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# Evaluation of rice (*Oryza sativa* L.) varieties and hybrids in relation to different nutrient management practices for yield, nutrient uptake and economics in SRI

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**ABSTRACT**

*A field experiment was conducted during kharif 2010 at Directorate of Rice Research farm, Rajendranagar. The experiment was laid in split plot design replicated thrice to assess the performance of three rice varieties (Vasumathi, Krishnahamsa and KRH-2) in main plots and to find the best management practices with six nutrient management practices [100% RDN through inorganic fertilizer; 75% RDN (inorganic) + 25% RDN (organic) through vermicompost; 50% RDN (inorganic) + 50% RDN (organic) through vermicompost; 25% RDN (inorganic) + 75% RDN (organic) through vermicompost; 100% RDN (organic) through vermicompost; Control (No manure and no fertilizer)] in sub- plots under System of Rice Intensification (SRI).The results revealed that hybrid KRH-2 recorded significantly higher grain and straw yield as well as nutrient uptake. Among the different nutrient management options, application of 50 percent recommended dose of nitrogen (through urea) and remaining 50 percent RDN through vermicompost resulted in significantly higher grain (5520.8 kg/ ha) and straw yield (6264.9 kg/ ha) in addition to nutrient uptake (157.9,30.7 and 166 N, P and K kg/ha respectively) followed by 100 % RDN (through urea) application. In terms of economics, hybrid KRH-2 with 50% RDN (inorganic) + 50% RDN (organic) through vermicompost recorded, respectively, higher gross and net returns (Rs 70,013 and 46,398/ha) but the maximum B: C ratio (2.07) was found associated with the hybrid KRH-2 in combination with 100% RDN (through urea).*

**Key words:** B: C ratio, inorganic fertilizer, nutrient uptake, System of Rice Intensification (SRI), vermicompost.

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## INTRODUCTION

Rice (*Oryza sativa L.*) is one of the most ancient crops being cultivated in 117 countries, hence called as "Global Grain". It is the staple cereal food grain of majority of India's over one billion population, contributes to nearly 44% of total food grain production. In India, it is grown over an area of 44.1 m.ha with a total production of 105 m t and a productivity of 2393 kg/ha [1]. India has to produce 114 m t of rice by the year 2030 to meet the food grain requirement of burgeoning population. Irrigated rice in particular, is a heavy consumer of water. It takes 5000 liters of water to produce 1 kg of rice and consumes 7650 $m^2$/ha [2]. As water for irrigation is becoming limited producing more rice with less water, as well as with less land and minimum fertilizer if possible, is important for sustainability

of rice production systems. The possible way to increase the productivity is through formulating better production technologies with improved cultivars and efficient nutrient management practices. The System of Rice Intensification (SRI) was introduced in India during the year 2000 as a viable alternative of rice cultivation that enhances the productivity while minimizing the inputs. However, while highlighting SRI [3] stated that the best SRI yields can be achieved with HYV's or hybrids. Some farmers' experiences indicate that, only long and medium duration rice varieties perform better than short duration varieties. Hence it is necessary to evaluate and harness the potential of different duration rice varieties developed at research stations for their suitability to SRI method. Our farmers are using more and more chemical fertilizers, excessive irrigation and more pesticides that have adverse impacts on soil health and crop productivity. The use of organic manures such as farm yard manure (FYM) and vermicompost has proved to be a viable component for rice across the globe. The quantities of the organics to be applied for achieving significant nutrient benefit under SRI method are to be ascertained for Southern Telangana zone of A.P. Keeping the above considerations in view, an investigation was planned to evaluate rice cultivars in relation to various fertility levels in SRI.

## MATERIALS AND METHODS

A field experiment was conducted at Directorate of Rice Research farm, Rajendranagar, Hyderabad during *kharif* 2010**.** The soil of the experimental site was clayey with a pH of 8.3, available N- 223 kg $ha^{-1}$; $P_2O_5$- 23.4 kg $ha^{-1}$ and $K_2O$- 307 kg $ha^{-1}$.The experiment was laid in split plot design replicated thrice to assess the performance of three varieties (Vasumathi, Krishnahamsa and KRH-2) in main plots and with six nutrient management practices [100% RDN through inorganic fertilizer; 75% RDN (inorganic) + 25% RDN (organic) through vermicompost; 50% RDN (inorganic) + 50% RDN (organic) through vermicompost; 25% RDN (inorganic) + 75% RDN (organic) through vermicompost; 100% RDN (organic) through vermicompost; Control (No manure and no fertilizer)] in sub- plots under System of Rice Intensification (SRI). The recommended dose was 100:60:40 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$. Organic manure in the form of vermicompost was applied. Entire dose of phosphorus and half of potassium and one third of nitrogen were applied basally. The remaining nitrogen was top dressed equally at active tillering and panicle initiation stages as per the treatments. The remaining half of potassium was applied at flowering stage. Observations on grain and straw yield were recorded. Plant samples collected are analyzed for N, P, K contents by adopting the standard procedures. The gross and net returns and benefit cost ratio due to different treatments were calculated based on cost of cultivation at the prevailing market prices. The experimental data recorded on various parameters were analyzed statistically following the analysis of variance procedure as described by Gomez and Gomez [4].

## RESULTS AND DISCUSSION

### Yield

The results of the experiment for the evaluation of rice cultivars in relation to different nutrient management practices for yield, nutrient uptake and economics in SRI are presented and are discussed here. The data on grain and straw yield of rice as influenced by varieties and integrated nutrient management (INM) practices is presented in Tables.1 & 2. The hybrid KRH-2 performed better in terms of the crop yield resulting in significantly higher grain yield over the other two cultivars *i.e.,* Vasumathi and Krishnahamsa. Maximum grain and straw yield was recorded with the application of 50 % RDN (through urea) +50 % RDN (organic) through vermicompost and was found to be significantly superior over the rest of the treatments followed by the treatment 100 % RDN (through urea). These results are in confirmation with Viraktamath [5].

The yield advantages due to integration of organic sources with inorganic fertilizers over inorganic fertilizers alone might be due to the availability of nutrients for a shorter period as mineralization of nitrogen is more rapid and in turn the losses of inorganic nitrogen due to volatilization, de-nitrification and leaching *etc.,* would be more. The results are in conformity with Prabhakara Setty *et al.* [6] and Subbalakshmi L [7]

The interaction between varieties and nutrient management practices on grain yield was significant. The highest yield was recorded by the hybrid KRH-2 when the treatment 50 % RDN (through urea) +50 % RDN (organic) through vermicompost was applied.

### Nutrient uptake

The data on NPK uptake (kg $ha^{-1}$) by rice crop as influenced by varieties and integrated nutrient management (INM) practices at harvest stage is presented in Table 3. Application of organic manures not only increased the uptake of

nitrogen through mineralization but also reduced the losses of nitrogen from soil. Increased potassium uptake with organic sources of FYM was due to the priming effect such that organics on decomposition release organic acids which solubilise native *i.e.*, fixed and non-exchangeable form of potassium and change the soil solution with potassium ions at later stages of crop growth [8].

**Table 1. Grain and Straw yield (kg ha$^{-1}$) as influenced by rice varieties in relation to different nutrient management practices**

| Treatments | Grain Yield | Straw yield |
|---|---|---|
| **Varieties** | | |
| $V_1$:Vasumathi | 3198.0 | 3914.0 |
| $V_2$:Krishnahamsa | 4947.8 | 5550.6 |
| $V_3$:KRH-2 | 6157.5 | 6649.3 |
| S.Em± | 92.7 | 123.4 |
| C.D at 5% | 362.1 | 481.7 |
| **Fertility levels** | | |
| 100% inorganic | 5182.1 | 5871.7 |
| 75% I+ 25% O | 4996.1 | 5657.1 |
| 50% I+ 50% O | 5520.8 | 6264.9 |
| 25% I+ 75% O | 4860.0 | 5515.8 |
| 100 % Organic | 4502.9 | 5008.9 |
| Control | 3544.9 | 3909.5 |
| S.Em± | 96.3 | 343.6 |
| C.D at 5% | 278.3 | 992.8 |

*I-Inorganic fertilizer; O-organic through vermicompost; Recommended dose of nitrogen: 100 kg ha$^{-1}$.*

**Table 2. Interaction effect between varieties and fertility levels on grain yield (kg ha$^{-1}$)**

| **Treatments** | **Fertility levels** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Varieties** | **$F_1$** | **$F_2$** | **$F_3$** | **$F_4$** | **$F_5$** | **$F_6$** | **Mean** |
| Vasumathi | 3540 | 3420 | 3800 | 3130 | 2850 | 2448 | 3198 |
| Krishnahamsa | 5478 | 5317 | 5678 | 5251 | 4471 | 3492 | 4948 |
| KRH-2 | 6528 | 6252 | 7084 | 6198 | 6188 | 4695 | 6157 |
| Mean | 5182 | 4996 | 5521 | 4860 | 4503 | 3544 | |
| **V x F at main** | | | | | | | |
| S.Em± | | | | 227.2 | | | |
| C.D at 5% | | | | 527.8 | | | |
| **V x F at sub** | | | | | | | |
| S.Em± | | | | 178.3 | | | |
| C.D at 5% | | | | 564.1 | | | |

*$F_1$-100% RDN through inorganic fertilizer; $F_2$-75% RDN (inorganic) + 25% RDN (organic) through vermicompost; $F_3$-50% RDN (inorganic) + 50% RDN (organic) through vermicompost; $F_4$-25% RDN (inorganic) + 75% RDN (organic) through vermicompost; $F_5$-100% RDN (organic) through vermicompost; $F_6$- Control.*

**Table 3. NPK uptake by grain and straw (kg ha$^{-1}$) as influenced by varieties and INM practices in SRI rice**

| Treatments | N | P | K |
|---|---|---|---|
| **Varieties** | | | |
| $V_1$:Vasumathi | 70.6 | 9.6 | 65.6 |
| $V_2$:Krishnahamsa | 109.9 | 17.1 | 114.1 |
| $V_3$:KRH-2 | 144.1 | 28.2 | 152.6 |
| S.Em± | 2.7 | 1.5 | 1.7 |
| C.D at 5% | 10.6 | 6.1 | 6.6 |
| **Fertility levels** | | | |
| 100% inorganic | 136.5 | 23.2 | 125.6 |
| 75% I+ 25% O | 110.7 | 20.7 | 114.9 |
| 50% I+ 50% O | 157.9 | 30.7 | 166.0 |
| 25% I+ 75% O | 100.2 | 16.3 | 104.6 |
| 100 % Organic | 85.2 | 12.0 | 91.9 |
| Control | 58.7 | 6.9 | 61.6 |
| S.Em± | 2.4 | 2.1 | 5.1 |
| C.D at 5% | 7.0 | 6.2 | 14.8 |

*I-Inorganic fertilizer; O-organic through vermicompost; Recommended dose of nitrogen: 100 kg ha$^{-1}$.*

## Economics

Hybrid KRH-2 with 50% RDN (inorganic) + 50% RDN (organic) through vermicompost recorded, respectively, higher gross and net returns but the maximum B: C ratio (2.07) was found associated with the hybrid KRH-2 in

combination with 100% RDN (through urea) because of higher cost incurred on organic sources with 50% RDN (inorganic) + 50% RDN (organic) through vermicompost application (B: C ratio of 1.96).

In conclusion, it could be recommended that rice hybrid KRH-2 in combination with integrated use of organic and inorganic nutrient sources (50 % RDN (through urea) +50 % RDN (organic) through vermicompost) would result in higher yield and economics under System of Rice Intensification (SRI) without impairing soil fertility status.

**Table 4. Gross and net returns (Rs ha$^{-1}$) and benefit cost ratio of rice as influenced by varieties and fertility levels**

| Varieties | Fertility levels | Gross returns (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B :C ratio |
|---|---|---|---|---|
| $V_1$ | $F_1$ | 49412 | 29290 | 1.46 |
| | $F_2$ | 47743 | 26716 | 1.27 |
| | $F_3$ | 53048 | 30555 | 1.36 |
| | $F_4$ | 43694 | 20416 | 0.88 |
| | $F_5$ | 39758 | 15428 | 0.63 |
| | $F_6$ | 34573 | 18371 | 1.13 |
| $V_2$ | $F_1$ | 48681 | 28725 | 1.44 |
| | $F_2$ | 47388 | 26334 | 1.25 |
| | $F_3$ | 50554 | 28255 | 1.27 |
| | $F_4$ | 46821 | 23493 | 1.01 |
| | $F_5$ | 39721 | 15469 | 0.64 |
| | $F_6$ | 30972 | 15020 | 0.94 |
| $V_3$ | $F_1$ | 64593 | 43537 | 2.07 |
| | $F_2$ | 61709 | 39588 | 1.79 |
| | $F_3$ | 70013 | 46398 | 1.96 |
| | $F_4$ | 61202 | 36803 | 1.51 |
| | $F_5$ | 61050 | 35507 | 1.39 |
| | $F_6$ | 45852 | 28410 | 1.63 |

*$F_1$-100% RDN through inorganic fertilizer; $F_2$-75% RDN (inorganic) + 25% RDN (organic) through vermicompost; $F_3$-50% RDN (inorganic) + 50% RDN (organic) through vermicompost; $F_4$-25% RDN (inorganic) + 75% RDN (organic) through vermicompost; $F_5$-100% RDN (organic) through vermicompost; $F_6$- Control.*

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