Journal of AgriSearch, 10 (4): 217-220
An Open Access International Peer Reviewed Quarterly

ISSN : 2348-8808 (Print), 2348-8867 (Online)
https://doi.org/10.21921/jas.v10i04.14375

# Productivity and Economics of Wheat under STCR based Nutrient Management in Alluvial Soil of North-West Bihar

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## ABSTRACT

A field experiment with six treatments of nutrients application under STCR approach was conducted during two successive *rabi* seasons of 2021-22 and 2022-23 to evaluate the productivity and economics of wheat. Results of two years study revealed that highest grain and straw yields (4.83 and 6.10 t ha$^{-1}$) were obtained under STCR approach with FYM against the targeted yield of 5.0 t ha$^{-1}$. It was found that among the STCR treatments integration of FYM produced significantly higher yield over those treatments hiving no FYM. It is also revealed that net return in STCR approach without integration of FYM was 9.82 to 27.89 percent higher than RDF whereas, integration of FYM with STCR enhances the net return 18.22 to 23.87 percent over STCR approach only. Therefore, the present study reveals that STCR approach of nutrient application is superior practice for enhancing productivity and net returns from wheat cultivation.

**Keywords:** Alluvial soil, Nutrient management, STCR, Wheat productivity

**ARTICLE INFO**

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|---|---|---|
| Received on | : | 29.11.2023 |
| Accepted on | : | 30.11.2023 |
| Published online | : | 31.12.2023 |



## INTRODUCTION

In India, wheat (*Triticum aestivum*, L.) is the second most important food crop after rice both in terms of area and production. It is a staple food for about a billion people in as many as 43 countries of the world (Verma *et al.* 2010). After green revolution, introduction of high yielding varieties (HYVs) coupled with spreading out of irrigation facilities, and augmented use of chemical fertilizers and other agro-chemicals have brought about impressive increase in the yield of wheat crop. About 50% of the total increase in food grain production has been attributed to the use of fertilizers and more than one-third of this increase is due to N-fertilizes alone. Fertilizer is one of the costliest inputs in agriculture and the use of right amount of fertilizer is fundamental for farm profitability and environmental protection (Kimetu *et al.* 2004). But, the cost of chemical fertilizers has been enhanced in recent years and altering the net return per unit area and at the same time unbalance use of nutrient fertilizers are practiced by the farmer which addicting the soil for higher doses and also leading to diminish the factor productivity and soil health.

Disproportion of nutrients application under traditional cultivation practice has been corrected through recommended dose of fertilizers (RDF) in past to the some extent while this practice is felt now erroneous in light of declining soil health due to intensive agriculture practices widening the gap between removal and supplied nutrients. The approach of soil test based nutrients application for targeted yields of crops (STCR) introduced by Truog (1960) and modified by Ramamoorthy *et al.* (1967) is now well established. This approach facilitates the farmers to apply only required amount of nutrient fertilizer matching with crop needs and fertility status of soil to realize the yield targets and sustain the soil fertility (Regar and Singh, 2014). Keeping all this point in mind the present investigation was conducted to determine the effect of soil test crop response approach with FYM and without FYM on wheat yield and economics in entisol.

## MATERIALS AND METHODS

In the present study field experiment was conducted with six treatments of nutrients application viz. **$T_1$:** Farmers practices (N:P:K:: 140:50:20), **$T_2$:** Recommended dose of fertilizers (N:P:K:: 120:60:40), **$T_3$:** STCR based targeted yield of 4 t ha$^{-1}$, **$T_4$:** STCR based targeted yield of 5 t ha$^{-1}$, **$T_5$:** STCR based targeted yield of 4 t ha$^{-1}$ with 5 t ha$^{-1}$ FYM, **$T_6$:** STCR based targeted yield of 5 t ha$^{-1}$ with 5 t ha$^{-1}$ FYM with three replications in randomized block design at Krishi Vigyan Kendra, Piprakothi, East Champaran, Bihar (26.54$^0$ N, 84.94$^0$ E) during two successive rabi seasons of 2021-22 and 2022-23 to evaluate the productivity and economics of wheat grown under soil test crop response (STCR) approach with and without integration of FYM. The soil of the experimental field was calcareous in nature. Based on soil test values of available nutrients and yield targets nutrients requirements were calculated using fertilizer adjustment equations developed for wheat. The soil test values, fertilizer adjustment equations and nutrients requirement obtained for corresponding yield targets has been given in Table 1 and 2.

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**Table 1:** Soil test value of nutrients and fertilizer adjustment equations used for calculation of fertilizer for young calcareous alluvial soil

| Nutrients in Soil | 2021-22 | 2022-23 | Fertilizer adjustment equation |
|---|---|---|---|
| Available N (Kg ha$^{-1}$) | 233.8 | 241.3 | FN = 5.95 T- 0.43 SN |
| Available $P_2O_5$ (Kg ha$_{-1}$) | 34.4 | 32.7 | $FP_2O_5$ = 3.03 T- 1.34 $SP_2O_5$ |
| Available $K_2O$ (Kg ha$^{-1}$) | 151.8 | 162.8 | $FK_2O$ = 3.16 T- 0.73 $SK_2O$ |

Where: FN, FP & FK= Nutrient (N, $P_2O_5$ & $K_2O$) applied through fertilizer (kg ha$^{-1}$) SN, $SP_2O_5$ & $SK_2O$= Available nutrient (N, P & K) in soil (kg ha$^{-1}$) T= Targeted yield (q ha$^{-1}$)

**Table 2:** Nutrients requirements computed from fertilizer adjustment equations for corresponding yield targets (Nutrients contributed through FYM is subtracted from actual).

| Treatments | 2021-22 | | | 2022-23 | | |
|---|---|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | N | $P_2O_5$ | $K_2O$ |
| Farmers practices (N:P:K:: 140:50:20) | 140 | 50 | 20 | 140 | 50 | 20 |
| RDF (N:P:K:: 120:60:40) | 120 | 60 | 40 | 120 | 60 | 40 |
| Targeted yield of 4 t ha$^{-1}$ | 137 | 75 | 30 | 134 | 77 | 26 |
| Targeted yield of 5 t ha$^{-1}$ | 197 | 105 | 62 | 194 | 108 | 58 |
| Targeted yield of 4 t ha$^{-1}$ with 5 t ha$^{-1}$ FYM | 112 | 65 | 5 | 109 | 67 | 1 |
| Targeted yield of 5 t ha$^{-1}$ with 5 t ha$^{-1}$ FYM | 172 | 95 | 37 | 169 | 98 | 33 |

After computation of the nutrients requirement for different treatments the contribution from FYM was subtracted from the actual amount of computed nutrients requirements. Half of the nitrogen and full amount of phosphorus and potassium and total FYM was incorporated in to the soil prior to sowing of wheat and remaining nitrogen was applied in two equal splits at CRI and flowering stages. Other standard agronomic practices are followed to raise the crop. Plot wise yield data was recorded to compute the productivity per hectare. The economics of the cultivation was calculated on the basis of prevailing cost of inputs and produce in local market and minimum support price (MSP). The experimental data were analyzed using standard statistical procedures given Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### Productivity of wheat

The data pertaining to grain and straw yield of wheat during 2021-22 and 2022-23 are presented in Table 3 and pooled values are presented in Fig. 1. The results showed that during both the years of experimentation grain and straw yield under farmers practices treatment was significantly lower than other treatments. Grain yield under STCR approach treatments was significantly high. The result clearly indicated that integration of FYM with STCR further increased the wheat yield of STCR approach of nutrients application alone at the same yield target levels. The results further indicated that maximum grain yield was obtained under T6 treatment (Targeted yield of 5.0 tha$^{-1}$+ FYM @ 5 t ha$^{-1}$) followed by T5 treatment (Targeted yield of 4 tha$^{-1}$ + FYM @ 5 t ha$^{-1}$). Highest straw yield was also obtained in T6 treatment followed by T5 treatment during both years. Increased yield under STCR approach with and without FYM might be because of balanced use of fertilizers as per soil and crop demand for potential growth and development. Integration of FYM with STCR further increased yield may be because of better

**Table 3:** Grain and straw yield of wheat under STCR approach

| Treatments | Grain Yield (t ha$^{-1}$) | | Straw Yield (t ha$^{-1}$) | |
|---|---|---|---|---|
| | 2021-22 | 2022-23 | 2021-22 | 2022-23 |
| $T_1$: Farmers practices (N:P:K:: 140:50:20) | 3.52$^a$ | 3.44$^a$ | 4.47$^a$ | 4.37$^a$ |
| $T_2$: RDF (N:P:K:: 120:60:40) | 3.67$^a$ | 3.73$^b$ | 4.87$^b$ | 4.74$^b$ |
| $T_3$: Targeted Yield of 4 t ha$^{-1}$ | 3.84$^b$ | 3.97$^c$ | 4.89$^b$ | 5.26$^c$ |
| $T_4$: Targeted Yield of 5 t ha$^{-1}$ | 4.32$^c$ | 4.15$^c$ | 5.51$^c$ | 5.49$^d$ |
| $T_5$: Targeted Yield of 4 t ha$^{-1}$ with 5 t ha$^{-1}$ FYM | 4.52$^c$ | 4.61$^d$ | 5.77$^d$ | 5.89$^e$ |
| $T_6$: Targeted Yield of 5 t ha$^{-1}$ With 5 t ha$^{-1}$ FYM | 4.83$^d$ | 4.77$^d$ | 6.07$^e$ | 6.10$^f$ |
| SE(m) | 0.08 | 0.06 | 0.07 | 0.05 |
| CD(p=0.05) | 0.25 | 0.18 | 0.21 | 0.15 |

conditioning of rhizospheric environment through FYM addition resulted in potential movement of water, air, temperature and nutrients in soil. Integration of organic source of nutrients with inorganic fertilizers significantly increases the available content of nutrients in soil and also improves soil environment (Karem *et al.* 2012; Brijesh *et al.* 2023).

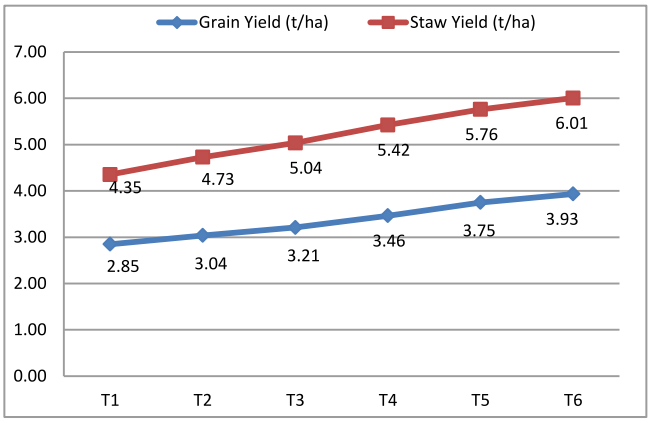


**Fig. 1**: STCR approach with and without FYM on grain and straw yields of wheat (Pooled data of 02 years)

**Economics of wheat production under STCR approach**

The data pertaining to production economics of wheat under STCR approach of nutrients application with and without integration of FYM for different yield targets are given in Table 4. The results indicated that net return (Rs $ha^{-1}$) in STCR approach without integration of FYM was 9.82 to 27.89 per cent higher than RDF whereas, integration of FYM with STCR enhances the net return 18.22 to 23.87 percent over STCR approach only. Under STCR approach with and without integration of FYM resulted higher net returns might be because of higher productivity resulted from greater nutrients use efficiency, which is well supported by Rai *et al.* (2016) who also reported that balanced application of plant nutrients increases the yield and nutrient use efficiency.

**Table 4:** Economics of wheat production under STCR approach

| Treatment | 2021-22 | | | | 2022-23 | | | |
|---|---|---|---|---|---|---|---|---|
| | Cost of nutrients (Rs. $ha^{-1}$) | Cost of produce (Rs. $ha^{-1}$) | Net return (Rs. $ha^{-1}$) | B:C ratio | Cost of nutrients (Rs. $ha^{-1}$) | Cost of produce (Rs. $ha^{-1}$) | Net return (Rs. $ha^{-1}$) | B:C ratio |
| **T1** | 5639 | 70928 | 28589 | 1.93 | 5639 | 73100 | 30761 | 1.99 |
| **T2** | 7080 | 73950 | 30170 (5.53)* | 2.01 | 7080 | 79262 | 35482 (15.34)* | 2.15 |
| **T3** | 7541 | 77376 | 33135 (9.82)** | 2.10 | 7378 | 84362 | 40284 (13.53)** | 2.29 |
| **T4** | 11763 | 87048 | 38585 (27.89)** | 2.37 | 11602 | 88187 | 39885 (12.40)** | 2.40 |
| **T5** | 11482 | 91078 | 42396 (18.22)*** | 2.44 | 11318 | 97962 | 49444 (23.34)*** | 2.63 |
| **T6** | 15704 | 97324 | 44420 (23.87)*** | 2.61 | 15542 | 101362 | 48620 (21.29)*** | 2.72 |

**Note: 1.** Cost of nitrogen, phosphorus, potassium in terms fertilizer like Urea, DAP and MoP is 592/-, 2700/- and 3500/- per quintal respectively and FYM was 125/- per quintal during the study period at East Champaran.

**Note: 2.** MSP of wheat was 2015/- per quintal in market year 2022-23 and 2125/- per quintal in market year 2023-24

**Note: 3.** Values in parenthesis are per cent increase. (* increase due to RDF over FP ** increase due to STCR over RDF and *** increase over STCR due to integration of FYM).

## CONCLUSIONS

The STCR approach of nutrients recommendations with and without integration of FYM is superior over general recommended dose of fertilizer application for enhancing the productivity and net returns, whereas the STCR approach with FYM was found most productive technique for cultivation of wheat in entisol of north-west Bihar. The STCR-based targeted yield approach also improves economic yields as it supplies nutrients as per crop requirement. Thus, STCR approach may be advised for its use by the farmers for getting higher crop productivity and profitability.

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**Citation:**

Kumar A, Singh AK, Rai A, Gangwar A, Kumar M, Pareek N, Kapil ST, Chanu NB, Padhi GK, Panda PP, Gupta RK and Kumar S.2023.Productivity and Economics of Wheat under STCR based Nutrient Management in Alluvial Soil of North-West Bihar. *Journal of AgriSearch* **10**(4): 217-220