was observed in both cumulative and residual effects at 60 DAS and at harvest.

Uptake Of Phosphorus

The data on differences in uptake of phosphorus by blackgram due to cumulative and residual effects of INM treatments were conspicuous from the data presented in the Table 3. Uptake of phosphorus increased in all the treatments in both cumulative and residual effects with progressive increase in the age of crop. Between cumulative and residual effects, all the cumulative treatments showed higher values of phosphorus uptake than their corresponding residual treatments.

At 30 DAS the difference in mean uptake values between cumulative and residual effects was 1.18 kg ha^{-1}.At 30 DAS, among the cumulative effects the treatment T_5 which received 100% RDN through VC during preceding rice crop and 100% RDF during *Rabi* blackgram recorded phosphorus uptake of 2.84 kg ha^{-1} which was on par with 100% organic manure treatments i.e., T_8, T_{11} and 50% RDF + 50% organic manure treatments i.e., T_4, T_7 and T_{10} and superior to rest of the treatments. Among the residual treatments phosphorus uptake by blackgram ranged from 0.81 (T_1) to 1.49 kg ha^{-1} (T_5) with a mean value of 1.22 kg ha^{-1}. The later treatment T_5 which received 100% RDN through VC during preceding rice crop recorded phosphorus uptake of 1.49 kg ha^{-1} which was significantly superior to treatments T_1, T_2, T_3, T_6 and T_9 while it was on par with treatments T_4, T_7, T_8, T_{10} and T_{11}.Similar trend in uptake of phosphorus was observed in both cumulative and residual effects at 60 DAS and at harvest.

Uptake Of Potassium

The differences in uptake of potassium by blackgram due to cumulative and residual effects of INM treatments were conspicuous from the data presented in the Table 4. Increased uptake of potassium was observed in all the treatments in both cumulative and residual effects with progressive increase in the age of crop. Between cumulative and residual effects, all the cumulative treatments showed higher values of potassium uptake than their corresponding residual treatments.

At 30 DAS the difference in mean uptake values between cumulative and residual effects was 5.0 kg ha^{-1}.At 30 DAS, among the cumulative effects, the potassium uptake by blackgram ranged from 6.7 to 10.3 kg ha^{-1} with a mean value of 8.9 kg ha^{-1}.Among the residual treatments potassium uptake by blackgram ranged from 3.0 (T_1) to 4.6 kg ha^{-1} (T_5) with a mean value of 3.9 kg ha^{-1}. Similar trend in uptake of potassium was observed in both cumulative and residual effects at 60 DAS and at harvest.

The increase in mean uptake of N, P and K at harvest due to cumulative effects over residual effects was by 74.3, 124 and 78 percent respectively. The higher concentration of these nutrients coupled with higher dry matter production resulted in higher uptake of these nutrients. Application of organic manures would increase the supply of major nutrients besides mobilizing unavailable nutrients into available forms and as a result the uptake of nutrients under INM treatments were greater than in treatments T_2 and T_1. The increased availability of nutrients, improved physical condition of soil, higher root activity under INM treatments might have resulted in greater extraction and translocation of nutrients to different parts of the plant. The results with respect to uptake of nutrients by blackgram were in accordance with those of (Sutaria et al., 2010, Bhikane et al., 2007, Vasanthi and Subramanian, 2004, Singh et al., 2009, Banik and Sharma, 2008, Arya et al., 2005).

Table 1 Cumulative and residual effects of integrated nutrient management treatments of *Kharif* rice on, Seed yield, Haulm yield in *Rabi* blackgram

Treatments given to *Kharif* rice			Seed yield (kg ha^{-1})		Haulm yield (kg ha^{-1})	
			CUM.	RES.	CUM.	RES.
T_1	-	Control (No RDFN)	1172	682	2274	1462
T_2	-	100% RDFN	1224	714	2389	1559
T_3	-	75% RDFN + 25% N-VC	1248	734	2481	1660
T_4	-	50% RDFN + 50% N-VC	1338	796	2708	1864
T_5	-	100% RDN-VC	1355	812	2791	1930
T_6	-	75% RDFN + 25% N-PM	1239	728	2448	1631
T_7	-	50% RDFN + 50% N-PM	1334	790	2684	1841

T_8 - 100% RDN-PM	1348	806	2761	1897
T_9 - 75% RDFN + 25% N-FYM	1232	723	2420	1611
T_{10} - 50% RDFN + 50% N-FYM	1329	785	2658	1821
T_{11} - 100% RDN-FYM	1342	802	2732	1879
SEm±	25	17	50	39
CD (P=0.05)	**74**	**49**	**148**	**114**
CV (%)	3.36	3.78	3.38	3.85
Mean	**1287**	**761**	**2577**	**1741**

CUM - Cumulative effects - 100% RDF (N,P_2O_5 and K_2O @ 30:60:40 kg ha^{-1}, respectively)

RES - Residual effects - 0 RDF

Table 2 Cumulative and residual effects of integrated nutrient management treatments of *Kharif* rice on uptake of nitrogen (kg ha^{-1}) in *Rabi* blackgram at 30,60 DAS and at harvest.

Treatments given to *Kharif* rice	30 DAS		60 DAS		Harvest	
	CUM	RES	CUM	RES	CUM	RES
T_1 - Control (No RDFN)	10.1	5.2	33.3	15.4	44.2	24.4
T_2 - 100% RDFN	11.0	5.8	35.9	16.7	47.4	26.3
T_3 - 75% RDFN + 25% N-VC	12.6	6.6	39.6	18.8	50.8	28.8
T_4 - 50% RDFN + 50% N-VC	14.2	7.6	44.4	21.6	56.5	32.5
T_5 - 100% RDN-VC	14.9	8.1	46.8	23.1	59.3	34.8
T_6 - 75% RDFN + 25% N-PM	12.1	6.3	38.4	18.2	49.8	28.1
T_7 - 50% RDFN + 50% N-PM	14.1	7.6	43.8	21.3	55.7	32.3
T_8 - 100% RDN-PM	14.7	8.0	46.1	22.6	58.4	34.1
T_9 - 75% RDFN + 25% N-FYM	11.6	6.1	37.3	17.4	49.0	27.4
T_{10} - 50% RDFN + 50% N-FYM	14.0	7.5	43.6	21.2	55.2	32.1
T_{11} - 100% RDN-FYM	14.5	7.8	45.4	22.2	57.5	33.3
SEm±	0.34	0.22	1.26	0.70	1.46	0.93
CD (P=0.05)	**1.00**	**0.66**	**3.72**	**2.07**	**4.30**	**2.76**
CV (%)	4.50	5.59	5.29	6.12	4.76	5.33
Mean	**13.1**	**7.0**	**41.3**	**19.9**	**53.0**	**30.4**

CUM - Cumulative effects - 100% RDF (N,P_2O_5 and K_2O @ 30:60:40 kg ha^{-1}, respectively)

RES - Residual effects - 0 RDF

Table 3 Cumulative and residual effects of integrated nutrient management treatments of *Kharif* rice on uptake of phosphorus (kg ha^{-1}) in *Rabi* blackgram at 30,60 DAS and at harvest.

Treatments given to *Kharif* rice			30 DAS		60 DAS		Harvest	
			CUM.	RES.	CUM.	RES.	CUM.	RES.
T_1	-	Control (No RDFN)	1.70	0.81	5.18	1.96	6.71	2.72
T_2	-	100% RDFN	1.88	0.93	5.54	2.24	7.09	3.15
T_3	-	75% RDFN + 25% N-VC	2.22	1.10	6.36	2.64	7.87	3.38
T_4	-	50% RDFN + 50% N-VC	2.72	1.40	7.78	3.34	9.59	4.37
T_5	-	100% RDN-VC	2.84	1.49	8.14	3.54	10.03	4.64
T_6	-	75% RDFN + 25% N-PM	2.13	1.06	6.17	2.55	7.72	3.30
T_7	-	50% RDFN + 50% N-PM	2.68	1.39	7.68	3.32	9.46	4.34
T_8	-	100% RDN-PM	2.80	1.46	8.01	3.47	9.88	4.54
T_9	-	75% RDFN + 25% N-FYM	2.04	1.02	5.99	2.39	7.60	3.23
T_{10}	-	50% RDFN + 50% N-FYM	2.65	1.38	7.61	3.30	9.37	4.32
T_{11}	-	100% RDN-FYM	2.75	1.42	7.89	3.40	9.72	4.44
SEm±			0.07	0.05	0.21	0.12	0.23	0.18
CD (P=0.05)			**0.21**	**0.14**	**0.61**	**0.35**	**0.67**	**0.52**
CV (%)			5.17	6.65	5.13	6.98	4.53	7.94
Mean			**2.40**	**1.22**	**6.94**	**2.92**	**8.64**	**3.86**

CUM - Cumulative effects - 100% RDF (N,P_2O_5 and K_2O @ 30:60:40 kg ha^{-1}, respectively)

RES - Residual effects - 0 RDF

Table 4 Cumulative and residual effects of integrated nutrient management treatments of *Kharif* rice on uptake of potassium (kg ha^{-1}) in *Rabi* blackgram at 30,60 DAS and at harvest.

Treatments given to *Kharif* rice			30 DAS		60 DAS		Harvest	
			CUM.	RES.	CUM.	RES.	CUM.	RES.
T_1	-	Control (No RDFN)	6.7	3.0	14.7	7.1	21.6	11.7
T_2	-	100% RDFN	7.4	3.2	15.9	7.5	23.2	12.6
T_3	-	75% RDFN + 25% N-VC	8.5	3.7	17.7	8.6	24.8	13.8
T_4	-	50% RDFN + 50% N-VC	9.8	4.3	20.3	9.8	27.6	15.6

T_5	-	100% RDN-VC	10.3	4.6	21.3	10.5	29.0	16.7
T_6	-	75% RDFN + 25% N-PM	8.2	3.5	17.2	8.2	24.4	13.5
T_7	-	50% RDFN + 50% N-PM	9.7	4.2	20.0	9.7	27.2	15.5
T_8	-	100% RDN-PM	10.2	4.5	21.1	10.4	28.6	16.3
T_9	-	75% RDFN + 25% N-FYM	7.8	3.3	16.7	7.7	24.0	13.2
T_{10}	-	50% RDFN + 50% N-FYM	9.5	4.2	19.7	9.6	27.0	15.4
T_{11}	-	100% RDN-FYM	10.0	4.3	20.7	9.9	28.2	16.0
SEm±			0.31	0.15	0.60	0.32	0.70	0.51
CD (P=0.05)			**0.91**	**0.46**	**1.78**	**0.95**	**2.06**	**1.49**
CV (%)			6.02	6.89	5.61	6.24	4.67	6.02
Mean			**8.9**	**3.9**	**18.7**	**9.0**	**26.0**	**14.6**

CUM - Cumulative effects - 100% RDF (N,P_2O_5 and K_2O @ 30:60:40 kg ha^{-1}, respectively)

RES - Residual effects - 0 RDF

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