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Effect of Integrated Nutrient Management Practices of *Kharif* Rice on Growth and Yield 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 plant height, dry matter production, yield attributes, seed and haulm yields of all the treatments were higher under cumulative effects than their respective residual effects. Among cumulative effects higher plant height (43.2 cm), dry matter production (4561 kg ha^{-1}), yield attributes, seed yield (1355 kg ha^{-1}) and haulm yield (2791 kg ha$^{-1)}$ 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. This treatment was on par with $T_8$and T_{11} i.e., 100% recommended dose of nitrogen (RDN) through PM and FYM and combined treatments i.e., 50% RDFN + 50% N through VC / PM / FYM and significantly superior to rest of all the treatments. Treatment T_1 recorded lowest growth parameters, yield attributes and yield.

Keywords: Black gram, INM, Growth, Yield

INTRODUCTION

Pulses are also known as food legumes and they are second only to cereals in terms of production and consumption in India. Black gram (*Vigna mungo L.*) is one of the oldest and important pulse crop of Asia (Kokani et al., 2014). Black gram consists of proteins (25 to 26%), carbohydrates (60%), Fat (1.5%), minerals, amino acids and vitamins. India is the largest producer of pulses in the world accounting for 25% of global share. 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. There is immense scope for improving the production potential by use of organic manures, inorganic fertilizers and bio fertilizers (Verma et al., 2017). Fertilizers continue to play an important role on the productivity of crops. But the use of chemical fertilizers alone is not sufficient to sustain the productivity due to deficiency of certain elements resulting in decline in productivity as well as soil health with time. Organic manures though improve soil health were seldom used to meet the nutrient requirement of crops because of their low nutrient content and slow release mostly governed by microbial activity. 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 Gregeroch, 2004). Thus it is widely recognized that neither use of organic manures alone nor chemical fertilizers can achieve the sustainability of the yield under the modern intensive farming. 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. Hence the main aim of the experiment was to study the cumulative and residual effects of INM treatments of *Kharif* rice on growth and yield of *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. Data on growth attributes i.e., plant height and dry matter production were recorded at 30,60 Days After Sowing (DAS) and at harvest. Yield attributes i.e., no. of pods per plant, no. of seeds per pod were recorded.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

Growth attributes

Plant height

The data on plant height of black gram recorded at 30, 60 DAS and at harvest due to cumulative and residual effects of INM treatments are presented in Table 1. All the cumulative treatments recorded higher plant height than their corresponding residual treatments. Plant height increased with increase in age of the crop up to harvest.At harvest, among the cumulative treatments, the treatment (T_5), which received 100% RDN through vermicompost during *kharif* rice and 100% RDF during rabi blackgram recorded maximum plant height of 43.2 cm, 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 T10.

However this treatment was significantly superior to 75%RDF + 25% organic manure treatments i.e., T_3, T_6, T_9 and T_2 (100% RDF). Whileamong the residual effects, minimum and maximum plant heights of 26.7 and 34.1 cm were recorded with treatments T_1 and T_5. The difference mean plant height at harvest between cumulative and residual effects was 7.9 cm.

Dry Matter Production

The data on dry matter production of black gram recorded at 30, 60 DAS and at harvest due to cumulative and residual effects of INM treatments are presented in Table 2. All the treatments under cumulative effects recorded higher dry matter production than their respective treatments for residual effects. Dry matter yield increased with increase in age of the crop up to harvest.At harvest, among cumulative treatments, treatment (T_5), which received 100% RDN through vermicompost during *kharif* rice and 100% RDF during rabi black gram recorded maximum dry matter yield of 4561 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}.

While among the residual effects treatment (T_5), which received 100% RDN through vermicompost during *kharif* rice recorded maximum dry matter yield of 2899 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}. The difference in mean dry matter yield at harvest between cumulative and residual effects was 1558 kg ha^{-1}.

Yield Attributes

Number of Pods Plant^{-1}

The data on number of pods plant^{-1} of black gram due to cumulative and residual effects of INM treatments are presented in Table 3.All the treatments meant for cumulative effects showed more number of pods than their respective treatments for residual effects. Among cumulative and residual effects, number of pods plant^{-1} of black gram ranged from 14.0 to 16.9 and 8.7 to 10.4 with mean values of 15.3 and 9.6 respectively. The difference in mean number of pods plant^{-1} between cumulative and residual effects was 5.7. Among the cumulative effects, the minimum and maximum number of pods plant^{-1} was observed with treatments T_1 (14.0) and T_5 (16.9), respectively. Among the

residual effects, the minimum and maximum number of pods plant^{-1} were recorded in treatments T_1 (8.7) and T_5 (10.4) respectively.

Number of Seeds Pod^{-1}

The data on number of seeds pod^{-1} of blackgram due to cumulative and residual effects of INM treatments are presented in Table 3. All the treatments meant for cumulative effects recorded higher number of seeds pod^{-1} than their respective treatments for residual effects. Among cumulative and residual effects, number of seeds pod^{-1}of blackgram ranged from 6.3 to 7.2 and 5.4 to 6.2 with mean values of 6.7 and 5.9 respectively. The difference in mean number of seeds pod^{-1}between cumulative and residual effects was 0.8.

Seed Yield

The data on seed yields of blackgram due to cumulative and residual effects of INM treatments are presented in Table 3. 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 3. 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}.

Blackgram being a leguminous crop does not require high doses of nitrogen as it fixes atmospheric nitrogen. However during the initial stages crop requires small quantity of nitrogen to enable rhizobia establish on the roots.Among cumulative effects, (application of 100% RDF to blackgram), application of inorganic fertilizers and organic manures to rice crop was very effective as it ensured ample supply of nutrients and resulted in better growth.Treatment T_5 (100% RDN-VC to rice + 100% RDF to blackgram) recorded maximum plant height, dry matter production, yield attributes, seed and haulm yields when compared to other treatments.

These significant residual effects due to conjunctive use of nutrients through organic manures (VC / PM / FYM) to preceding rice crop and inorganic fertilizer of succeeding blackgram might be due to the microbial and physical improvement of the soil in addition to the mineralized macro and micro nutrients released slowly and steadily over a period of time which probably were utilized by the crop at critical stage of translocation of photosynthates to the seed. Similar observations were made by (Ramesh et al., 2006, Sutaria et al., 2010, Usha P Bhaskaran and Devi Krishna, 2009, Bhikani et al., 2007).

Under residual effects increased growth parameters, yield attributes and yield were observed under INM treatments than under non INM treatments (T_2) and control (T_1). This may be due to slow release of plant nutrients from organic manures which were applied to preceding rice crop, since mineralization of organic manures takes relatively more time as compared to chemical fertilizers. (Pal and Brahmachari, 2005, Pal et al., 2005).

CONCLUSION

Based on findings of the experiments it is possible to conclude that the residual effects of INM treatments and recommended dose of fertilizers treatment applied to rice crop during *Kharif* season were not sufficient and the succeeding black gram crop raised during *Rabi* requires minimum fertilization in order to sustain the yield levels.Residual effect of organic manures on the succeeding crop i.e., blackgram was in consonance with the concept that organic manures decompose slowly over a prolonged period.

Table-1 Cumulative and residual effects of integrated nutrient management treatments of Kharif rice on plant height (cm) 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)	756	476	2469	1304	3532	2119
T_2	100% RDFN	818	515	2640	1401	3730	2251
T_3	75% RDFN + 25% N-VC	923	581	2891	1554	3934	2416
T_4	50% RDFN + 50% N-VC	1045	668	3243	1759	4360	2734
T_5	100% RDN-VC	1093	708	3393	1865	4561	2899
T_6	75% RDFN + 25% N-PM	886	558	2803	1501	3862	2358
T_7	50% RDFN + 50% N-PM	1030	663	3198	1745	4299	2713
T_8	100% RDN-PM	1076	693	3339	1825	4489	2837
T_9	75% RDFN + 25% N-FYM	852	536	2723	1451	3798	2306
T_{10}	50% RDFN + 50% N-FYM	1021	659	3170	1736	4261	2699
T_{11}	100% RDN-FYM	1059	678	3288	1787	4420	2778
SEm±		27	17	78	46	105	72
CD (P=0.05)		**79**	**51**	**230**	**136**	**311**	**213**
CV (%)		4.80	4.91	4.47	4.90	4.44	4.89
Mean		**960**	**612**	**3014**	**1630**	**4113**	**2555**

CUM - Cumulative effects - 100% RDF (N,P2O5 and K2O @ 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 dry matter production (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)	756	476	2469	1304	3532	2119
T_2	100% RDFN	818	515	2640	1401	3730	2251
T_3	75% RDFN + 25% N-VC	923	581	2891	1554	3934	2416
T_4	50% RDFN + 50% N-VC	1045	668	3243	1759	4360	2734
T_5	100% RDN-VC	1093	708	3393	1865	4561	2899
T_6	75% RDFN + 25% N-PM	886	558	2803	1501	3862	2358
T_7	50% RDFN + 50% N-PM	1030	663	3198	1745	4299	2713
T_8	100% RDN-PM	1076	693	3339	1825	4489	2837
T_9	75% RDFN + 25% N-FYM	852	536	2723	1451	3798	2306
T_{10}	50% RDFN + 50% N-FYM	1021	659	3170	1736	4261	2699
T_{11}	100% RDN-FYM	1059	678	3288	1787	4420	2778
SEm±		27	17	78	46	105	72
CD (P=0.05)		**79**	**51**	**230**	**136**	**311**	**213**
CV (%)		4.80	4.91	4.47	4.90	4.44	4.89
Mean		**960**	**612**	**3014**	**1630**	**4113**	**2555**

CUM - Cumulative effects - 100% RDF (N,P2O5 and K2O @ 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 number of Pods per plant, Seeds per pod, Seed yield, Haulm yield in *Rabi* blackgram**

Treatments given to *Kharif* rice	Pods plant^{-1}		Seeds pod^{-1}		Seed yield (kg ha^{-1})		Haulm yield (kg ha^{-1})	
	CUM.	RES.	CUM.	RES.	CUM.	RES.	CUM.	RES.
T_1 - Control (No RDFN)	14.0	8.7	6.3	5.4	1172	682	2274	1462
T_2 - 100% RDFN	14.1	8.8	6.4	5.7	1224	714	2389	1559
T_3 - 75% RDFN + 25% N-VC	14.2	9.1	6.6	5.9	1248	734	2481	1660
T_4 - 50% RDFN + 50% N-VC	15.9	10.1	6.8	6.1	1338	796	2708	1864
T_5 - 100% RDN-VC	16.9	10.4	7.2	6.2	1355	812	2791	1930
T_6 - 75% RDFN + 25% N-PM	14.2	9.0	6.5	5.8	1239	728	2448	1631
T_7 - 50% RDFN + 50% N-PM	15.7	10.0	6.7	6.1	1334	790	2684	1841
T_8 - 100% RDN-PM	16.7	10.3	7.1	6.2	1348	806	2761	1897
T_9 - 75% RDFN + 25% N-FYM	14.1	8.9	6.4	5.8	1232	723	2420	1611
T_{10} - 50% RDFN + 50% N-FYM	15.6	9.9	6.7	6.0	1329	785	2658	1821
T_{11} - 100% RDN-FYM	16.4	10.2	7.0	6.2	1342	802	2732	1879
SEm±	0.44	0.21	0.20	0.13	25	17	50	39
CD (P=0.05)	**1.30**	**0.62**	**0.60**	**0.39**	**74**	**49**	**148**	**114**
CV (%)	5.02	3.83	5.24	3.83	3.36	3.78	3.38	3.85
Mean	**15.3**	**9.6**	**6.7**	**5.9**	**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

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