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STCR-based Fertilizer Recommendation under Integrated Nutrient Management for Higher Productivity of Wheat Crop (*Triticum aestivum* L.)

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ABSTRACT: A field study involving nine treatments comprising STCR-based integrated nutrient management modules to improve soil health, fertilizer-use efficiency and productivity of wheat crop (*Triticum aestivum* L.) was conducted in randomized block design during 2021-22 and 2022-23 at Rajasthan College of Agriculture, Udaipur, Rajasthan, India. STCR based integrated nutrient management study was conducted to examine its importance in attaining target yields, improving soil nutrient status and nutrient utilization in wheat (*Triticum aestivum* L.). The experiment was carried out for two consecutive years in the wheat crop. The nitrogen (N), phosphorus (P) and potassium (K) requirement for attaining targeted yield of wheat (50 q/ha) were estimated following soil test crop response-based target yield equations (TYE). Results indicated that the 75% STCR + vermicompost (2 t/ha) (T_6) recorded highest grain (5321 kg/ha) and straw (7048 kg/ha)yield of wheat, which were 21.37 and 21.66 % higher in terms of grain and straw yield over 100 % RDF (T_2), respectively. 75% STCR + vermicompost (2 t/ha) was remained statistically at par with the treatment 75% RDF + vermicompost (2 t/ha) (T_4) with respect to grain and straw yield of wheat. The available N, P_2O_5 and K_2O content in post-harvest soil were significantly improved with 100% RDF through vermicompost + Azotobacter (T_8)and it was found statistically at par with the application of treatments 75% STCR + vermicompost (2 t/ha) (T_6)and 75% RDF + vermicompost (2 t/ha) (T_4). The two year study based on STCR under INM clearly demonstrated that STCR based integrated use of fertilizers can produce target yields and save the fertilizer without destroying soil fertility and soil health.

Keywords: STCR, Integrated Nutrient Management, Soil Nitrogen, Phosphorus, Potassium, Wheat.

INTRODUCTION

Wheat [*Triticum aestivum* L.] is one of the world's and India's most important staple food crop. It may be grown in a variety of soil and climatic conditions. It is a nutritious diet that contains around 78 percent carbohydrate, 12 percent protein, 2 percent fat and minerals, as well as a significant quantity of vitamins. At present nutrient mining is a major threat for agricultural soil as there is wide gaps between crop removal and fertilizer application have been created by irregular supplement use. The profitability of fertilizers over the past 35 years has shown a declining trend, from 48 kg of food grains per kg of NPK fertilizer in 1970–1971 to 10 kg of food grains per kg of NPK fertilizer in 2007–2008 (Aulakh and Benbi 2008; Subba Rao and Reddy 2009). The use of the proper amount of fertilizer is essential for farm productivity and environmental assurance. Fertilizer is likely the most expensive component of the agribusiness. Farmers that apply inorganic fertilizers without knowledge of the soil's nutrient condition or the crop's need for the supplement have adverse effects on both the crop and the soil, including hazardous supplement quality and a lack of it due to misuse or inadequate application. Using the soil test crop response (STCR) approach, there is a great deal of potential to boost wheat productivity. This method uses fertiliser adjustment equations to prescribe fertiliser doses when a substantial correlation between the applied fertilisers and soil test results has been established. Because the STCR correlation idea combines soil and plant analysis to provide information on the actual balance between applied and accessible nutrients in the soil, its recommendations are more quantitative, accurate, and significant (Sharma *et al.*, 2016).

On the other hand, although organic manure is a useful and renewable source of nutrients, its application to soils alone is insufficient to satisfy the nutrient

requirements of contemporary crop types, which leads to low crop yields. However, their ongoing use improves the soil's resistance and resilience capacity in addition to its biological activity, biomass, diversity, and physical characteristics (Sharma *et al.,* 2015; Kumar *et al.,* 2014). Therefore, integration of inorganic with organics may go long way in maintaining sustainable crop production and enhancing soil health through their complementary effects (Antil *et al.,* 2011). Soil test crop response (STCR) based integrated fertiliser use in combination with vermicompost and chemical fertiliser through soil test method is therefore necessary to improve the nutrient delivery system in terms of balanced nutrient management. Therefore, the goal of the current study was to evaluate the effect of of soil test crop response based fertilizer recommendations for wheat crop.

MATERIAL AND METHODS

A field experiment was conducted with wheat crop variety DBW-187 at Rajasthan College of Agriculture, Udaipur, Rajasthan in *Rabi* seasons of 2021-22 and 2022-23. The experiment was laid out in randomized block design with three replications and nine treatments. The following treatments were imposed *viz*., T_1 : Control, T_2: 100% RDF (120-60-40), T_3:STCR based NPK Fertilizer dose, T_4:75% RDF + Vermicompost (2 t/ha), T_5:50% RDF + Vermicompost (4 t/ha),T_6:75% STCR + Vermicompost (2 t/ha),T_7:50% STCR + Vermicompost (4 t/ha),T_8: 100% RDF through Vermicompost + Azotobacter, T_9 : Integrated nutrient management (INM) - 50% of nutrients through organic (Vermicompost) + 50% of nutrients through inorganic Fertilizer + Azotobacter. Nutrients doses (kg/ha) were calculated from the fertilizer adjustment equations for targeting yield 50 q/ha of wheat crop. The fertilizer adjustment equations given below:

$FN= 4.40T-0.40SN$

$FP_2O_5= 4.00T-5.73SP$

$FK_2O= 2.53T-0.16SK$

Where, (FN, FP_2O_5 and FK_2O = Fertilizer doses (kg ha^{-1}) and (SN, SP and SK = Soil test values (kg ha^{-1}), T stand for Target Yield of the crop (q ha^{-1})

A calculated quantity of nitrogen was added in accordance with urea treatments. The wheat crop received a half dose of nitrogen as a basal at planting and the other half in two equal splits at tillering and heading. At the time of wheat sowing, phosphorus and potassium were added in accordance with treatments using DAP and muriate of potash as a base dose. The required quantity of vermicompost was applied two weeks before sowing of the crop as per treatment. The sowing of wheat was done in the month of November during *Rabi* season 2021-22 and 2022-23. The irrigations were given as per need of the crop and two hand weeding were done for removing the weeds from experimental field. The yields (grain and straw of crop) were recorded at harvest. The soil samples collected after harvest of crop were analyzed for available nitrogen by alkaline permanganate method (Subbaiah and Asija 1956), available phosphorus (Olsen *et al.*, 1954) and available potassium by ammonium acetate method (Richards,1954). Statistical methods Panse and Sukhatme (1985) were used for analyzing the data.

RESULTS AND DISCUSSION

Yield. Application of 75% STCR + Vermicompost (2 t/ha) (T_6) significantly increased the grain and straw yield of wheat as compared to other treatments (Table 1 and Fig. 1). Integrated use of fertilizer with 2 tonnes vermicompost/ha based on STCR recorded significantly higher grain and straw yield (5296 and 5346 kg/ha, mean 5321 kg/ha) and (7029 and 7066 kg/ha, mean 7048 kg/ha), respectively and it was remained at par with the treatment 75% RDF + vermicompost (2 t/ha) (T_4) during both years of experiments as well as in pooled analysis. Other treatments, *i.e.,* T_9, T_7 and T_5 were found statistically at par with each other in respect of grain yield as well as straw yield of wheat, but these treatments recorded significantly higher grain as well as straw yield of wheat over the STCR based NPK Fertilizer dose (T_3) and 100% RDF (120-60-40) (T_2). Increased productivity may result from improved physical, chemical, and biological qualities, as well as from increased microbial activity and the transformation of inaccessible nutrients into available forms (Sharma *et al.,* 2015). The higher yield of wheat seemed to be the cumulative effect of yield attributes which was boosted by balanced nutrient supply (Yaduvanshi *et al.*, 2013).

Soil fertility. Application of 100% RDF through vermicompost + Azotobacter (T_8) significantly increased the available N, P_2O_5 and K_2O content in soil over STCR based chemical fertilizer and recommended dose of fertilizer (Table 2). The higher amount of available nitrogen (314.68 and 316.76 kg/ha, mean 315.72 kg/ha) was noted with 100% RDF through vermicompost + Azotobacter (T_8) and it was found statistically at par with the application of treatments 75% STCR + vermicompost (2 t/ha) (T_6) and 75% RDF + vermicompost (2 t/ha) (T_4). However, rest of the treatments also significantly improved the available nitrogen status over control. Increase in available nitrogen content with 100% RDF through vermicompost + Azotobacter (T_8) or with 75% STCR + vermicompost (2 t/ha) may be attributed to enhanced mineralization of vermicompost which might be helped in buildup of available nitrogen (Yaduvanshi *et al.,* 2013).

The available phosphorus content in soil (29.06 and 30.14 kg/ha, mean 29.60 kg/ha) increased with 100% RDF through vermicompost + Azotobacter (T_8) as compared to STCR based chemical fertilizer and recommended dose of fertilizer. However, 100% RDF through vermicompost + Azotobacter (T_8) did not differ significantly with 75% STCR + vermicompost (2 t/ha) (T_6) and 75% RDF + vermicompost (2 t/ha) (T_4) treatments in respect of available phosphorus. Application of 100% RDF through vermicompost + Azotobacter (T_8) being at par with 75% STCR + vermicompost (2 t/ha) (T_6) and 75% RDF + vermicompost (2 t/ha) (T_4) recorded significantly higher available phosphorus over STCR based fertilizer and recommended dose of fertilizer. The increases in

available phosphorus content in soil due to addition of vermicompost may be due to its solubilizing effect of native P. Similar results were reported by Sharma *et al.* (2015); Sharma *et al.* (2016). The maximum available K_2O content (501.00 and 502.21 kg/ha, mean 501.61 kg/ha) was recorded with 100% RDF through vermicompost + Azotobacter (T_8). Application of 100% RDF through vermicompost + Azotobacter (T_8)being at par with 75% STCR + vermicompost (2 t/ha) (T_6) and 75% RDF + vermicompost (2 t/ha) (T_4) which were recorded significantly higher available K over STCR based fertilizer and recommended dose of fertilizer. Addition of vermicompost along with inorganic fertilizers had a beneficial effect in increasing the K availability. Similar results were reported by Sharma *et al.* (2015); Sharma *et al.* (2016).

Table 1: Effect of Integrated Nutrient Management on grain and straw yield of wheat.

Treatments	Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
T_1 : Control	2963	2900	2932	4517	4485	4501
T_2 :100% RDF (120-60-40)	4355	4412	4384	5786	5800	5793
T_3 : STCR based NPK Fertilizer dose	4390	4450	4420	5924	5998	5961
T_4 :75% RDF + Vermicompost (2 t/ha)	5167	5250	5209	6966	7000	6983
T_5 :50% RDF + Vermicompost (4 t/ha)	4750	4812	4781	6460	6504	6482
T_6 :75% STCR + Vermicompost (2 t/ha)	5296	5346	5321	7029	7066	7048
T_7 :50% STCR + Vermicompost (4 t/ha)	4786	4890	4838	6512	6530	6521
T_8:100% RDF through Vermicompost + Azotobacter	3586	3629	3608	4952	4996	4974
T_9 : Integrated nutrient management (INM) - 50% of nutrients through organic (Vermicompost) + 50% of nutrients through inorganic Fertilizer + Azotobacter	4805	4900	4855	6571	6600	6585
SEm±	119.91	114.93	83.05	131.20	132.89	110.81
CD (p=0.05)	359.49	344.55	239.23	393.62	398.68	319.22

Table 2: Effect of Integrated Nutrient Management on available N, P_2O_5 and K_2O in soil after harvest of wheat.

Treatments	Available N (kg ha^{-1})			Available P_2O_5 (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
T_1 : Control	245.62	243.66	244.64	18.20	17.69	17.95	360.32	358.14	359.23
T_2 :100% RDF (120-60-40)	265.14	266.09	265.62	20.25	21.47	20.86	397.62	398.75	398.19
T_3 : STCR based NPK Fertilizer dose	270.37	271.33	270.85	21.46	21.98	21.72	400.24	401.56	400.90
T_4 :75% RDF + Vermicompost (2 t/ha)	307.95	308.57	308.26	28.45	29.09	28.77	487.34	488.62	487.98
T_5 :50% RDF + Vermicompost (4 t/ha)	288.26	289.00	288.63	25.26	26.80	26.03	435.55	436.75	436.15
T_6 :75% STCR + Vermicompost (2 t/ha)	309.12	310.24	309.68	28.85	29.36	29.11	495.41	496.56	495.99
T_7 :50% STCR + Vermicompost (4 t/ha)	290.34	291.13	290.74	25.80	26.55	26.18	442.75	444.12	443.44
T_8 :100% RDF through Vermicompost + Azotobacter	314.68	316.76	315.72	29.06	30.14	29.60	501.00	502.21	501.61
T_9 : Integrated nutrient management (INM) - 50% of nutrients through organic (Vermicompost) + 50% of nutrients through inorganic Fertilizer + Azotobacter	291.26	292.35	291.81	26.35	27.00	26.68	450.22	452.60	451.41
SEm±	4.41	4.34	2.19	0.65	0.62	0.32	10.95	10.36	5.33
CD (p=0.05)	13.23	13.02	7.50	1.94	1.87	0.92	32.82	31.06	15.35

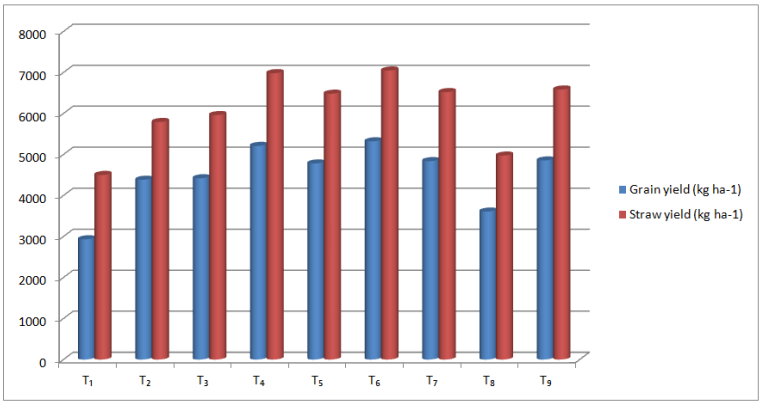

Fig. 1. Effect of Integrated Nutrient Management on grain and straw yield of wheat.

CONCLUSIONS

Application of 75% Soil Test Crop Response (STCR) along with vermicompost at a rate of 2 tons per hectare (T_6) not only produced the targeted yield of wheat but also improved the soil fertility as compared to application of chemical fertilizer alone. Thus, 75% Soil Test Crop Response (STCR) along with vermicompost at a rate of 2 tons per hectare can play a vital role in exploiting high yield potential of wheat crop through its beneficial effect on nutrients supply and soil properties.

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REFERENCES

Antil, R. S., Narwal, R. P., Singh, B. and Singh, J. P. (2011). Long-term effects of FYM and N application on soil health and productivity under pearl millet–wheat cropping system. *Indian Journal of Fertilizer*, *7*, 14–32.

Aulakh, M. S. and Benbi, D. K. (2008). Enhancing fertilizer use efficiency. In: Proceedings of FAI Annual Seminar 2008, 4-6 December, 2008. The Fertilizer Association of India, New Delhi, India. pp. SII-4 (1-23).

Kumar, S., Patra, A. K., Singh, D. and Purakayastha, T. J. (2014). Long term chemical fertilization along with farmyard manure enhances resistance and esilience of soil microbial activity against heat stress. *Journal of Agronomy and Crop Science*, *200*(2), 156–162.

Olsen, S. R., Cole, C. V., Frank, S. W. and Dean, L. A. (1954). Estimation of available phosphorus by extraction with sodium bicarbonate. *United States Development of Agriculture Circular number*, 939.

Panse, V. G. and Sukhatme, P. V. (1985). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Richards, L. A. (1954). Diagnosis and improvement of saline-alkali soils. Agriculture Handbook 60, USDA, Washington.

Sharma, V. K., Pandey, R. N. and Sharma, B. M. (2015). Studies on long term impact of STCR based integrated fertilizer use on pearl millet (Pennisetum glaucum)-wheat (Triticum aestivum) cropping system in semi arid condition of India. *Journal of Environmental Biology*, *36*(1), 241–247.

Sharma, V. K., Pandey, R. N., Kumar, S., Chobhe, K. A. and Chandras, S. (2016). Soil test crop response based fertilizer recommendations under integrated nutrient management for higher productivity of pearl millet (Pennisetum glaucum) and wheat (Triticum aestivum) under long term experiment. *Indian Journal of Agricultural Science*, *86*(8), 1076-1081.

Subba Rao, A. and Reddy K. S. (2009). Implications of soil fertility to meet future demand: Indian scenario. In Proceedings of the IPI-OUAT-IPNI International Symposium on Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damages, Vol. 1 (Eds.MS Brar and SS Mukhopadhyay), 5-7 November 2009. IPI, Horgen, Switzerland and IPNI, Norcross, USA. pp. 109-135.

Subbaiah, B. V. and Asija, G. L. (1956). A rapid procedure for determination of available nitrogen in soil. *Current Science*, *25*, 259–260.

Yaduvanshi, N. P. S., Sharma, D. R. and Swaroop, A. (2013). Impact of integrated nutrient management on soil properties and yield of rice and wheat in a long-term experiment on a reclaimed sodic soil. *Journal of the Indian Society of Soil Science*, *61*, 188–194.

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