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Residual Effect of Organic Nutrient Management in Aromatic Rice on Growth & Productivity of Greengram.

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Abstract : *The present study was taken up to investigate the effect of organic nutrient management on growth & economics of aromatic rice and its residual effect on greengram in rice-greengram cropping system. The experiment was carried out in Randomized Block Design (RBD) with 12 treatments & three replications to study the organic nutrient management in aromatic rice during Kharif 2014 & 2015 seasons and its residual effect on greengram in Rabi 2014-15 & 2015-16 seasons under rice-greengram cropping system. The residual effect of nutrient management practices of rice significantly influenced the primary branches of greengram. Application of organic sources both as sole and combination produced significantly more no of number of branches in both the years as well as in pooled analysis over RDF and control. As per the pooled data analysis the highest number of nodules per plant was observed in T10 (50% RDN from VC+50% RDN from GLM) i.e. 21.2. As per the pooled data analysis the highest dry matter was observed in T10 i.e. 374 g/m^2 which was significantly differing from other treatments and lowest was observed in T_1 Control (No fertilizer applied) i.e. 222.5 g/m^2. Number of pods per plant was highest for the treatment T10 i.e. 17.5 which was significantly different from other treatments and lowest was observed in T1-Control (No fertilizer applied) i.e. 10. The number of seeds per pods was highest for the treatment T10 i.e. 11.5 which was significantly different from other treatments and lowest was observed in T1-Control (No fertilizer applied) i.e. 8.97.*

Key words: *Aromatic rice, Greengram, Organic nutrient management, Orissa, Residual effect.*

I. Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food crops, which supplies major source of calories for about 45 per cent of world population, particularly to the people of Asian countries. The production of rice in India has four fold increase from 1950–51 to 2001–02. This has enabled the country to attain self sufficiency in rice production & food security. Nevertheless, India did not become a major rice exporting country for a long period of time. Rice export from India constitutes the major share of Basmati rice. Nearly two-third of Basmati rice produced in India is exported.

Enhancing the rice productivity through the improvement of yield potential of genotypes and appropriate nutrient management has been the main thrust of Indian rice policy. Inorganic fertilizer is one of the key factors to increase the rice productivity. Rice yield and biomass increased rapidly due to increased use of chemical fertilizers. In the recent years, crop productivity has stagnated or decreased in spite of consumption of increased rate of chemical fertilizers. As a result, agricultural ecosystems remain in a state of chemical nutrient saturation, leading to huge nutrient losses through leaching, runoff, volatilization, emissions, immobilization and subsequent low nutrient use efficiency. Benefits of organic manures like farm yard manure, green manures, Azolla and Vermicompost are well known but the availability is reducing day by day. These organic manures are not only good sources of nutrients but also improve the physical structure of the soil (Ramesh *et al*., 2005). Apart from containing NPK these also contain small amounts of trace elements especially boron, copper, iron, sulphur, zinc and with fair quantity of growth promoting substances. Hence the present study was taken up to investigate the effect of organic nutrient management on growth & economics of scented rice and its residual effect on greengram in rice-greengram cropping system.

II. Materials and Methods

A field experiment entitled at Gadarupasha, Gop, Puri, Odisha during K*harif-Rabi* season of 2014-15 and K*harif-Rabi* season of 2015-16. The field is situated at **19° 53' 27'' N Latitude** and **86° 06' 01'' E Longitude** with an average altitude of 2m above mean sea level and comes under East & South Eastern Coastal Plain Agro-climatic Zone of Odisha. Field experiment was conducted in 12 plots with 3 replications. The soil of the experimental plot was sandy clay loam in texture, acidic in soil reaction with medium level of organic carbon and available nitrogen but high level of available phosphorus and medium level of potassium. The climate of the area is warm and moist with hot & humid summer and mild winter. The rainfall is monsoonal & unimodal.

The experiment was conducted on aromatic rice–greengram cropping system where aromatic rice was grown as Kharif crop and greengram as Rabi crop. The experiment was carried out in Randomized Block Design (RBD) with 12 treatments & three replications to study the organic nutrient management in aromatic rice during Kharif 2014 & 2015 seasons and its residual effect on greengram in Rabi 2014-15 & 2015-16 seasons under rice-greengram cropping system. During both the years of experimentation, randomization of treatments in Kharif and Rabi season remained the same. All the plots demarcated by 10 cm high ridges on all sides. Adequate numbers of irrigation channels were also constructed to provide irrigation independently to each plot.

Treatment details:
$\mathbf{T_1}$ – Control, $\mathbf{T_2}$ – 100% RDN from chemical Fertiliser (60:30:30), $\mathbf{T_3}$ – 100% RDN from FYM, $\mathbf{T_4}$ – 100% RDN from Vermicompost (VC), $\mathbf{T_5}$ – 100 % RDN from Green Leaf Manure (GLM) (Dhaincha), $\mathbf{T_6}$ – 100% RDN from Azolla, $\mathbf{T_7}$ – 50% RDN from FYM+50% RDN from VC, $\mathbf{T_8}$ – 50% RDN from FYM+50% RDN from (GLM), $\mathbf{T_9}$ – 50% RDN from FYM+50% RDN from Azolla, $\mathbf{T_{10}}$ – 50% RDN from VC+50% RDN from GLM, $\mathbf{T_{11}}$ – 50% RDN from VC+50% RDN from Azolla, $\mathbf{T_{12}}$ –50% RDN from GLM+50% RDN from Azolla The Rice (*Oryza sativa* L.) variety Nua Acharamati and for Greengram (*Vigna radiate L.*) variety OBGG-52 were used for the experiment. To study the residual effect of nutrient applied to rice on the succeeding crop, the individual plots were prepared manually without disturbing the layout. Greengram crop was grown as residual crop.

III. Results and Discussion

Residual effect of organic nutrient management of rice plays a significant role on growth, yield attributes and productivity of greengram.

1. Growth attributes

1.1 Plant Height (cm)

Observation recorded on plant height of greengram at different growth stages revealed that the plant height increased with the advancement of crop age and reached the maximum in maturity during both the years. In general maximum rate of increased in plant height was recorded during the vegetative period and thereafter it declines towards maturity. Residual effect on nutrient management practices of rice exerted significant effect on plant height of greengram. The plant height of greengram at maturity stage was recorded for all the treatments and is presented in Table-1. As per the pooled data of both the years the highest plant height was recorded for T10 which was at par with T7 and T8.

1.2 Number of primary branches per plant

The data on number of primary branches per plant of greengram recorded at maturity were statistically analyzed and presented in Table-1. The residual effect of nutrient management practices of rice significantly influenced the primary branches of greengram. Application of organic sources both as sole and combination produced significantly more no of number of branches in both the years as well as in pooled analysis over RDF and control. As per the pooled data highest number of primary branches per plant was observed in T10 i.e. 9.2 which was significantly differing from other treatments and lowest was observed in T_1 Control (No fertilizer applied). Similar findings are reported by S. Alagappan and R.Venkitaswamy, 2015.

1.3 Number of Nodules per plant

The data on number of nodules per plant of greengram counted at 30 DAS were statistically analyzed and presented in Table-1. The residual effect of nutrient management practices of rice significantly influenced the no of nodules per plant of greengram. Application of organic sources both as sole and combination produced significantly more no of number of nodules per plant in both the years as well as in pooled analysis over RDF and control. As per the pooled data analysis the highest number of nodules per plant was observed in T10 i.e. 21.2 which was remained at par with T12, T7, T8 and significantly differing from other treatments and lowest was observed in T_1 Control (No fertilizer applied).

1.4 Dry Matter Accumulation

Data with respect to dry matter application recorded at harvest were analyzed statistically and presented in Table-1. The residual effect of nutrient management practices of rice significantly influenced the dry matter accumulation of greengram. Application of organic sources both as sole and their combination produced significantly more dry matter accumulation in both the years as well as in pooled analysis over RDF and control. As per the pooled data analysis the highest dry matter was observed in T10 i.e. 374 g/m2 which was significantly differing from other treatments and lowest was observed in T_1 Control (No fertilizer applied) i.e. 222.5 g/m2.

2. Yield attributes

2.1 Number of pods per plant

The data on number of pods per plant estimated at harvest were analyzed statistically and presented in Table-2. Residual effect of nutrient management practices of rice exerted significant influence on production of pods in greengram. The residual effect of organic nutrition as sole and as combination resulted in higher number of pods per plant during both the year and also for the pooled data. As per the pooled data the number of pods per plant was highest for the treatment T10 i.e. 17.5 which was significantly different from other treatments and lowest was observed in T1- Control (No fertilizer applied) i.e. 10.

2.2 Number of seeds per pod

The data on number of seeds per pod estimated at harvest were analyzed statistically and presented in Table-2. Residual effect of nutrient management practices of rice exerted significant influence on production of seeds per pod in greengram. Variation was observed due to residual effect on nutrient management. As per the pooled data the number of seeds per pods was highest for the treatment T10 i.e. 11.5 which was significantly different from other treatments and lowest was observed in T1- Control (No fertilizer applied) i.e. 8.97. The residual effect of organic nutrition as sole and as combination resulted in higher number of seeds per pod during both the year and also for the pooled data.

2.3 Test Weight (g)

The data pertaining to thousand seed weight (test weight) recorded at maturity were analyzed statistically and presented inTtable-2. Residual effect of nutrient management practices of rice was found to be significant on test weight in greengram. Variation was observed due to residual effect on nutrient management. As per the pooled data test weight was highest for the treatment T10 i.e. 48.38 gm which was significantly different from other treatments and lowest was observed in T1- Control (No fertilizer applied) i.e. 35.29. The residual effect of organic source as sole and as combination resulted in higher test weight during both the year and also for the pooled data. Similar findings are reported by Kumari & Reddy (2011).

3. Crop Productivity

The seed yield, stick yield and harvest index recorded after harvesting and processing of the crop were presented below.

3.1 Seed yield (kg/ha)

The seed yield recorded from each plot at harvest was analyzed statistically and presented in the Table-3. Perusal of seed yield data reflected that residual effect of nutrients management practices of rice has significant effect on seed yield. As per the pooled data the highest seed yield is produces by T10 (946 kg /ha) which remained at par with T7 and T8 which significantly differ from other treatments. Lowest result was observed in T_1- Control (No fertilizer applied). Seed yield of greengram was comparatively higher in plots applied with organic nutrition of rice than T1 and T2. Similar findings are reported by Mohanty *et al.* 2015.

3.2 Stick yield (kg/ha)

The stick yield recorded from each plot at harvest was analyzed statistically and presented in the Table-3. Residual effect of nutrient management practices of rice exerted significant effect on stick yield of greengram. Similar to trend in grain yield, stick yield of greengram was also higher in plots applied with organic nutrition of rice than T1 and T2. As per the pooled data stick yield was found to be highest in T10 (2786.7 kg/ha) which significantly differ from other treatments. Lowest result was observed in T_1- Control (No fertilizer applied).

3.3 Harvest Index (%)

The data on harvest index worked from seed and stick yield were statistically and presented in the Table-3. Residual effect of nutrient management practices of rice exerted significant effect on harvest index of greengram. As per the pooled data harvest index was found to be highest in T11 (30%) which differ from other treatments. Lowest result was observed in T_1- Control (No fertilizer applied).

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Table-1 Residual effect of nutrient management in rice on growth attributes of greengram.

Treatments	Plant Height(cm)			Primary branches/Plant			Nodules/Plant			DMA (gm/m2)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1 – Control (No Fertiliser)	26.6	27.4	27.0	5.3	5.7	5.5	10.0	11.3	10.7	216.67	228.33	222.50
T_2 – 100% RDN from RDF(60:30:30)	28.5	29.2	28.9	5.7	6.1	5.9	15.3	16.7	16.0	235.67	250.00	242.83
T_3 – 100% RDN from FYM (12.5 t/ha)	30.8	31.6	31.2	6.4	6.6	6.5	17.0	18.7	17.8	260.33	266.67	263.50
T_4 – 100% RDN from VC(5 t/ha)	31.7	31.7	31.7	6.7	7.0	6.8	18.0	19.0	18.5	281.00	286.00	283.50
T_5 – 100 % RDN from Dhaincha (10 t/ha)	31.3	32.7	32.0	6.5	6.8	6.6	17.0	16.7	16.8	272.00	272.63	272.32
T_6 – 100% RDN from Azolla(14 t/ha)	30.2	32.0	31.1	6.3	7.3	6.8	16.3	18.7	17.5	252.33	260.00	256.17
T_7 – 50% RDN from FYM+50% RDN from VC	34.5	34.9	34.7	8.6	8.7	8.7	20.0	21.7	20.8	335.33	336.00	335.67
T_8 – 50% RDN from FYM+50% RDN from Dhaincha	33.8	35.0	34.4	8.3	8.6	8.5	19.3	21.7	20.5	328.00	330.33	329.17
T_9 – 50% RDN from FYM+50% RDN from Azolla	32.1	34.1	33.1	6.9	6.4	6.7	18.3	19.0	18.7	293.00	295.67	294.33
T_{10} – 50% RDN from VC+50% RDN from Dhaincha	**35.4**	**35.9**	**35.7**	**9.3**	**9.1**	**9.2**	**21.7**	**20.7**	**21.2**	**373.67**	**374.33**	**374.00**
T_{11} – 50% RDN from VC+50% RDN from Azolla	33.2	35.5	34.3	7.6	7.6	7.6	18.7	18.7	18.7	310.67	310.33	310.50
T_{12} –50% RDN from Dhaincha+50% RDN from Azolla	32.6	33.5	33.1	7.3	7.5	7.4	18.7	20.7	19.7	296.67	309.33	303.00
S Em (±)	0.53	0.53	0.43	0.19	0.11	0.13	0.36	1.24	0.70	7.92	7.73	7.59
CD (P=0.05)	1.57	1.54	1.26	0.55	0.33	0.37	1.05	3.63	2.05	23.23	22.66	22.26

Table-2 Residual effect of nutrient management in Rice on yield attributes of Greengram

Treatment	No of Pods/Plant			No. of Seeds/Pod			Test Weight(g)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1 – Control (No Fertiliser)	9.73	10.27	10.00	8.73	9.20	8.97	35.02	35.56	35.29
T_2 – 100% RDN from RDF(60:30:30)	10.27	10.53	10.40	8.87	9.20	9.03	37.28	37.18	37.23
T_3 – 100% RDN from FYM (12.5 t/ha)	11.40	11.50	11.45	9.57	9.67	9.62	39.23	39.63	39.43
T_4 – 100% RDN from VC(5 t/ha)	11.87	12.37	12.12	10.00	10.30	10.15	40.59	40.11	40.35
T_5 – 100 % RDN from Dhaincha(10 t/ha)	11.53	12.23	11.88	9.73	9.97	9.85	40.38	41.08	40.73
T_6 – 100% RDN from Azolla(14 t/ha)	10.67	11.13	10.90	9.33	9.40	9.37	37.97	39.63	38.80
T_7 – 50% RDN from FYM+50% RDN from VC	15.53	15.93	15.73	11.00	10.90	10.95	45.87	45.83	45.85
T_8 – 50% RDN from FYM+50% RDN from Dhaincha	15.00	17.33	16.17	10.83	11.10	10.97	43.36	44.11	43.74
T_9 – 50% RDN from FYM+50% RDN from Azolla	12.60	13.43	13.02	10.10	10.67	10.38	40.96	40.75	40.85
T_{10} – 50% RDN from VC+50% RDN from Dhaincha	**16.80**	**18.20**	**17.50**	**11.53**	**11.46**	**11.50**	**48.34**	**48.41**	**48.38**
T_{11} – 50% RDN from VC+50% RDN from Azolla	14.47	14.50	14.48	10.43	11.10	10.77	42.89	43.35	43.12
T_{12} –50% RDN from Dhaincha+50% RDN from Azolla	13.33	14.37	13.85	10.20	11.00	10.60	41.71	42.25	41.98
S Em (±)	0.23	0.35	0.25	0.21	0.24	0.17	0.72	0.59	0.62
CD (P=0.05)	0.66	1.02	0.73	0.61	0.69	0.51	2.12	1.74	1.81

Table-3 Residual effect of nutrient management on greengram seed yield, stick yield & Harvest index.

Treatment	Seed Yield(Kg/Ha)			Stick Yield(Kg/Ha)			Harvest Index		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1 – Control (No Fertiliser)	646.7	686.7	666.7	1520.0	1596.7	1558.3	25.6	25.6	25.6
T_2 – 100% RDN from RDF(60:30:30)	653.3	663.3	658.3	1703.3	1836.7	1770.0	27.7	26.5	27.1
T_3 – 100% RDN from FYM (12.5 t/ha)	690.0	693.3	691.7	1913.3	1973.3	1943.3	26.5	26.0	26.3
T_4 – 100% RDN from VC(5 t/ha)	763.3	760.0	761.7	2046.7	2100.0	2073.3	27.2	26.6	26.9
T_5 – 100 % RDN from Dhaincha(10 t/ha)	723.3	756.7	740.0	1996.7	1969.7	1983.2	26.6	27.8	27.2
T_6 – 100% RDN from Azolla(14 t/ha)	663.3	670.0	666.7	1860.0	1930.0	1895.0	26.3	25.8	26.1
T_7 – 50% RDN from FYM+50% RDN from VC	913.3	930.0	921.7	2440.0	2430.0	2435.0	27.3	27.7	27.5
T_8 – 50% RDN from FYM+50% RDN from Dhaincha	893.3	903.3	898.3	2386.7	2400.0	2393.3	27.3	27.4	27.3
T_9 – 50% RDN from FYM+50% RDN from Azolla	793.3	810.0	801.7	2136.7	2146.7	2141.7	27.1	27.4	27.3
T_{10} – 50% RDN from VC+50% RDN from Dhaincha	**953.3**	**940.3**	**946.8**	**2783.3**	**2790.0**	**2786.7**	27.7	28.8	28.3
T_{11} – 50% RDN from VC+50% RDN from Azolla	860.0	893.3	876.7	2246.7	2210.0	2228.3	**29.8**	**30.1**	**30.0**
T_{12} –50% RDN from Dhaincha+50% RDN from Azolla	803.3	830.0	816.7	2163.3	2263.3	2213.3	27.1	26.9	27.0
S Em (±)	17.65	17.72	16.73	81.52	79.89	79.19			
CD (P=0.05)	51.77	51.96	49.07	239.10	234.31	232.24			