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Residual Effect of Nutrient Management Practices in Hybrid Rice under Sri on Growth and Yield of Greengram (*Vigna radiata* L.) in Rice-greengram Cropping System

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Abstract

The field experiments were conducted to study the residual effect of nutrient management practices of *kharif* rice on growth and yield of rabi greengram was conducted at Krishi Vigyan Kendra, Balasore Odisha during *rabi* 2013−14 and 2014−15. The experiment was laid out in RBD during the *kharif* season with 12 treatments replicated thrice and *rabi* greengram was grown in the residual fertility in the plots without disturbing the layout. The residual effect of different nutrient management prcatices applied to *kharif* rice significantly influenced the growth, yield attributes and yield of *rabi* greengram. Growth attributes *viz*. Plant height, number of branches, dry matter accumulation and number of nodules per plant showed significant improvement due to combined application of nutrients from organic and inorganic sources. Application of 75% N through chemical fertilizers along with 25% N through vermicompost to preceding *kharif* rice had significant residual effect on *rabi* grrengram and recorded significantly higher seed yield (959 kg ha^{-1}) and stover yield (2753 kg ha^{-1}).

Keywords: Nutrient management, residual effect, growth, yield, greengram

1. Introduction

Rice-pulse is one of the important cropping systems practiced in India. The cropping sequence of rice-pulse is practically feasible, viable, economical, eco-friendly, water saving technology for sustaining soil fertility and rice productivity. Awareness about crop quality and soil health increased the attention of people towards organic farming (Alagappan and Venkitaswamy, 2016). Use of chemical fertilizers alone may not keep pace with time in maintenance of soil health for sustaining the productivity. 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. The escalating costs of fertilizers on one hand and undesirable effects on soil properties on the other hand have led to inclusion of organic manures in cultivation of crops (Rama Lakshmi et al., 2014). Hence, balanced use of nutrients through organic sources like farmyard manure, vermicompost, neem cake and biofertilizers are prerequisites to sustain soil fertility, to produce maximum crop yield with optimum input level and it also leaves behind sufficient residual effect for the sequence crops (Dahiphale, 2003).

Among rice-pulse cropping systems, rice-greengram cropping system is the most important cropping system *in vogue* in Odisha (Mohanty et al., 2015). At present, studies on nutrient utilization in cropping system of different crops are available but, residual effect different nutrient management practices applied to hybrid rice grown under SRI on the performance of succeeding greengram with respect to growth and yield is very meagre. Hence, the present study was undertaken.

2. Materials and Methods

A field experiment was conducted at Instructional Farm of Krishi Vigyan Kendra (OUAT), Baliapal, Balasore which lies in North Eastern Coastal Plain Zone of Odisha. The experiment was conducted for two years during *rabi* season of 2013−14 and 2014−15 to study the residual effect of various nutrient management practices applied to *kharif* hybrid rice grown under SRI on growth and yield of greengram. The soil of experimental site was sandy loam, slightly acidic in reaction (pH 6.7), low in organic carbon (0.36%), available N (232.4 kg ha^{-1}), medium in available P (32.3 kg ha^{-1}) available K (180.2 kg ha^{-1}) and EC 0.20 dSm^{-1}. Treatments applied to preceding *kharif* rice crop were T_1 (No nitrogen); T_2 (50% recommended dose of N through fertilizers *i.e.* 50% RDFN); T_3 (75% RDFN); T_4 (100% RDFN); T_5 (75% RDFN+25% N through FYM); T_6 (75% RDFN+25% N through vermicompost); T_7 (75% RDFN+25% N through neem cake); T_8 (75% RDFN+*Azospirillum* @ 5 kg ha^{-1});

T_9 (50% RDFN+*Azospirillum* @ 5 kg ha^{-1}); T_{10} (50% RDFN+25% N through FYM+*Azospirillum* @ 5 kg ha^{-1}); T_{11} (50% RDFN+25% N through vermicompost+*Azospirillum* @ 5 kg ha^{-1}); T_{12} (50% RDFN+25% N through neem cake+*Azospirillum* @ 5 kg ha^{-1}). The recommended dose of N, P and K applied to *kharif* rice was 100, 50 and 50 kg ha^{-1}, respectively. Experiment was laid out in RBD and with three replications. The *rabi* greengram crop was grown on residual nutrients without disturbing the layout made during *kharif* season.

Greengram cv. IPM-02-14 was taken as the test crop for the *rabi* experiment. Seeds were sown with a row spacing of 25 cm @ 25 kg ha^{-1} after harvest of rice crop. *Rhizobium* and PSB cultures were inoculated @ 25 g each per kg of seed before sowing. Plant to plant spacing was maintained at 10 cm by thinning the additional plants after 10 days of sowing. A light irrigation was provided at the time of flowering and pod filling stage. Foliar applications of 2% DAP and 0.15% Boron was made at 40 and 50 days after sowing. Observations on growth and yield attributes were recorded periodically. The matured pods were plucked manually from the plants in net plot area for recording the plot wise economic yield. The pods were sun dried for 3−4 days and threshed manually. The seed and haulm yield were recorded plot-wise after reduction of moisture content to 10−12% and these were tabulated and analyzed as per the standard procedure.

3. Results and Discussion

3.1. Plant height

The mean data pertaining to plant height of greengram revealed that treatments applied to preceding rice crop had a positive residual effect on growth parameters like plant height of greengram. It could be seen that plant height increased with the advancement of crop age and attained the maximum at the maturity stage. Residual treatment T_6 (75% RDNF+25% N by vermicompost) resulted in significantly taller plants than all other treatments at all the stages of crop growth. The height was found to be lowest (39.44 cm) with control (T_1) as per the pooled data (Table 1). The results are in conformity with those of Ghanshyam and Jat (2010)

3.2 . No. of branches plant^{-1}

The pooled analysis over two years data showed that the number of branches plant^{-1} in greengram influenced significantly by the residual effect of different treatment treatments applied to the preceding rice crop. At 30 and 45 DAS T_6 (75% RDNF+25% N through vermicompost recorded significantly higher number of branches plant^{-1} followed by T_7, T_8, T_5 and these treatments were found statistically at par. At harvest, T_7 resulted in higher number of branches plant^{-1} (4.49) and it was found to be at par with T_6, T_5, T_{11} and T_{12}. Control recorded (T_1) lowest number of branches at all the stages of crop growth. Similar results were also obtained by Mohanty et al. (2014)

Table 1: Residual effect of nutrient management practices on growth attributes of greengram (Pooled data of 2 years)

Treatments	Plant height (cm)			No. of primary branches plant^{-1}			Leaf area index			Dry matter accumulation (g m^{-2})		
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T_1	15.83	30.80	39.44	2.30	3.31	3.64	0.67	2.12	1.68	53.86	205.23	246.33
T_2	16.29	34.30	43.46	2.75	3.56	4.03	0.75	2.77	2.01	60.24	214.41	283.66
T_3	16.54	36.00	44.47	3.05	3.48	3.77	0.80	3.06	2.21	63.68	222.33	300.66
T_4	17.39	37.01	45.19	3.14	3.86	4.01	0.86	3.24	2.50	71.76	234.42	318.23
T_5	17.71	39.63	47.49	3.14	4.29	4.30	0.88	3.49	2.76	73.08	247.72	346.64
T_6	17.90	40.20	47.86	3.38	4.36	4.40	0.91	3.56	2.83	73.60	257.16	352.45
T_7	17.32	37.40	45.49	3.35	4.25	4.49	0.84	3.35	2.65	66.96	245.00	340.05
T_8	16.30	35.54	44.02	3.17	4.23	4.03	0.83	3.19	2.24	64.60	222.63	313.85
T_9	16.17	35.07	43.59	2.96	4.14	4.02	0.78	3.08	2.10	61.72	218.75	299.23
T_{10}	17.70	38.09	45.98	2.93	3.74	3.64	0.84	3.41	2.50	70.16	242.31	329.22
T_{11}	17.59	38.80	46.49	3.10	4.10	4.40	0.86	3.40	2.57	69.74	243.66	329.46
T_{12}	16.89	36.70	44.24	3.00	4.07	4.37	0.80	3.21	2.30	65.30	227.39	310.44
SEm±	0.24	0.76	0.75	0.11	0.16	0.11	0.02	0.09	0.07	1.60	6.24	11.29
CD (*p*=0.05)	0.71	2.23	2.20	0.32	0.47	0.32	0.07	0.27	0.22	4.69	18.30	33.10

T_1: No Nitrogen; T_2: 50 % RDFN; T_3: 75 % RDFN; T_4: 100 % RDFN; T_5: 75% RDFN + 25% N through FYM; T_6: 75% RDFN+25% N through VC; T_7: 75% RDFN+25% N through NC; T_8: 75% RDFN+Azo; T_9: 50% RDFN + Azo; T_{10}: 50% RDFN+25% N through FYM + Azo; T_{11}: 50% RDFN + 25% N through VC + Azo; T_{12}: 50% RDFN+25% N through NC+Azo

3.3. Leaf area index (LAI)

The residual effect of different sources of nutrition applied in *kharif* rice crop exerted a significant influence on leaf area index of greengram (Table 1). The pooled data shows that the leaf area index increased as the age of crop advanced up to 45 DAS and then gradually decreased up to the harvest stage. The highest leaf area index was recorded 3.56 with 75% RDFN+25% N through vermicompost (T_6) and with a lowest value of 2.12 under T_1. As the crop age advances 45 DAS, the leaf area index gradually decreased due to leaf senescence and at harvest T_6 recorded a highest value of 2.83 though it was found statistically at par with T_5 and T_7. The control treatment recorded lowest value of LAI *i.e.* 1.68.

3.4. Dry matter accumulation m^{-2}

Residual effect of various treatments applied to hybrid rice grown in *kharif* season significantly influenced the dry matter production in succeeding greengram crop grown during *rabi* season. The pooled data pertaining to the residual effect of rice on greengram is presented in Table 1 and it indicated that there was rapid increase in dry matter as the crop advances up to 45 DAS and after that there was gradual increase up to the maturity stage. Application of 75% RDNF+25% N through vermicompost evinced considerable effect on greengram and produced highest dry matter at 30 DAS (73.60 g m^{-2}), 60 DAS (257.16 g m^{-2} and at harvest (352.45 g m^{-2}). The lowest dry matter accumulation *i.e.* 246.33 g m^{-2} was recorded with control (T_1). These results are in conformity with those of Ramesh (2014).

3.5. No. of pods $plant^{-1}$

The number of pods $plant^{-1}$ of greengram significantly influenced by the residual effect of nutrient management practices applied to preceding *kharif* rice crop. From the pooled data analysis it was observed that application of 75% RDFN+25% N through vermicompost (T_6) showed significantly highest number of pods $plant^{-1}$ (24.85) and control (T_1) resulted in lowest number of pods $plant^{-1}$ (17.20). These results are in the similar line obtained by Lavanya and Ganapathy (2011) and Sangeetha et al. (2013)

3.6. No. of seeds pod^{-1}

The data related to number of seeds per pod are presented in Table 2 indicated that different levels of nutrient management treatments on hybrid rice has significant residual impact on the number of seeds pod^{-1} in greengram. The number of seeds per pod was significantly higher with 75% RDNF+25% N through vermicompost (11.68) in the pooled data. These results are in conformity with those of Singh and Gujar (2012) and Sangeetha et al. (2013).

3.7. 1000 seed weight

It is noticed from the data that the treatments applied to rice did not able to produce significant effect on 1000 seed weight of greengram. However, T_7 (75% RDNF+25% N through neem cake) recorded numerically higher seed weight than other treatments.

3.8. Seed yield

The various sources of nutrition management practices applied to hybrid rice have significant residual impact on the seed yield of succeeding greengram (Table 2). From the data, it could be observed that T_6 (75% RDFN+25% N through vermicompost) resulted in significantly higheer seed yield 959

Table 2: Residual effect of nutrient management practices on yield attributes and yields of greengram (Pooled data of 2 years)

Treatments	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	1000 seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
T_1	17.20	8.99	36.33	575	1716	25.10
T_2	19.53	9.69	36.56	634	1895	25.07
T_3	20.59	10.07	36.67	702	2057	25.40
T_4	21.69	10.80	36.65	746	2106	26.14
T_5	24.30	11.52	37.12	808	2379	25.35
T_6	24.85	11.68	37.18	959	2753	25.84
T_7	23.80	11.35	37.20	768	2181	26.05
T_8	20.37	10.01	36.67	722	2132	25.30
T_9	20.05	9.99	36.65	709	2121	25.05
T_{10}	22.94	11.22	36.98	759	2169	25.91
T_{11}	22.90	11.06	36.80	755	2190	25.62
T_{12}	21.60	10.63	36.72	728	2158	25.22
SEm±	0.68	0.39	0.95	30	75	1.14
CD (*p*=0.05)	1.99	1.16	NS	88	220	NS

RDFN: Recommended dose of nitrogen through fertilizer; VC: Vermicompost; NC: Neem cake; Azo: *Azospirillum* @ 5 kg ha^{-1}

kg ha^{-1} which is 66.8% higher than the control (575 kg ha^{-1}). The seed yield recorded with the residual effect of 75% RDFN+25% N through FYM (T_5) and 75% RDFN+25% N through neem cake (T_4) was 808 and 768 kg ha^{-1}, respectively. Similar results were also observed by Ghanshyam and Jat (2010); Alagappan and Venkitaswamy (2015)

3.9 . Haulm yield

The haulm yield recorded followed the similar trend as that of seed yield. From the pooled data it was observed that, in the preceding rice where 75% RDNF+25% N through vermicompost was applied exhibited the highest haulm yield of 2753 kg ha^{-1} and the lowest yield was observed with control (1716 kg ha^{-1}). Similar trends were also reported by Ghanshyam and Jat (2010) and Alagappan and Venkitaswamy (2015).

3.10 . Harvest index

The pooled analysis over two years data revealed that the harvest index was not varied significantly due to residual effect of different treatments however, highest value of harvest index was obtained with T_7 (75% RDNF+25% N through neem cake).

4. Conclusion

Residual effect of different organic and inorganic sources of nutrients applied to preceding *kharif* rice grown under SRI had significant effect on growth, yield attributes and yield of succeeding *rabi* greengram in rice-greengram cropping system. Application of 75% N through chemical fertilizers along with 25% N through vermicompost to preceding *kharif* rice had significant residual effect on *rabi* greengram and resulted in significantly higher values of growth parameters, yield attributes and productivity of greengram.

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