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Performance of direct seeded rice as influenced by STCR based nutrient management

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Abstract
An experiment was conducted to assess performance of direct seeded rice under the soil test crop response (STCR) based nutrients management. The study was undertaken during *Kharif* season of 2016 at the soil science research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur Madhya Pradesh, India. The field experiment was laid out in four replications and six treatments *viz.*, T_1: Control, T_2: GRD (120:60:40 kg N, P_2O_5 and K_2O ha^{-1}), T_3: Targeted Yield 50 q ha^{-1} (115:90:49 kg N, P_2O_5 and K_2O ha^{-1}), T_4: Targeted Yield qha^{-1} (157:125:70 kg N, P_2O_5 and K_2O ha^{-1}), T_5: Targeted Yield 50 q ha^{-1} (115:90:49 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1}) and T_6: Targeted Yield 60 q ha^{-1}(157:125:70 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1}) in Randomized Block Design. Yield attributing characters like panicles per plant, panicle length (cm), panicle weight plant^{-1} (g), number of grains per panicle and test weight (g) were found higher in T_6 (1.45, 21.27, 19.81, 119.73 and 24.49, respectively) and increase to the tune of 17.88, 26.23, 29.73, 47 and 17.68%, respectively, over control. Similarly, seed and straw yield found maximum in T_6 with application of 157:125:70 kg N, P_2O_5 and K_2O with 5 t FYM ha^{-1} (5725 and 7623 kg ha^{-1}, respectively). The targeted yield of T_6 (60 q + 5 t FYM ha^{-1}) could not be achieved and deviated by ± 4.58% negatively, whereas the targeted yield of T_5 (50 q + 5 t FYM ha^{-1}) was obtained comfortably. Such findings explicitly showed that the usage of STCR-based fertilizers coupled with FYM was greatly successful in achieving the higher yield.

Keywords: STCR, fertilizers, manure, direct seeded rice, target yield

1. Introduction
Rice (*Oryza sativa* L.) is the most important crop in developing nations and a staple meal for over half of the population worldwide. Rice cultivation is the main single usage of land for food production, and consumes 9 per cent of the earth's arable land space Rice supplies energy for 21%, calories for 40% of the world 's population and 15% of protein per capita (IRRI, 2002) [5]. The slogan "RICE IS LIFE" is most appropriate for India as this crop plays vital role in our national food security and a mean of live hood for millions of rural households. India is the second largest rice producing country in the world after China. The nation needs to raise its food grain production to 450 million tonnes by 2050 to sustain food security. It implies the future of food production will come from improved paddy yield. In India, rice occupies 43 million ha (mha) and generates about 125 million tonnes (mt) with an average productivity of 2.85 t ha^{-1}. Rice alone contributes about 43 per cent to the basket of Indian food grain (Economic Survey 2016) [1].

Nowadays Direct Seeded Rice (DSR) becoming prominent due to its low input requirement particularly water. It gives a very good atmosphere to enhance water use efficiency and reduce labour requirement. In order to maximize the profitability of crops, farmers are disproportionately utilizing fertilizers that deteriorate soil quality and reduce benefit cost ratio. Thus the application of fertilizers without the proper knowledge of nutrient status of soil, cause adverse effect on soil and crop health both. So nutrient's balanced application is one of the most important factors for efficient crop growth and increasing the quality of the product. Soil and plant test based fertilizers application is now being promoted all over the world. Soil monitoring allows one to know the state of nutrients and their imbalances in the soil and to resolve the nutrients imbalances (Rao and Srivastava, 2000) [10]. In soil research, the fertilizer recommendation is generally provided for specific crops by taking into account only the usable soil nutrient level, through categorizing soil into small, medium and high fertility groups. Within fertility class there is a very broad range of variation of specific nutrients, farmers overlooking large variations in their actual volume in the soil, so the soil test and STCR equation gives the idea about application of accurate amount of nutrients. The STCR-based fertilizer recommendations also known as "Prescription Based Fertilizer Recommendations" take into account standard of nutrient present in soil to achieve targeted crop yields under a particular agro-climatic situation. Thus, the application of soil test-based nutrients not only helps in improving crop productivity but also increases the benefit cost ratio.

In the other side, increasingly changing habitats, climate change and water scarcity are severely affecting food stability. These problems may be overcome or reduced by implementing agro-ecological, organic, and other sustainable methods of farming. To achieve better yield, the entire biological alternative should be incorporated into the nutrient management practices. While doing so, it is necessary to bear in mind that it should be farmer's friendly, low cost and easily adaptable technology at local level. A judicious mix of organic and Inorganic nutrient sources is important for sustainable agriculture which can guarantee high-quality food production (Nambiar, 1991) [9].

2. Material and Methods

The investigation was conducted in *Kharif* season of 2016 at the soil science research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) to assess performance of direct seeded rice as influenced by STCR based nutrient management. The crop cultivar *Kranti* was grown with different treatments based on STCR equation for present investigation. Initial soil samples were collected and analyzed for pH, EC, organic carbon, available nitrogen, Phosphorus and Potassium (Table 1). Based on these soil test values and target yield (50 q ha^{-1} and 60 q ha^{-1}) the fertilizers were calculated using STCR equation and added to the different treatments. The study was consists of six treatments of nutrient management to achieve the targeted yield of rice which were replicated four times in a randomized block design.

2.1 STCR based nutrient application

Fertilizer Adjustment Equations for Rice

$FN = 4.25\ T - 0.45\ SN$

$FP_2O_5 = 3.55\ T - 4.89\ SP$

$FK_2O = 2.10\ T - 0.18\ SK$

Whereas, FN - Fertilizer nitrogen (kg ha^{-1}), FP_2O_5 - Fertilizer phosphorus (kg ha^{-1}), FK_2O - Fertilizer potassium (kg ha^{-1}), T - Desired yield target (q ha^{-1}), SN - Available soil nitrogen (kg ha^{-1}), SP - Available soil phosphorus (kg ha^{-1}) and SK - Available soil potassium (kg ha^{-1}).

The treatments details are:-

T_1: Control

T_2: General recommended dose (120:60:40 kg N, P_2O_5 and K_2O ha^{-1})

T_3: Targeted Yield 50 q ha^{-1} (115:90:49 kg N, P_2O_5 and K_2O ha^{-1})

T_4: Targeted Yield 60 q ha^{-1} (157:125:70 kg N, P_2O_5 and K_2O ha^{-1})

T_5: Targeted Yield 50 q ha^{-1} with 5 t FYM ha^{-1} (115:90:49 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1})

T_6: Targeted Yield 60 q ha^{-1} with 5 t FYM ha^{-1} (157:125:70 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1})

The source of nitrogen, phosphorus and potassium were urea, single super phosphate and muriate of potash, respectively. Full doses of phosphorus, potassium and half dose of nitrogen as per treatment were applied as basal. The remaining half amount of nitrogen was top-dressed in two split doses at 30 and 60 DAS.

In this experiment, five tagged plants were picked from each plot and then the number of panicles of each plant was counted by hand and represented as a mean value. In the same plants, at the time of harvest, five panicles from marked plants of each plot were randomly selected and the number of tillers was counted and the length of each panicle was calculated from base to tip of panicle with the help of measuring scale and expressed as average in cm. After that the panicle weight of each plant taken by means of electronic balance. The mean panicle weight was figured out and presented as an average in g. The number of grains $panicle^{-1}$ collected from the random panicles as the plot wise and expressed as the mean value. Random grain samples were taken from each plot and then 1000 grains were counted manually and the final weight was correctly measured and represented in g with the help of electronic balance. Crop was harvested and bundles rendered plot wise and permitted to dry for 2-3 days in the field and then weighed. Plot wise manual threshing was done and yields of grain and straw were calculated and expressed in kg ha^{-1}.

Experimental data was statistically analyzed by the standard analysis of variance technique appropriate to randomized block design to test the significance of treatment as suggested by Gomez and Gomez (1984) [5].

3. Results and Discussion

3.1 Effect of different treatments on yield attributes

The results of the experiment indicated that the data on yield attributes (*Viz.*, number of panicles $plant^{-1}$, panicle length, panicle weight $plant^{-1}$, number of grains $panicle^{-1}$ and 1000-grain weight or test weight of grains) given in Table 2. influenced by different treatments of fertilizers with and without FYM. The maximum value of number of panicles per plant (1.45) were observed under treatment T_6 (157:125:70 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}) which is 17.88% higher over control (1.23). Maximum significant increment in panicle length (21.27 cm) was recorded under the treatment T_6, which was statistically at par with T_2, T_3, T_4 and T_5, whereas minimum panicle length (16.85 cm) was observed under control. Thus treatment T_6 average panicle length higher by 26.23% over control. Kumar *et al.* (2014) [6] have also confirmed that the application of 125% RDF + 5 t vermicompost ha^{-1} increased the panicle length (23.12%) of rice over control significantly.

It is evident from the data that panicle weight $plant^{-1}$ (19.81 g) was observed significantly higher under treatment T_6 (29.73% higher) as compare with control. Application of higher doses of NPK nutrients with FYM (T_6) had obtained significantly maximum number of grains $panicle^{-1}$ (119.73) over control, which was statistically at par with T_3, T_4 and T_5. However, the minimum number of grains $panicle^{-1}$ (81.45) was associated with control, followed by T_2 (99.73). It means in treatment T_6 number of grains per panicle increased 47% as compare to control.

3.2 Effect of different treatments on yield

Data on test weight of grains as significantly affected by various treatments are presented in table 3. Significantly maximum test weight of grains (24.49 g) was registered under treatment T_6 (157:125:70 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}), whereas minimum test weight of grains (20.81 g) was found in control plot, followed by GRD (23.17 g). Similarly, grain and straw yield were found significantly higher in T_6 (5725 and 7623 kg ha^{-1}, respectively) over control. The targeted yield of T_6 (60 q ha^{-1}) could not be achieved and deviated by

4.58% negatively; whereas the targeted yield of T_5 (50 q ha^{-1}) was obtained conveniently. The target grain yield was achieved only in treatment T_5 which was significantly increased over control. Maximum grain yield (5725 kg ha^{-1}) was recorded with application of 157:125:70 kg N:P_2O_5:K_2O + 5 t FYM ha^{-1}, which was statistically significant with other treatments except T_4 and T_5, whereas minimum grain yield of 2781 kg ha^{-1} was found under control. The effect of treatments on straw yield also followed the similar trend as that of grain yield. The higher yield of straw (7623 kg ha^{-1}) was obtained with higher level of inorganic fertilizers along with FYM (T_6), which was significantly superior to control (4295 kg ha^{-1}), T_2 (GRD) and T_3. However, it was statistically at par with T_4 and T_5. Singh and Verma (2001) [11] stated that application of FYM @ 10 t ha^{-1} coupled with 50% recommended N recorded maximum values of yield attributes of rice *viz.*, number of tillers $hill^{-1}$, panicle length, grains $panicle^{-1}$ and there was 77.6% increase in the grain yield of rice over control. Improvement in yield attributes may be ascribed to adequate and regular nutrients supplying capacity of the soil and translocation of nutrients to the sink. The improvement in yield and yield traits under higher level nutrients might be due to higher absorption of nutrients and increased photosynthesis activity lead higher accumulation of biomass.

Similar findings were also reported by Naing Oo *et al.* (2010) [8], Subehia and Sepehya (2012) [12], Gautam *et al.* (2013) [3], Kumar *et al.* (2014) [6] and Mahmud *et al.* (2016) [7]. Earlier, Chesti *et al.* (2015) [2] reported that significantly higher grain yield of 5.36 t ha^{-1} with the application of 100% NPK+10 t FYM ha^{-1} as compared to the grain yield of 4.96 t ha^{-1} with the 100% NPK alone. It is evident from the data that the numerically higher value of harvest index (42.89%) was recorded under T_6, whereas minimum (39.30%) in control, followed by (41.97%) in T_2.

Table 1: Chemical properties of soil at initial stage

Name of Chemical properties	pH	Electrical Conductivity (dS m^{-1} at 25 ^{0}C)	Organic Carbon (g kg^{-1})	Available Nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})
Analysed value	7.57	0.321	5.41	217.83	21.45	311.57
Soil category	Neutral to slightly alkaline	Safe	Medium	Low	High	Medium

Table 2: Effect of different treatments on yield attributes of rice

Treatments	No. of panicles per plant	panicle length (cm)	Panicle weight $plant^{-1}$ (g)	Number of grains per panicle
T_1: Control	1.23	16.85	15.27	81.45
T_2: GRD	1.31	19.33	18.31	99.73
T_3: T.Y. 50 q ha^{-1}	1.34	19.97	18.73	105.39
T_4: T.Y. 60 q ha^{-1}	1.41	20.75	19.35	113.21
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	1.39	20.61	19.23	112.17
T_6: T.Y. 60 q ha^{-1} + 5 t FYM ha^{-1}	1.45	21.27	19.81	119.73
SEm ±	0.06	0.77	0.74	4.93
CD *(p=0.05)*	0.17	2.37	2.27	15.17

Table 3: Effect of different treatments on yield of rice

Treatments	Grain (kg ha^{-1})	Straw (kg ha^{-1})	Test weight (g)	Harvest Index (%)
T_1: Control	2781	4295	20.81	39.30
T_2: GRD	4237	5859	23.17	41.97
T_3: T.Y. 50 q ha^{-1}	4819	6587	23.55	42.25
T_4: T.Y. 60 q ha^{-1}	5371	7235	24.21	42.61
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	5213	7051	23.87	42.51
T_6: T.Y. 60 q ha^{-1} + 5 t FYM ha^{-1}	5725	7623	24.49	42.89
SEm ±	219	313	0.91	1.77
CD *(p=0.05)*	675	963	2.81	NS

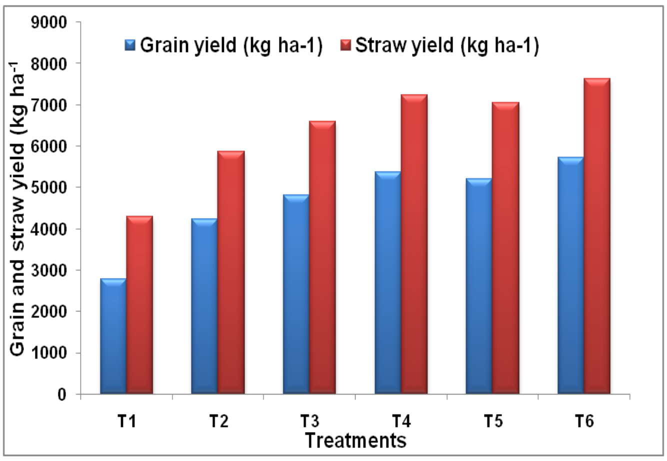

Fig 1: Grain and straw yield of rice as influenced by different treatments

4. Conclusion

STCR equation and target yield based application of fertilizers and manure would help to provide the appropriate amount of nutrient for the crop. It not only helps to enhance crop yield but fetch higher net return also. If the nutrient availability in soil and requirement for a targeted yield is known, the fertilizer requirement can be calculated from the scientific equations. STCR technology is very useful to improve farmer's knowledge about the amount of soil nutrients that are present in the soil and nutrient requirement of the crop which will enhance productivity of the crop.

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6. References

1. Anonymous, Annual Report, Directorate of Economics & Statistics, Directorate of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, Krishi Bhawan, New Delhim 2016.
2. Chesti MH, Kohli A, Mujtaba A, Sofi JA, Nazir Q, Tabasum Peer QJA *et al*. Effect of integrated application of inorganic and organic sources on soil properties, yield and nutrient uptake by rice (*Oryza sativa* L.) in Intermediate Zone of Jammu and Kashmir. Journal of the Indian Society of Soil Science. 2015; 63(1):88-92.
3. Gautam P, Sharma GD, Rachana R, Lal B. Effect of integrated nutrient management and spacing on growth parameters, nutrient content and productivity of rice under system of rice intensification. International Journal of Research in Bio Sciences. 2013; 2(3):53-59.
4. Gomez AA, Gomez KA. Statistical procedures for Agricultural Research. 2nd Edn. John Wiley and Sons, New York, 1984.
5. International Rice Research Institute. Rice Almanac, 3rd Edition. (Gramene Reference ID 8379), 2002.
6. Kumar A, Meena RN, Yadav Lalji, Gilotyia YK. Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice. The Bio-scan. 2014; 9(2):595-597.
7. Mahmud AJ, Shamsuddoha ATM, Nazmul HM. Effect of Organic and Inorganic Fertilizer on the Growth and Yield of Rice (*Oryza sativa* L.). Nature and Science. 2016; 14(2):45-54.
8. Naing Oo A, Banterng P, Polthanee A, Trela-Ges V. The effect of different fertilizers management strategies on growth and yield of upland Black Glutinous rice and soil property. Asian Journal of Plant Sciences. 2010; 9:414-422.
9. Nambiar KKM. Long-term fertility effects on wheat productivity. In wheat for the Non-traditional Warm areas, (ed.) Saunders D.A., CIMMYT, 1991, 516-521.
10. Rao AS, Srivastava. Soil test based fertilizer use: a must for sustainable agriculture. Fertilizer News. 2000; 45(2):25-28.
11. Singh RP, Verma TS. Dynamics of nitrogen fractions with long term addition of lanatana camera biomass in rice-wheat cropping sequences. Journal of the Indian Society of Soil Science. 2001; 49:407-412.
12. Subehia SK, Sepehya Swapana. Influence of long-term nitrogen substitution through organics on yield, uptake and available nutrients in a rice-wheat system in an acidic soil. Journal of the Indian Society of Soil Science. 2012; 60(3):213-217.