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Growth, nutrient content, and uptake in hybrid rice under SRI with different sources of nutrition

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Abstract
An investigation in the field was carried out at Instructional Farm of Krishi Vigyan Kendra (OUAT), Baliapal, Balasore, Odisha. For two years, the experiment was steered *i.e. Kharif* and *Rabi* season of 2013-14 and 2014-15 to study the "Response of Hybrid Rice under SRI - Green gram Cropping System to Sources of Nutrition". The 12-treatment RBD experiment was designed. Using the SRI approach, the hybrid rice variety Ajay was transplanted. Periodically, observations regarding the growth and yield parameters of both crops were documented and subjected to statistical analysis. The findings demonstrated a considerable impact on the development and yield of hybrid rice produced under SRI when both organic and inorganic sources of nitrogen were applied simultaneously. Due to the combined application of nutrients from organic and inorganic sources, growth parameters such as plant height, number of branches, dry matter accumulation, and number of nodules per plant exhibited substantial enhancement. Rabi green gram had a noteworthy residual effect with application of 75% N by chemical fertilizers and 25% N through vermicompost to previous kharif rice. This resulted in a significantly greater seed yield (959 kg ha^{-1}) and stover yield (2753 kg ha^{-1}).

Keywords: SRI, hybrid rice, number of tillers, plant height, leaf area index and crop growth rate

1. Introduction
The most significant cereal crop and food crop in India is rice, which is a staple diet for the vast majority of our population. It is essential to a regular diet, but it is also a crucial component of religious rituals, spiritual occasions, and holy festivals. Based on an estimated 400 grams of rice per day per person and an annual population growth rate of 1.5%, the demand for rice in India is predicted to reach 140 million tonnes by 2025 and to meet this demand, an additional 38% of rice must be produced by 2020 (Tripathy and Mishra 2011) [6].
Hybrid rice can be one of the most practical ways to enhance food production by 15 to 20% without resorting to mono-cropping; the hybrid vigor of the rice contributes to the increase in grain yield (Yuan, 2004) [7]. The System of Rice Intensification (SRI) technique, which raises rice output by 16%, seems to be another feasible substitute for contemporary rice farming (Geethalaxmi *et al*. 2011) [1]. Nitrogen is the most important plant nutrient which is lacking in majority of agricultural soils, and the rice crop only uses 30-40% of the applied nitrogen due to various losses resulting in a very low N-use efficiency. Integrated Nutrient Management (INM) can help in the combined use of all plant nutrient sources to maintain the soilh fertility and optimizing nutrient supply to achieve targeted crop productivity (Roul and Mishra, 2007) [4]

2. Materials and Methods
The field study was conducted at the Instructional Farm of Krishi Vigyan Kendra, Baliapal, Balasore during the year 2013-14 and 2014-15. The soil of the experimental field was sandy loam in texture, well drained with low in organic carbon and available nitrogen but medium in available phosphorus (P_2O_5) and potassium (K_2O). The soil is slightly acidic in reaction. Average monsoonal rainfall of 1442 mm was experienced during the experiment period. The experiment was conducted in Randomized Block Design with three-replications. The test variety was hybrid rice variety Ajay (CRHR-7) which was a medium duration (135 days) variety.

The size of individual plot was 5 x 4 m^2. The treatments were: T_1 : Control; T_2 : 50% Recommended Dose of Nitrogen through chemical fertilizers (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 Neem Cake (NC); T_8 : 75% RDFN + Azospirillum @ 5 kg/ha; T_9 : 50% RDFN + Azospirillum @ 5 kg/ha; T_{10} : 50% RDFN + 25% N through FYM + Azospirillum @ 5 kg/ha; T_{11} : 50% RDFN + 25% N through VC + Azospirillum @ 5 kg/ha and T_{12} : 50% RDFN + 25% N through NC + Azospirillum @ 5 kg/ha. The recommended dose of fertilizer was 100-50-50 kg N-P-K ha^{-1}, respectively. The P_2O_5, K_2O and $ZnSO_4$ were applied to all the treatments as per recommended dose. Boron (20%) was sprayed @ 0.15% at flowering initiation stage. The rice crop was planted in SRI method and the seed rate was 5 kg ha^{-1}. Fourteen days old seedlings were transplanted with cropping geometry of 25 cm x 25 cm. Drainage channels were made to remove excess water during the crop period. The crop was harvested when more than 80 percent grains were ripened and the total yield of grain and straw was recorded plot-wise separately.

3. Results

3.1 Growth parameters

Plant height (Table 1) was measured at various phases of rice growth and the mean plant height of rice grew with the advancement of crop age and reached its maximum during harvest. Aapplication of 100% recommended doses of nitrogen through inorganic fertilizer (T_4) recorded tallest plants at all the stages of crop growth viz. 30 DAT (66.1 cm), 60 DAT (104.9 cm), 90 DAT (127.4 cm) and harvest (129.2 cm). It was, nevertheless, comparable to treatments using a combination of organic and inorganic sources *i.e.* T_5 (75% N through chemical fertilizer (RDFN) + 25% N through FYM) and T_6 (75% N through chemical fertilizer (RDFN) + 25% N through Vermicompost).

Total number of rice tillers m^{-2} (Table 2) influenced by the various treatments under investigation is presented in Table 2. At 30 DAT during the first year and in pooled analysis application of 100% RDFN (T_4) recorded significantly higher number of tillers m^{-2} (298) than other treatments. But it was found at par with 75% RDFN + Azospirillum (T_8), 75% RDFN + 25% N through FYM (T_5), 75% RDFN + 25% N through vermicompost (T_6). At 60 DAT, 90 DAT and maturity, T_6 produced highest number of tillers m^{-2} (404) followed by T_5, T_8, T_{11} and T_4. Lowest total numbers of tillers m^{-2} were observed no nitrogen (T_1) conditions.

The results revealed that LAI increased progressively from 30 to 60 DAT and thereafter a decreasing trend was observed irrespective of treatments (Table 3). Maximum leaf area index (1.92) was recorded under the treatment T_4 (100% RDFN), which was at par with the treatments T_5 (75% RDFN + 25% N through VC) and T_6 (75% RDFN + 25% N through FYM) at 30 DAT. While at 60 DAT, T_6 recorded highest leaf area index (5.59) followed by T_5 (5.56) and T_4 (5.51) and these treatments were found to be at par. At 90 DAT, T_6 resulted in higher value of leaf area index (5.38) followed by T_5, T_{11} (50% RDFN +25% N through VC + Azospirillum), T_{10} (75% RDFN + 25% N through FYM + Azospirillum) and T_4 (100% RDFN). Moreover, T_6, T_5, T_{11} and T_{10} were found to be statistically at par. In T_1 recorded the lowest leaf area index throughout the crop growth period in both the years.

Crop growth rate (CGR) of rice was calculated for different growth period and were analyzed statistically and presented in Table 4. Administering 75% RDFN +25% N through vermicompost (T_6) significantly influenced the crop growth rate at all the stages over the years of study except 90 DAT to harvest interval. Pooled data showed that T_6 application registered significantly higher crop growth rate (26.25 g m^{-2} day^{-1}) during 60-90 DAS which was followed by T_5 and T_4 100% RDFN (21.9 g m^2 day^{-1}). The lowest crop growth rate was documented under control (16.73 g m^{-2} day^{-1}) at 60-90 DAS.

3.2 Nutrient content

Tables 5 and 6, respectively, show the nitrogen, phosphorus and potassium concentration of grain and straw. Application of 100% RDFN (T_4) recorded higher N content in rice grain *i.e.* 1.275, 1.291 and 1.283% during 2013, 2014 and in pooled data, respectively. It was found to be at par with T_{11}, T_{10}, T_8, T_5 and T_7 during 2014 and pooled data whereas, the value of N content in grain due to different treatments was non-significant during 2013. Further, the highest N content in straw was found in T_6 (0.635) and it was observed at par with T_5 and T_5 with T_4. The significantly lower N content in grain and straw was observed with Control (T_1). The P content in grains and straw did not vary significantly due to different treatments during 2013. However, combined use of organic and inorganic sources showed slightly higher P content in both grain and straw. The potassium content of the grain differed significantly due to different treatments.

3.3 Nutrient Uptake

The Nitrogen uptake by rice grain and straw is presented in Table 7. The analysis of total uptake of nitrogen by both grain and straw resulted similar trend and highest nitrogen uptake value of 95.80 kg ha^{-1} was recorded with T_6 followed by 89.14 kg ha^{-1} with T_5. The lowest total nitrogen uptake value was recorded with control (T_1) i.e 48.13 kg ha^{-1}. The uptake of phosphorus by grain, straw, and overall uptake is presented in Table 8. Application of 75% RDFN + 25% N through vermicompost (T_6) recorded significantly highest uptake of phosphorus by rice grain. The potassium uptake by rice grain, straw and total uptake as affected by various treatments are presented in Table 9. The K uptake by grains, straw and total uptake was found to be highest *i.e.* 17.80, 12.23 and 30.04, respectively with treatment T_6 (75% RDFN + 25% N through vermicompost) and it was found to be at par with T_5 (75% RDFN + 25% N through FYM). The lowest phosphorus uptake in grain, straw and total uptake was recorded control (T_1) during the experimental period.

4. Discussion

The study findings indicate that the growth metrics of hybrid rice cultivated under SRI, namely plant height, number of tillers $pant^{-1}$, LAI, and CGR, were notably impacted by the sources of nutrition used. It was observed that, independent of the sources of nutrition, the plant growth characteristics rose gradually as crop age grew. Maximum plant heights were observed when the full prescribed dose of nitrogen (N) was administered through fertilizers. This could be because there was more N available for the crop to grow. Plant height increased more quickly between 30 and 60 days after planting than between 60 and 90 days, which may have been caused by the physiological stage transitioning from vegetative to reproductive between 60 and 90 days. Growth was somewhat slower in treatments with 75% N through fertilizer and 25% N through FYM and 75% N through fertilizer and 25% N through vermicompost than in 100% RDFN. This could be because fertilizers release nitrogen more slowly than vermicompost.

Again, rice crop grown under SRI resulted in increase in plant height (Mohanty, 2014) [3] which might be due to younger plant transplanting, optimum plant population and geometry leads to more availability of resources to the crop plants due to vigorous and deeper root system. The alternate wetting and drying with use of cono weeder to check weeds may loosen the soil thus encourages better root penetration and proliferation. During the early phases, there was a higher number of tillers m^{-2} with 100% RDFN, which may have been caused by the nitrogen from applied fertilizers becoming available more quickly. But in later phases, the number of tillers came out to be highest when 75% of the nitrogen came from fertilizer and 25% from vermicompost. This was closely followed by 75% of the nitrogen coming from fertilizer and 25% from FYM and 100% RDFN. This could be because vermicompost has more main and minor nutrients available. The LAI of rice crop grown under SRI might be higher due to open plant structure and lower angle of inclination of leaves which results more spread of leaves (Thakur *et al*. 2011) [5]. Crop growth rate (CGR) was lower during the initial stages of crop growth, higher during 60-90 DAT and very low during from 90 DAT to maturity which was due to shift of crop from vegetative to reproductive stage.

The data on nutrient content and nutrient uptake of rice revealed that the N content in rice grain was found to be highest with the application of 100% N through fertilizers than other treatments during both the years of experimentation which might be due to readily availability mobility of nitrogen from inorganic sources than organic manures in rice grain (Kumari *et al*. 2010) [2]. Similar, trend was also recorded with respect to P and K content. The N uptake by grain, straw and total uptake were observed to be highest with the 75% N through fertilizers and 25% N through vermicompost than rest of the treatments however, the treatments were found to be at par with respect N uptake by rice straw. Higher N content of straw and higher yields of the crop caused the highest N uptake under this treatment. The P and K uptake by straw and total uptake was not significantly influenced by different treatments during the experiment period. The increase in nutrient uptake was may be due to prolonged availability of nutrients when fertilizers were applied in combination with organic manures and combined application might be improved the physio-chemical and biological properties of soil resulting in higher crop yield and uptake (Mohanty 2014) [3].

Table 1: Effect of sources of nutrition on plant height of hybrid rice under SRI

Treatments	Plant height, cm											
	30DAT			60DAT			90 DAT			At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	46.5	50.3	48.4	85.2	86.4	85.8	109.6	110.7	110.2	111.4	112.3	111.9
T_2: 50% RDFN	55.7	56.4	56.1	92.5	93.2	92.9	114.5	115.6	115.1	116.2	117.2	116.7
T_3: 75% RDFN	60.4	62.5	61.5	98.6	99.6	99.1	116.2	118.5	117.4	117.9	119.9	118.9
T_4: 100% RDFN	65.3	66.1	65.7	104.1	105.7	104.9	126.5	127.3	126.9	128.7	129.6	129.2
T_5: 75% RDFN + 25% N through FYM	64.8	66.8	65.8	103.6	105.4	104.5	125.8	126.7	126.3	128.2	129.1	128.7
T_6: 75% RDFN + 25% N through VC	63.4	65.4	64.4	102.4	103.2	102.8	121.7	122.5	122.1	123.8	124.3	124.1
T_7: 75% RDFN + 25% N through NC	60.5	61.5	61.0	99.2	100.3	99.8	116.3	119.5	117.9	122.5	122.2	122.4
T_8: 75% RDFN + *Azo.*	60.3	61.8	61.1	100.7	101.6	101.2	122.5	123.6	123.1	124.3	125.9	125.1
T_9: 50% RDFN + *Azo.*	58.8	60.2	59.5	99.3	99.5	99.4	117.6	119.2	118.4	119.2	121.2	120.2
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	62.5	64.6	63.6	100.2	101.4	100.8	122.9	124.2	123.6	124.9	126.4	125.7
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	61.6	63.7	62.7	101.4	102.9	102.2	123.6	124.8	124.2	125.8	127.1	126.5
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	59.1	60.7	59.9	99.7	100.8	100.3	122.4	123.7	123.1	124.3	125.8	125.1
SEm (±)	1.96	1.25	0.95	1.4	1.17	1.07	2.38	2.48	1.07	2.35	1.24	1.41
CD (0.05)	5.74	3.67	2.79	4.09	3.42	3.14	6.97	7.27	3.14	6.88	3.65	4.14

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 2: Effect of sources of nutrition on number of tillers m^{-2} of hybrid rice under SRI

Treatments	No. of tillers m^{-2}											
	30 DAT			60 DAT			90 DAT			At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen(Control)	208	217	212	278	286	282	245	269	257	238	249	244
T_2: 50% RDFN	222	229	226	302	313	308	269	276	273	256	261	259
T_3: 75% RDFN	248	242	245	347	359	353	308	311	310	290	296	293
T_4: 100% RDFN	295	301	298	363	392	378	336	340	338	317	321	319
T_5: 75% RDFN + 25% N through FYM	253	266	260	390	407	399	345	359	352	329	340	335
T_6: 75% RDFN + 25% N through VC	256	262	259	395	412	404	351	362	357	335	345	340
T_7: 75% RDFN + 25% N through NC	250	258	254	362	379	371	317	336	327	297	319	308
T_8: 75% RDFN + *Azo.*	246	279	263	386	398	392	341	342	342	321	325	323
T_9: 50% RDFN + *Azo.*	250	255	253	354	365	360	310	317	314	289	302	296
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	236	241	239	362	381	372	335	348	342	316	331	324
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	240	253	247	377	386	382	343	356	350	328	337	333
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	231	239	235	352	366	359	326	342	334	310	322	316
SEm (±)	10.0	14.56	9.82	12.72	15.39	8.79	11.37	16.66	9.09	11.08	13.75	8.42
CD (0.05)	29.91	42.70	28.81	37.31	45.13	25.79	33.36	48.85	26.66	32.50	40.32	24.70

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 3: Effect of sources of nutrition on leaf area index (LAI) of hybrid rice under SRI

Treatments	Leaf area index								
	30DAT			60DAT			90 DAT		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	1.37	1.39	1.38	4.76	4.81	4.79	3.25	3.59	3.42
T_2: 50% RDFN	1.42	1.43	1.43	4.95	5.03	4.99	3.86	4.34	4.10
T_3: 75% RDFN	1.59	1.62	1.61	5.14	5.21	5.18	4.77	4.58	4.68
T_4: 100% RDFN	1.89	1.94	1.92	5.47	5.54	5.51	4.80	4.69	4.75
T_5: 75% RDFN + 25% N through FYM	1.82	1.86	1.84	5.52	5.60	5.56	5.22	5.36	5.29
T_6: 75% RDFN + 25% N through VC	1.78	1.81	1.80	5.56	5.62	5.59	5.36	5.39	5.38
T_7: 75% RDFN + 25% N through NC	1.66	1.70	1.68	5.20	5.27	5.24	4.87	4.96	4.92
T_8: 75% RDFN + *Azo.*	1.67	1.71	1.69	5.18	5.28	5.23	4.98	5.06	5.02
T_9: 50% RDFN + *Azo.*	1.54	1.59	1.57	5.13	5.22	5.18	4.94	4.98	4.96
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	1.63	1.69	1.66	5.35	5.42	5.39	4.95	5.19	5.07
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	1.69	1.72	1.71	5.42	5.50	5.46	5.06	5.27	5.17
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	1.60	1.71	1.66	5.22	5.31	5.27	4.78	4.89	4.84
SEm (±)	0.08	0.08	0.08	0.14	0.13	0.11	0.16	0.15	0.12
CD (0.05)	0.23	0.24	0.23	0.41	0.38	0.32	NS	0.45	0.35

Table 4: Effect of sources of nutrition on crop growth rate (CGR) of hybrid rice under SRI

Treatments	Crop growth rate, g m^{-2} day^{-1}								
	30 - 60 DAT			60 - 90 DAT			90 - At harvest		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	7.87	8.39	8.01	16.06	17.18	16.73	3.20	3.59	3.40
T_2: 50% RDFN	9.49	9.82	9.66	19.22	18.85	19.03	2.70	4.01	3.36
T_3: 75% RDFN	11.14	11.63	11.23	20.45	19.36	20.06	3.34	2.98	3.16
T_4: 100% RDFN	12.11	12.94	12.35	23.22	20.24	21.90	3.22	5.57	4.40
T_5: 75% RDFN + 25% N through FYM	13.26	13.63	13.44	21.62	22.56	22.09	3.98	4.09	4.04
T_6: 75% RDFN + 25% N through VC	13.22	13.71	13.47	25.94	26.57	26.25	4.06	2.79	3.43
T_7: 75% RDFN + 25% N through NC	12.63	12.32	12.61	20.09	21.20	20.51	4.14	3.56	3.85
T_8: 75% RDFN + *Azo.*	13.04	12.56	13.03	19.90	21.64	20.54	5.26	4.11	4.68
T_9: 50% RDFN + *Azo.*	11.71	11.93	11.82	19.06	19.29	19.17	1.54	1.84	1.69
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	12.79	13.05	12.92	20.26	20.20	20.23	3.73	3.67	3.70
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	13.03	13.31	13.17	20.80	20.81	20.80	4.77	5.04	4.91
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	12.37	12.94	12.54	18.78	20.97	20.00	5.47	3.08	4.27
SEm (±)	0.78	0.61	0.70	1.22	0.87	1.06	1.00	0.77	0.72
CD (0.05)	2.30	1.78	2.06	3.59	2.55	3.10	NS	NS	NS

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 5: Effect of sources of nutrition on N, P and K content of hybrid rice grain grown under SRI

Treatments	(In grain) Content,%								
	N			P			K		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	1.136	1.142	1.139	0.254	0.261	0.258	0.222	0.227	0.225
T_2: 50% RDFN	1.141	1.147	1.144	0.256	0.267	0.262	0.225	0.226	0.226
T_3: 75% RDFN	1.156	1.167	1.162	0.261	0.276	0.269	0.227	0.229	0.228
T_4: 100% RDFN	1.275	1.291	1.283	0.275	0.319	0.297	0.249	0.258	0.254
T_5: 75% RDFN + 25% N through FYM	1.203	1.218	1.211	0.259	0.275	0.267	0.243	0.259	0.251
T_6: 75% RDFN + 25% N through VC	1.123	1.243	1.183	0.266	0.261	0.264	0.226	0.247	0.237
T_7: 75% RDFN + 25% N through NC	1.194	1.211	1.203	0.268	0.287	0.278	0.235	0.237	0.236
T_8: 75% RDFN + *Azo.*	1.212	1.227	1.220	0.259	0.296	0.278	0.239	0.249	0.244
T_9: 50% RDFN + *Azo.*	1.148	1.156	1.152	0.258	0.271	0.265	0.226	0.228	0.227
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	1.234	1.248	1.241	0.271	0.301	0.286	0.243	0.25	0.247
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	1.252	1.265	1.259	0.273	0.312	0.293	0.245	0.254	0.250
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	1.176	1.189	1.183	0.265	0.282	0.274	0.231	0.235	0.233
SEm (±)	0.058	0.038	0.039	0.012	0.013	0.009	0.007	0.007	0.004
CD (0.05)	NS	0.113	0.113	NS	0.037	0.025	0.020	0.019	0.013

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 6: Effect of sources of nutrition on N, P and K content of hybrid rice straw grown under SRI

Treatments	(In straw) Content%								
	N%			P%			K%		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	0.583	0.595	0.594	0.091	0.092	0.092	1.465	1.470	1.468
T_2: 50% RDFN	0.590	0.598	0.597	0.092	0.093	0.093	1.471	1.489	1.480
T_3: 75% RDFN	0.597	0.601	0.599	0.093	0.094	0.094	1.483	1.496	1.490
T_4: 100% RDFN	0.606	0.619	0.613	0.096	0.097	0.097	1.519	1.539	1.529
T_5: 75% RDFN + 25% N through FYM	0.613	0.623	0.618	0.096	0.097	0.097	1.529	1.549	1.539
T_6: 75% RDFN + 25% N through VC	0.634	0.635	0.635	0.097	0.098	0.098	1.536	1.556	1.546
T_7: 75% RDFN + 25% N through NC	0.598	0.607	0.603	0.094	0.095	0.095	1.487	1.509	1.498
T_8: 75% RDFN + *Azo.*	0.601	0.609	0.605	0.094	0.095	0.095	1.499	1.521	1.510
T_9: 50% RDFN + *Azo.*	0.596	0.599	0.598	0.092	0.093	0.093	1.479	1.489	1.484
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	0.603	0.611	0.607	0.095	0.096	0.096	1.509	1.520	1.515
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	0.604	0.612	0.608	0.095	0.096	0.096	1.516	1.534	1.525
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	0.597	0.604	0.601	0.093	0.094	0.094	1.485	1.499	1.492
SEm (±)	0.008	0.005	0.005	0.002	0.002	0.001	0.014	0.049	0.024
CD (0.05)	0.023	0.014	0.015	NS	NS	NS	NS	NS	NS

Table 7: Effect of sources of nutrients on Nitrogen uptake of hybrid rice under SRI

Treatments	Nitrogen uptake, Kg ha^{-1}								
	Grain			Straw			Total		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	43.47	46.88	45.18	2.81	3.10	2.96	46.33	49.99	48.13
T_2: 50% RDFN	47.47	52.11	49.78	3.10	3.39	3.24	50.59	55.50	53.03
T_3: 75% RDFN	60.12	58.01	59.05	3.61	3.76	3.69	63.73	61.77	62.74
T_4: 100% RDFN	76.85	78.39	77.62	4.36	4.85	4.61	81.42	83.24	82.22
T_5: 75% RDFN + 25% N through FYM	81.39	87.33	84.37	4.55	5.00	4.77	85.94	92.34	89.14
T_6: 75% RDFN + 25% N through VC	89.40	92.20	90.77	4.80	5.25	5.03	94.11	97.45	95.80
T_7: 75% RDFN + 25% N through NC	66.54	64.67	65.61	4.06	4.18	4.12	70.32	68.85	69.73
T_8: 75% RDFN + *Azo.*	70.49	73.85	72.22	4.25	4.52	4.39	74.55	78.37	76.61
T_9: 50% RDFN + *Azo.*	51.93	56.28	54.08	3.34	3.89	3.62	55.00	60.17	57.70
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	72.19	71.22	71.71	4.29	4.43	4.36	76.72	75.66	76.07
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	74.53	73.73	74.05	4.34	4.59	4.46	78.71	78.33	78.51
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	64.29	62.49	63.39	3.96	4.09	4.02	68.17	66.58	67.41
SEm (±)	4.57	3.01	3.22	0.14	0.16	0.10	4.61	3.01	3.22
CD (0.05)	13.41	8.84	9.44	0.40	0.46	0.28	13.52	8.82	9.46

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 8: Effect of sources of nutrition on Phosphorus uptake of hybrid rice under SRI

Treatments	Phosphorus uptake, Kg ha^{-1}								
	Grain			Straw			Total		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	9.68	10.70	10.19	0.44	0.48	0.46	10.12	11.18	10.65
T_2: 50% RDFN	10.66	12.08	11.36	0.48	0.53	0.51	11.14	12.61	11.86
T_3: 75% RDFN	13.59	13.77	13.69	0.56	0.59	0.58	14.15	14.36	14.26
T_4: 100% RDFN	16.65	19.38	18.01	0.69	0.76	0.73	17.34	20.14	18.74
T_5: 75% RDFN + 25% N through FYM	16.17	18.22	17.13	0.71	0.78	0.75	16.88	19.00	17.88
T_6: 75% RDFN + 25% N through VC	17.95	17.92	17.94	0.73	0.81	0.77	18.69	18.74	18.72
T_7: 75% RDFN + 25% N through NC	14.89	15.30	15.11	0.64	0.66	0.65	15.53	15.96	15.75
T_8: 75% RDFN + *Azo.*	15.04	17.85	16.43	0.66	0.70	0.68	15.70	18.55	17.11
T_9: 50% RDFN + *Azo.*	11.59	13.28	12.42	0.52	0.61	0.56	12.10	13.89	12.98
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	15.85	17.25	16.56	0.68	0.70	0.69	16.52	17.95	17.24
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	16.24	18.15	17.22	0.68	0.72	0.70	16.92	18.87	17.92
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	14.44	14.82	14.62	0.62	0.64	0.63	15.06	15.45	15.25
SEm (±)	0.95	1.14	0.84	0.02	0.03	0.02	0.96	1.14	0.84
CD (0.05)	2.79	3.36	2.47	0.07	0.09	0.06	2.81	3.33	2.46

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

Table 9: Effect of sources of nutrients on Potassium uptake of hybrid rice under SRI

Treatments	Potassium uptake, Kg ha^{-1}								
	Grain			Straw			Total		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1: No Nitrogen (Control)	8.48	9.29	8.88	7.07	7.67	7.37	15.55	16.96	16.25
T_2: 50% RDFN	9.36	10.23	9.80	7.72	8.44	8.08	17.08	18.67	17.88
T_3: 75% RDFN	11.81	11.36	11.58	8.98	9.36	9.17	20.79	20.72	20.75
T_4: 100% RDFN	15.05	15.66	15.35	10.94	12.06	11.50	25.99	27.73	26.85
T_5: 75% RDFN + 25% N through FYM	15.81	17.13	16.47	11.35	12.43	11.89	27.16	29.56	28.36
T_6: 75% RDFN + 25% N through VC	17.27	18.33	17.80	11.64	12.82	12.23	28.91	31.16	30.04
T_7: 75% RDFN + 25% N through NC	13.04	12.68	12.86	10.09	10.39	10.23	23.13	23.07	23.09
T_8: 75% RDFN + *Azo.*	13.85	15.09	14.46	10.61	11.29	10.94	24.46	26.38	25.40
T_9: 50% RDFN + *Azo.*	10.18	11.11	10.64	8.30	9.61	8.96	18.48	20.72	19.60
T_{10}: 50% RDFN + 25% N through FYM + *Azo.*	14.27	14.30	14.29	10.73	11.03	10.88	25.00	25.33	25.16
T_{11}: 50% RDFN + 25% N through VC + *Azo.*	14.55	14.81	14.69	10.89	11.50	11.19	25.44	26.32	25.88
T_{12}: 50% RDFN + 25% N through NC + *Azo.*	12.61	12.35	12.50	9.87	10.14	10.01	22.48	22.49	22.50
SEm (±)	0.62	0.64	0.54	0.35	0.39	0.21	0.79	0.80	0.63
CD (0.05)	1.81	1.88	1.59	1.03	1.15	0.62	2.31	2.35	1.86

RDFN: Recommended dose of nitrogen through fertilizer, VC: Vermicompost, NC: Neem cake, *Azo*: *Azospirillum*

5. Conclusion

Growth parameters viz. plant height, number of tillers, leaf area index and CGR were influenced significantly due to the different treatment. Maximum values of all most all parameters were recorded with the application of 75% RDN through fertilizers + 25% N through vermicompost followed by 75% RDN through fertilizers + 25% N through FYM and 100% RDN through fertilizers at all the stages of crop growth and found to be significantly higher over control during both the years and pooled analysis. Growth rate was found slow up to 30 DAT, faster during 30-60 DAT and moderate towards maturity. The production of hybrid rice under SRI was highest when recommended dose of nitrogen was applied from organic and inorganic sources i.e. 75% RDFN + 25% N through vermicompost was applied.

6. References

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