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STCR based fertilizer recommendation with sorghum (*Sorghum bicolar* L.) gradient experiment in alluvial soil

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Abstract
To study the effect of N, P, K fertilizers on sorghum, a gradient experiment was conducted at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi Uttar Pradesh India during 2019-20 in *kharif* season. $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$, fertilizer levels were applied to strip I, II and III, respectively. NPK were applied through urea, single super phosphate and muriate of potash fertilizers respectively. Sorghum Var.CHS-28 was grown as a gradient crop. At harvest plant samples were collected and analyzed for NPK content and calculated total uptake of nutrients. Grain and straw yields of sorghum were also recorded. The results revealed that an application of graded levels of NPK fertilizers significantly influenced NPK uptake, grain and straw yields of sorghum crop.

Keywords: Sorghum, gradient, experiment, nutrient uptake and available nutrient

Introduction
Sorghum (*Sorghum bicolour* L.) is the most important cereal crop after wheat, rice, maize and barley. Sorghum species are native to tropical and subtropical regions of Africa and Asia. Maharashtra, Uttar Pradesh, Madhya Pradesh, Rajasthan, and Tamil Nadu are the major sorghum growing states. Other states grow sorghum in small areas primarily for green fodder. Sorghum has been, for centuries, one of the most important staple foods for millions of poor rural people in the semiarid tropics of Asia and Africa.Globally, sorghum is cultivated on 41.58 million hectares to produce 65.27 million tonnes, with productivity hovering around 1.71 tonnes per hectare. India contributes about 16% of the world's sorghum production (Anonymous, 2010a) [5]. In India, sorghum grain is eaten by human either by breaking the grain and cooking it in the same way as rice or by grinding it into flour and preparing *'chapatis'*. To some extent it is also eaten as parched and popped grain. This grain is also fed to swine, cattle, and poultry. Sorghum grain contains about 2.8 – 3.0 per cent fat, 8 - 12 per cent protein and 70 per cent carbohydrates; therefore, it can satisfactorily replace other grains in the feeding programme for dairy cattle, poultry and swine. Its industrial use has tremendous scope. The major thrust will be on enhancing alternate uses of sorghum and its utilization as a major ethanol production, starch, grain alcohol production, food, feed, fodder, and fuel (bio-energy) for industrial utilization (Ali Azam and Start, 1999) [1].

Soil test crop response (STCR) studies help to generate fertilizer adjustment equations and calibration charts for recommending fertilizers on the basis of soil tests and achieving targeted yield of crops (Singh and Biswas, 2010)[11]. The reliability of soil test values make accurate prediction of crop response to applied nutrient vary with soil and crop. Build up and maintenance of soil fertility and consequent provision of balanced nutrition to crops are the keys to sustain long term productivity. The need to apply fertilizers in balanced quantitative proportions according to crop requirements and soil available nutrients for targeted yields has been well recognized as a better approach than existing practice of general fertilizer recommendation. This will ensure efficient utilization and profitable fertilizer application rates for higher and profitable sorghum crop production.

Material and Methods
To establish significant relationship between soil test values, uptake for NPK and yield, a gradient sorghum crop experiment was carried out in the Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India, during 2019-20 in kharif season. The soil of the experimental site was alluvial, pH=8.2, 0.058 EC (dS m^{-1}). The available nitrogen, phosphorus and potassium status were 234.30, 29.75, 203.55 kg ha^{-1}, respectively. Plot wise nutrient levels were tested before applying NPK.

Soil samples (0-15 cm) from three strips were collected and analyzed for available nitrogen, by the alkaline permanganate method (Subbiah and Asija, 1956) [3]; available phosphorus, by Olsen *et al*. (1954) [8] and available potassium, by the ammonium acetate method (Hanway and Heidal, 1952) [6] as described by Jackson (1973) [7]. In 2010, selected site of 1269.6 square meter dimension was divided into three strips of equal size and in each strip, different fertilizer dose, low - 0, 0, 0, medium – 120, 60, 60 and high – 240, 120, 120 kg ha^{-1} N, P_2O_5, K_2O, respectively were applied to develop a fertility gradient and sorghum variety CHS-28 was grown as an exhaust crop during Kharif 2019-20 for stabilizing fertility gradient in field. At maturity, sorghum crop harvested, grain and straw yield from each strip was recorded. Plant samples were also collected from each strip and analyzed for content of nitrogen, phosphorus, potassium and calculated uptake of nutrients by standard method (Jackson, 1973)[7].

Table 1: Effect of graded levels of N, P_2O_5 and K_2O fertilizer application on grain & straw yield and total nutrient uptake of gradient crop of sorghum variety CHS-28

Strips	Fertilizer dose applied (kg ha^{-1})			Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Total Nutrient uptake (kg ha^{-1})		
	N	P_2O_5	K_20			N	P_2O_5	K_20
I	0	0	0	1734	6845	92.65	15.57	109.55
II	120	60	60	2505	8251	121.39	24.82	152.35
III	240	120	120	3528	9274	149.83	33.06	190.67
SEm$\pm$				28.60	43.19	0.45	0.31	0.66
CD (0.05)				69.99	105.69	1.10	0.76	1.61

Results and Discussion

Yield

The grain yield of gradient crop sorghum variety CHS-28 in strip I, II and III were 1734 kg ha^{-1}, 2505 kg ha^{-1} and 3528 kg ha^{-1}, respectively. The straw yield registered in strip I, II and III were 6845, 8251 and 9274 kg ha^{-1}. This might be due to better total nutrient uptake by the crop which favorably influenced the growth and yield of wheat as reported by Santhi and Selvakumari (1999) [10].

Total nutrient uptakes

The results of N, P and K total nutrient uptake by sorghum crop, grain and straw yield are given in table 1. The total nitrogen uptake of strip I, II and III were 92.65, 121.39 and 149.83 kg ha^{-1}, respectively. The total phosphorus uptake values were 15.57 (strip I), 24.82 (strip II) and 33.06 kg ha^{-1} (strip III). While the total potassium uptake was 109.55 in strip I, 152.35 in strip II and 190.67 kg ha^{-1} in strip III. A progressive increase in N, P and K uptake was found from strip I to strip III. Singh (2014) [4] also reported that under integrated plant nutrient system.

The total uptake of nitrogen increased from strip I (92.65 kg ha^{-1}) to strip III (149.83 kg ha^{-1}). This may be due to adequate quantity of nitrogen available to crop, which would have created favorable for N uptake resulting in vigorous growth, similar results reported by (Radha madhav *et al*. 1996) [9].

The significant increase in total P uptake from 15.57 kg ha^{-1} to 33.06 kg ha^{-1} was due to higher levels of phosphorus application which would have led to higher root proliferation of the crop. The increase in K total uptake from 109.55 to 190.67 kg ha^{-1} can be attributed to higher application fertilizer potassium and higher potassium fixation capacity of soil, similar finding reported by (Singh, 2014) [4].

Table 2: Physiochemical properties and fertility status of soil

Strips	Fertilizer dose application (kg ha^{-1})			EC (dSm^{-1})	pH	O.M. %	Nutrients (kg ha^{-1})		
	N	P_2O_5	K_2O				N	P_2O_5	K_2O
I	0	0	0	0.247	7.82	1.175	235.2	38.62	274.50
II	120	60	60	0.259	8.00	1.291	259.6	42.22	301.66
III	240	120	120	0.267	8.10	1.422	290.5	44.46	342.09
SEm$\pm$				0.0005	0.052	0.003	0.88	0.381	2.52
CD(0.0)				0.001	0.136	0.008	2.161	0.932	6.171

Soil Characteristics

The soil test values after crop harvest give significant effect of fertilizer treatment on soil properties. The pH, EC and organic matter content increases. The pH of strip Ist, IInd and IIIrd were 7.82, 8.0 and 8.1, respectively. EC of strip, Ist, IInd and IIIrd were 0.247, 0.259 and 0.267 (dS m^{-1}), respectively. While Organic matter of strip, Ist, IInd and IIIrd were 1.17, 1.29 and 1.42 kg ha^{-1}, respectively in table 2. Fertilizer treatment significantly increased the nutrient availability. The amount of mean available nitrogen of strip Ist, IInd and IIIrd were 235.21, 259.64 and 290.47 kg ha^{-1}, respectively. The amount of mean available phosphorus of strip, Ist, IInd and IIIrd were 38.62, 42.22 and 44.46 kg ha^{-1}, respectively. While the amount of mean available potassium of strip, Ist, IInd and IIIrd were 274.50, 301.66 and 342.09 kg ha^{-1}, respectively. This may be due to the adequate application of the fertilizer in the crop. Similar results reported by (Singh *et al*. 2015) [2].

Conclusion

From the STCR gradient crop experiment, it is concluded that an application of graded levels of NPK fertilizers significantly influenced total NPK uptake, grain and straw yield of sorghum crop. Therefore, soil test based fertilizer recommendation a useful tool for balanced nutrition of crops but also able to improve the soil health and economic condition of farmers, and also able to maintain agricultural as well as environmental sustainability.

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References

1. Ali Azam A, Start DP. Role and importance of sorghum in the livelihoods of the urban poor. Proceedings of a

workshop on sorghum utilization and the livelihoods of the poor in India, organized by ICRISAT, Hyderabad, 1999, 61-66.
2. Singh YV, Parveen, Ayesha Dey P, Singh SK, Meena R. Soil Test Crop Response Gradient Experiment with Wheat (*Triticum aestivum* L.) to NPK Fertilizers in Varanasi. Indian Journal of crop ecology. 2015; 4(1):8-12.
3. Subbiah BV, Asija GI. A rapid procedure for determination of available nitrogen in soils. Current Science. 1956; 31:196-198.
4. Singh YV. STCR based gradient experiment with sorghum (*Sorghum biocolar* L.) to NPK fertilizers in the alluvial soil. Indian Journal of crop ecology. 2014; 2(2):83-86.
5. Anonymous. Agriculture Statistics at a glance. Directorate of Economics and Statistics, Department of Agriculture and cooperation, Ministry of Agriculture, Government of India, New Delhi - 110 001, India, 2010a.
6. Hanway JJ, Heidal H. Soil analysis methods asused in Iowa state college soil testing laboratory. Lowa State College of Agriculture Bulletin. 1952; 57:1-31.
7. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi, 1973.
8. Olsen SR, Cole CV, Watanbe FS, Dean LA. Estimation of available phosphorus in soil by extracting with sodium bicarbonate. U.S.A. Circ. 939. (c.f. methods of soil analysis, part 2. Ed. C. A. Black. American Society of Agronomy, Madison, Wisconsin), 1954.
9. Radha Madhav M, Ravikumar A, Venkateswaralu B. Effect of different sources of nitrogen on growth, yield and nutrient uptake of rice. Andhra Agricultural Journal. 1996; 43(2-4):119-122.
10. Santhi R, Selvakumari G. Yield targeting and integrated plant nutrition systems for soil fertility maintenance in a rice based cropping sequence. Madras Agricultural Journal. 1999; 86(1-3):138-139.
11. Singh KD, Biswas PP. Balanced and integrated nutrient management of sustainable crop production. Fertilizer News. 2000; 23(10):38-42.