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*Review article*

# EFFECT OF DIFFERENT NUTRIENT MANAGEMENT OPTIONS ON RICE UNDER SRI METHOD OF CULTIVATION- A REVIEW

P. Sri Ranjitha[a] and K.I. Reddy[b]

[a]PhD Scholar, ANGRAU, Hyderabad, Andhra Pradesh, India.
[b]PhD Scholar, BCKV, Mohanpur, West Bengal, India.
Corresponding author, e-mail: indu4reddy@gmail.com

Rice (*Oryza sativa (L.)*) is one of the most important stable food crops in the world. In Asia, more than two billion people are getting 60-70 per cent of their energy requirement from rice and its derived products. In India, rice occupies an area of 44 million hectare with an average production of 90 million tonnes with productivity of 2.0 tonnes per hectare. Demand for rice is growing every year and it is estimated that in 2010 and 2025 AD the requirement would be 100 and 140 million tonnes respectively. To sustain present food self-sufficiency and to meet future food requirements, India has to increase its rice productivity by 3 per cent per annum [21]. Rice cultivation requires large quantity of water and for producing one kg rice, about 3000 - 5000 litres of water depending on the different rice cultivation methods such as transplanted rice, direct sown rice (wet seeded), alternate wetting and drying method (AWD), system of rice intensification (SRI) and aerobic rice. Owing to increasing water scarcity, a shifting trend towards less water demanding crops against rice is noticed in most part of the India and this warrants alternate methods of rice cultivation that aims at higher water and crop productivity. There are evidences that cultivation of rice through system of rice intensification (SRI) can increase rice yields by two to three fold compared to current yield levels.

So with this background the available literature on "Effect of different nutrient management options on rice under SRI method of cultivation" has been reviewed and presented under the following heads

## Growth

[22] Observed positive response in terms of plant height and biomass production with the application of recommended fertilizer level over farmers practices. [1] Opined that application of well decomposed compost to rice in SRI method favoured the improvement of better soil structure and supply of nutrients, which led to enhanced crop growth and biomass production. [6] Observed that enhanced rate of application of nitrogen would improve the leaf area index and photosynthetic activity in SRI. [9] Reported that the full growth potential of 7 to 14 days old seedlings would be exploited by addition of organic manures along with chemical fertilizers, rather than the application of individual sources alone.

Fertilizing the soil with farmyard manure or compost would promote positive soil biological processes; enhance the availability of nutrients over a longer period to remove balanced nutrients for better growth and development [13]. [24] reported that the status of available N, P and K was lower in treatments that received N, P and K fertilizers alone than in the treatments with vermicompost plus N, P and K besides poultry manure or sheep goat manure plus N, P and K and vermicompost from any one of the organic materials and N, P, K during the years 1999 and 2000, respectively. [3] observed maximum plant height and dry matter production at 60, 90 DAT and maturity, with application of FYM @ 10 t $ha^{-1}$ + 100 percent RDF which was on par with 100 percent RDF alone but was significantly superior to application of FYM alone (10 t $ha^{-1}$). Maximum number of tillers (190 and 397) was recorded with application of 100 percent RDF, followed by FYM @ 10 t $ha^{-1}$ + 100 percent RDF.

Application of 50 percent recommended dose of nitrogen (RDN) through poultry manure/FYM and remaining 50 percent RDN through inorganic fertilizers resulted in significantly taller plants (76.31 cm), maximum number of tillers hill$^{-1}$ (46) and greater dry matter (165.27, 163.60 g hill$^{-1}$) but was statistically on par with 100 percent RDN through inorganic sources of fertilizers [16]. [5] Stated that the growth attributes like height of plants (64.02 cm, 63.94 cm), number of effective tillers plant$^{-1}$ (16.56, 15.70) and dry matter accumulation plant$^{-1}$ (35.23 g, 34.50 g) were the highest with the application of 100 percent N through fertilizer than 50 percent N through fertilizer + 50 percent N through FYM. Plants grown under SRI method with FYM + RDF flowered and matured early as compared to application of fertilizer alone and the increase in productive tillers was 20 percent with RDF over no fertilizer [11].

## Yield attributes and yield

In SRI application of organic amendments in conjunction with inorganic fertilizer resulted in a positive correlation between number of tillers per plant and the number of grains panicle$^{-1}$ [22]. Experiments conducted by [2] in Madagascar showed that higher grain yield (6.26 t ha$^{-1}$) was obtained from plots with SRI method with the application of compost and was found superior to conventional rice cultivation. Use of chemical fertilizers alone in SRI practice increased yield, but did not contribute to soil quality, which was a key factor in SRI performance [19]. On farm trials conducted on SRI proved that addition of 2 t ha$^{-1}$ of organic matter and application of nitrogen by local recommendation produced significantly higher grain yield over organics alone in Indonesia [23]. [10] reported higher grain and straw yields under SRI method (5.6 and 5.98 t ha$^{-1}$ respectively) over conventional method with 50 percent chemical (N: P: K: S: Zn at 30:20:20:5:2.5 kg ha$^{-1}$) + 50 percent (cow dung @ 5 t ha$^{-1}$) organic fertilizer treatment (5.04 and 5.67 t ha$^{-1}$ respectively).

[3] reported that higher effective tillers, maximum filled grains per panicle (111) were observed with the application of FYM @ 10 t ha$^{-1}$ + 100 percent RDF (337) over 100 percent RDF (292.2) and FYM 10 t ha$^{-1}$ (261.7 and 96.7). The superiority of integrated nutrient management (INM) might be due to presence of humic acid compounds which helps in dissolution of minerals and chelation of micronutrients [14]. [16] stated that the application of 50 percent recommended dose of nitrogen (RDN) through poultry manure/FYM and remaining 50 percent RDN through inorganic fertilizers resulted in higher number of effective tillers hill$^{-1}$ (35.88, 34.83 respectively) and increased number of filled grains panicle$^{-1}$ (271.86, 265.56 respectively) but was statistically on par with 100 percent RDN through inorganic sources of fertilizers. [8] reported highest grain yield with 50 percent compost + 50 percent NPK source, which was at par with 50 percent FYM + 50 percent NPK in the year 2004 and both the practices produced significantly higher grain yield over FYM or compost or NPK fertilizer alone. However, in the year 2005, 50 percent compost + 50 percent NPK proved better than all the nutrient sources. Singh *et al.* (2006 b) stated that the grain yield differences among different nutrient management options under SRI were non-significant. [3] observed that in SRI, application of FYM @ 10 t ha$^{-1}$ + 100 percent RDF (100N + 60 $P_2O_5$ + 40 $K_2O$ kg ha$^{-1}$) recorded higher grain yield (5050 kg ha$^{-1}$) over that of application of 100 percent RDF (4725 kg ha$^{-1}$) and FYM @ 10 t ha$^{-1}$ alone (4132 kg ha$^{-1}$). Higher harvest index value (45.2 percent) was observed with the conjunctive use of organic and inorganic nutrient sources over their individual application of FYM 10 t ha$^{-1}$ and 100 percent RDF. [15] concluded that among the nutrient management practices studied, application of 100 percent NPK (80:60:40 kg ha $^{-1}$) + FYM @ 5 t ha$^{-1}$ resulted in significantly higher yield (4.7 and 5.5 t ha$^{-1}$ in 2005 and 2006 respectively), closely followed by 50 percent NPK + FYM @ 10 t ha$^{-1}$ and remained at par with each other irrespective of the establishment methods (SRI, ICM and Conventional methods).

Rice hybrid KRH-2 grown under SRI, with application of 50 percent nitrogen through FYM and 50 percent nitrogen through inorganic sources recorded significantly higher grain and straw yield (8.35 and 8.58 t ha$^{-1}$ respectively) but was on par with the treatment of 100 percent nitrogen supplied through inorganic source alone [16]. [21] found that highest grain yield of 5.8 t ha$^{-1}$ was obtained by the treatment *i.e.,* green leaf manure (6.25 t ha$^{-1}$) + recommended fertilizers compared to application of green manure alone in SRI method of cultivation. [5] reported that yield contributing characters like test weight of grains were found higher with the application of 100 percent N through fertilizer (17.81) which was on par with 50 percent N through fertilizer + 50 percent N through FYM (17.79). [11] Reported that application of FYM @ 10 t ha$^{-1}$ enhanced the seed yield by 6.38 percent over vermicompost. Treatment RDF (75:75:87.5) also recorded higher seed yield of 4.12 t ha$^{-1}$ compared to no fertilizer (3.33 t ha$^{-1}$). Application of FYM and RDF produced seeds with better quality.

Combined application of FYM @ 5 t $ha^{-1}$ along with half recommended levels of nitrogen through chemical and gypsum at 1 t $ha^{-1}$ registered highest yield (7.6 t $ha^{-1}$) than application of press mud at 5 t $ha^{-1}$ along with half recommended nitrogen through chemical and gypsum at 1 t $ha^{-1}$ (6.5 t $ha^{-1}$) [17]. [12] showed that the maximum yield obtained under SRI method was 7.3 t $ha^{-1}$ by applying 80 kg N $ha^{-1}$, while the maximum yield under conventional flooding was 6.4 t $ha^{-1}$ using 160 kg N $ha^{-1}$. [7] Found that NPK + Zn + S treatment recorded the highest grain yield (5.30 t $ha^{-1}$) when compared to other treatments like NPK (4.10 t $ha^{-1}$), NPK + Zn (4.84 t $ha^{-1}$), NPK + S (4.78 t $ha^{-1}$), NPK + FYM (4.93 t $ha^{-1}$).

## Nutrient uptake

Higher nitrogen uptake by grain and straw (56.0 and 26.7 kg $ha^{-1}$ respectively) was observed with the application of FYM @ 10 t $ha^{-1}$ + 100 percent RDF but was comparable with the treatment of 100 percent RDF alone. Similarly highest P and K uptake (16.6 kg $ha^{-1}$ and 10.3 kg $ha^{-1}$ P; 18.9and 127.1 kg $ha^{-1}$ K) by grain and straw was obtained by FYM @ 10 t $ha^{-1}$ +100 percent RDF, followed by 100 percent RDF and lowest was with FYM @ 10 t $ha^{-1}$ [3]. [20] stated that SRI and conventional method performed equally but SRI was significantly superior in NPK uptake when organic manure was applied. Total nitrogen uptake was maximum with the application of 100 percent N through fertilizer (79.05 kg $ha^{-1}$) as compared to 50 percent N through fertilizer + 50 percent N through FYM (77.74 kg $ha^{-1}$) [5]. Among the different nutrient applications, NPK + Zn + S treatment recorded the highest nutrient uptake followed by NPK + Zn, NPK + S and NPK + FYM. Application of NPK + FYM recorded highest quantity of available soil N, P and K content after crop harvest [7].

## Economics

[3] reported that gross returns were highest with FYM 10 t $ha^{-1}$ + 100 percent RDF (Rs 30,839 $ha^{-1}$). However, net returns and benefit cost ratio was maximum with 100 percent RDF (Rs 19,288 $ha^{-1}$ and 2.0 respectively) treatment. [4] revealed that SRI with integrated nutrient management (50 percent FYM + 50 percent RD of NPK) and SRI with 100 percent organic manuring saved 28.63 percent and 34.25 percent respectively input cost as compared to conventional method of transplanting with recommended fertilizer and cultural practices. Application of 100 percent nitrogen through fertilizer recorded maximum NMR (Rs 15331.80 $ha^{-1}$) and B: C ratio (2.08) when compared to that of 50 percent N through fertilizer + 50 percent N through FYM with a NMR of (Rs 9645 $ha^{-1}$) and B: C ratio (1.51) [5]. [7] found that application of NPK + Zn + S recorded higher mean values of net returns (Rs 58,982 $ha^{-1}$) and B:C ratio (1.99) followed by NPK + FYM (Rs 55,723 $ha^{-1}$ and 1.92).

## REFERENCES

[1] Barison, J 2002 a. Evaluation of nutrient uptake and nutrient- use efficiency of SRI and conventional rice cultivation methods in Madagascar. In: *Assessments of the System of Rice Intensification (SRI)*: Proceedings of an International conference held in Sanya, China, April 1-4, 143-147.

[2] Barison, J 2002 b. Nutrient use efficiency and nutrient uptake in conventional and intensive (SRI) rice cultivation systems in Madagascar. In: *Assessments of the System of Rice Intensification* (SRI). Proceedings of the International Conference, Sanya, China, April 1-4, Ithaca, NY (USA), CIIFAD, 61-69.

[3] Bharathy, V. E. 2005. Effect of FYM and rotary weeding on crop yield in the System of Rice Intensification (SRI). *M.Sc. (Ag.) Thesis*. Acharya N G Ranga Agricultural University, Hyderabad, India.

[4] Bhuva, N.P., Patel, R.R., Chauhan, N.P., Makwana, I.K., Mehta, A.M and Pathak, A.R. 2006. Performance of rice variety Gr-11 under System of Rice Intensification. In: *National Symposium on System of Rice Intensification (SRI)* –Present Status and Future Prospects, November 17-18, 65.

[5] Borkar, L.S., Khawale, V.S., Raut, B., Patil, T.S and Kolte Harsha, S. 2008. Studies on spacing and nitrogen management under System of Rice Intensification (SRI). Journal of Soils and Crops. 18 (2): 438-441.

[6] Bua, Jiang Dong, Dai Tingbo and Zbu Yan. 2002. Physiological characteristics and high yield techniques with SRI rice. *China Rice* published by Ministry of Agriculture, 116-124.

[7] Chandrapala, A.G., Yakadri, M., Mahender Kumar, R and Bhupal Raj, G. 2010. Productivity and economics of rice (*Oryza sativa*) - maize (*Zea mays*) as influenced by methods of crop establishment, Zn and S application in rice. Indian Journal of Agronomy. 55(3): 171-176.

[8] Dinesh Kumar., Shivay, Y.S and Mishra, B.N. 2006. Field evaluation of System of Rice Intensification (SRI) and Conventional Rice Culture (CRC) with organic and inorganic sources of nutrients in North India. In: *National Symposium on System of Rice Intensification (SRI)* - Present Status and Future Prospects, November 17-18, 96.

[9] Gani, A., Rahman, A., Dahono., Rustum and Hengsdijk, H. 2002. Synopsis of water management experiments in Indonesia. In: Water Wise Rice Production, IRRI, 29-37.

[10] Hossain, M.Z., Hossain, S.M.A., Anwar, M.P., Sarker, M.R.A and Mamun, A.A. 2003. Performance of BRRI Dhan 32 in SRI and conventional methods and their technology mixes. Pakistan Journal of Agronomy. 195-200.

[11] Krishna, A., Biradarpatil, N.K., Manjappa, K. and Channappagoudar, B.B. 2008. Evaluation of System of Rice Intensification (SRI) Cultivation, Seedling Age and Spacing on Seed Yield and Quality in Samba Mashuri (BPT-5204) Rice. Karnataka Journal of Agricultural Sciences. 21(1): 20-25.

[12] Limei Zhao, Lianghuan Wu, Yongshan Li., Xinghua Lu., Defeng Zhu and Norman Uphoff. 2009. Influence of System of Rice Intensification on rice yield and nitrogen and water use efficiency with different N application rates. Experimental Agriculture. 45: 275-286.

[13] Mc Hugh, O.V., Steenhuis, T.S., Barison, J., Fernandes, E.C.M and Uphoff, N. 2002. Farmer implementation of alternate wet-dry and non-flooded irrigation practices in the System of Rice Intensification (SRI). Water Wise Rice Production. IRRI, Philippines. 89 - 102.

[14] Mehra, R.K. 2006. Text book of Soil Science. *Indian Council of Agricultural Research*, Pusa, New Delhi, India, 489.

[15] Munda, G.C., Anup Das Patel, D.P. 2007. Performance of Lowland Rice (*Oryza sativa L.)* as influenced by Stand Establishment Methods and Nutrient Management Practices at Mid Altitude of Meghalaya. In: *SRI India 2007 Second National Symposium on System of Rice Intensification* (*SRI) in India*-Progress and Prospects. Papers and Extended Summaries, 3-5th October, Agartala, Tripura, India, 92-93.

[16] Prabhakara Setty, T.K., Bandi, A.G., Satnam Singh and Sanjay, M.T. 2007. Influence of Integrated Nutrient Management on growth and yield of hybrid rice under System of Rice Intensification (SRI) and Aerobic method of cultivation. In: *SRI India 2007*. *Second National Symposium on System of Rice Intensification (SRI) in India* – Progress and Prospects. Papers and Extended Summaries, 3-5th October, Agartala, Tripura, India, 82-84.

[17] Raju, R.A and Sreenivas, Ch. 2008. Agronomic evaluation of system of rice intensification methods in Godavari delta. Oryza. 45 (4): 280-283.

[18] Singh, A.P., Yadav, D.S and Singh, R.A. 2006 b. Effects of levels of nitrogen and number of seedlings on performance of hybrid rice (*Oryza sativa)*. *National Symposium on Conservation Agriculture and Environment*, Banaras Hindu University, Varanasi, October, 26-28, 211.

[19] Stoop, W.A., Uphoff, N and Kassam, A. 2002. A review of agricultural research issues raised by the System of Rice Intensification (SRI) from Madagascar: Opportunities for improving farming systems for resource poor farmers. Agricultural Systems. 71: 249-274.

[20] Surekha, K., Mahender Kumar, R., Padmavathi, Ch., Latha, P.C., Subba Rao, L.V., Ravindra Babu, V., Prasad, J.S., Srinivas Prasad, M., Muthuraman, P., Rupela, O.P., Vinod Goud, V., Rao, K.V and Viraktamath, B.C. 2007. In: *SRI India 2007 Second National Symposium on System of Rice Intensification (SRI) in India* – Progress and Prospects, Papers and Extended Summaries, 3-5th October, Agartala, Tripura, India, 85-86.

[21] Thiyagarajan T M 2007. SRI in Tami Nadu: Current Scenario In: *SRI India 2007 Second National Symposium on System of Rice Intensification (SRI) in India* – Progress and Prospects. Papers and Extended Summaries, 3-5th October, Agartala, Tripura, India, 136-138.

[22] Uphoff, N. 1999. Agroecological implications of the System of Rice Intensification (SRI) in Madagascar. Environment Development and Sustainability. Vol 1: 231-297.

[23] Uphoff, N and Randriamiharisoa, R. 2002. Reducing water use in irrigated rice production with the Madagascar System of Rice Intensification (SRI). In: Water Wise Rice Production, IRRI, Philippines, 71-87.

[24] Vasanthi, D and Kumaraswamy, K. 1999. Efficacy of vermicompost to improve soil fertility and rice yield. Journal of Indian Society of Soil Science. 47: 268-272.