

**Effect of STCR based application of organic and inorganic fertilizers on growth, productivity and economics of wheat (*Triticum aestivum L.*) in Inceptisol of Prayagraj, India**

**ABSTRACT**

A field experiment was carried out during Rabi season of 2020-2021 and 2021-2022 at the Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh) at research field of department of Soil Science to find out the “Effect of STCR based application of organic and inorganic fertilizers on growth, productivity and economics of wheat (*Triticum aestivum L.*) in Inceptisol of Prayagraj”. The experiment was laid out in Factorial Randomized Block Design, with three replications. The Soil texture class Sandy loam, experimental area falls in order of Inceptisol. The Soil pH (7.6), EC at 25<sup>0</sup>c (0.63dSm<sup>-1</sup>), organic carbon (0.42%), available nitrogen (94.50 kg ha<sup>-1</sup>), available phosphorus (31.5 kg ha<sup>-1</sup>) and available potassium (302.4 kg ha<sup>-1</sup>) were found in experiment field during 2021. The growth attribute like plant height was observed significant at 30, 60, 90 and 120 DAS on pooled basis (2020-2021 and 2021-2022). The best treatment combination was (T9) STB+FYM 15 tha<sup>-1</sup> (150:15:150 NPK kg ha<sup>-1</sup>) + FYM 15 tha<sup>-1</sup> that showed the highest in grain weight in 1<sup>st</sup> year (46.52 g) and 2<sup>nd</sup> year (47.01g) respectively. From the economical point of view, the treatment (T9) combination gave the maximum net return of ₹ (44922.0 ha<sup>-1</sup>) with B:C ratio of (1.84).

**Key words:** Wheat crop, STCR, Integrated plant nutrients and soil properties

## **1. Introduction**

In India, Uttar Pradesh (32.59 million tons) is highest producer of wheat followed by Madhya Pradesh (19.61 million tons), Punjab (17.57 million tons) etc.

(Agricultural Statistics at a Glance,2020).

Wheat has been described as “Staff of life or king of cereals” and one of the most important staple food crops. “ Wheat has its own outstanding importance as a human food; it is rich in carbohydrates, protein and calories. Wheat is cultivated in at least 43 countries of the world. The leading countries in wheat cultivation are China, India, Thailand, Indonesia and U.S.A and total production of wheat was 647 million tons under area of 218 million hectares with productivity of 2960 kg ha<sup>-1</sup>”. (FAO, 2012).

“Developed the methodology of soil test based nutrient recommendation for targeted yield. It is a more quantitative, precise and meaningful approach because it involves combined use of soil and plant analysis, which provide information on real balance between applied nutrient and available nutrients of soil”. (Rama Moorthy *et al.*,1967).

“Soil Test Crop Response (STCR) approach provides the balanced supply of required quantities of nutrients to the crops thus avoiding the over and under usage of fertilizers. This prevents the environmental hazards and results in higher returns. Crop requirements are satisfied to produce the highest economic yields, ensure the quality of the produce and avoid excessive levels of nutrients” (Boldea *et al.*, 2015).

The STCR approach reach out to farmer through saving of fertilizer nutrient and a desired yield can be opined as per economic condition of farmers (Bhatt *et al.*,2021).

### **Objectives:**

1. To study integrated use of chemical fertilizer and FYM on growth and yield of wheat.
2. To evaluate the best treatment for wheat crop.
3. To calculate benefit cost ratio(B:C), of different treatment combination of wheat.

## **2. MATERIALS AND METHODS**

The field experiment was conducted during the rabi season 2020-2021 and 2021-2022, in Soil Science Research farm of Department of Soil Science & Agriculture Chemistry, Naini Agricultural Institute, at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P.).

### **EXPERIMENTAL SITE**

The experiment was conducted at research farm of Department of Soil Science at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj the area is

situated on the South of Prayagraj on the right side of the river Yamuna on the South of Rewa road at a distance of about 6 Km from Prayagraj city. It is situated at 25°24'30" N latitude, 81°51'10" E longitude and at the altitude of 98 meter above the mean sea level (MSL).

### CLIMATIC CONDITION

Argo- climatically, Prayagraj District represents the subtropical belt of the South East of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location ranges between 46°C and seldom falls below 4°C-5°C. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100 mm annually.

### COLLECTION OF SOIL SAMPLE

The Soil sample were collected randomly from depth 0-15 cm and 15-30 cm depth from 5 spots of the experimental farm just before layout of experiment. The experiment was analyzed for physical and chemical properties, after air dried and passed through 2.0 mm size and size of sample reduced by canning and quartering. A perusal of soil data categorized as sandy loam in soil texture class belongs to order Inceptisol and neutral to saline in reaction.

### TREATMENT DETAILS:

The experiment was setup in a Randomized block design with three replication and nine treatments. The wheat variety PBW-343 was grown during the two experiment years 2020-2021 and 2021-2022.

List 1 : List of treatment combinations used for the study

TREATMENT	TREATMENT COMBINATIONS
T1	Farmers practice (Farmers practice (80:57:0 NPK kg ha <sup>-1</sup> )
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha <sup>-1</sup> )

T3	GRD+FYM 5 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>
T4	GRD+FYM 10 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>
T5	GRD+FYM 15 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha <sup>-1</sup> )
T7	STB+FYM 5 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>
T8	STB+FYM 10 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>
T9	STB+FYM 15 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>

**List 2 : Initial soil status of the experiment field during 2021**

Soil characteristics	Soil depth (0-15cm)
Soil pH	7.6
Electrical conductivity(dsm <sup>-1</sup> )	0.63
Organic carbon (%)	0.42
Available nitrogen (kgha <sup>-1</sup> )	94.50

Available phosphorus(kgha <sup>-1</sup> )	31.5
Available potassium(kgha <sup>-1</sup> )	302.4

### 3.Results and Discussion

#### Plant height(cm)

STCR-based application of fertilizers and manure leads to the statistically significant variation in plants height at all growth stage (Table 1). It is evident from the data that plant height was increased with increasing levels of NPK with FYM. It clearly shows that the plant height increased with the age of plants, and it was maximum at 120 DAS. In the second year (2021-2022) with treatment (T9) which was 30.66 cm at 30DAS, in treatment(T6) which was 55.22 cm at 60 DAS, in treatment (T8) which was 103.44 cm at 90 DAS and in treatment (T8) which was 107.11cm at120 DAS respectively. Also reported that 125 kg N ha<sup>-1</sup> significantly increased the plant height (95.2 &96.7 cm) by Chaturvedi (2006). This result corroborates the finding of Yadav and Chippa (2005) who reported a significant increase in plant height by application of FYM up to 30 t ha<sup>-1</sup>. Kavinder *et al.*, (2019) also report similar results in wheat, the farm yard manure along with 120 kg Nha<sup>-1</sup> was the best treatment in combination, played a significant role in marking highest plant height. Yugal *et al.*, (2015) reported that the plant height of wheat crop was significantly influenced with STCR dose with 5 t FYM ha<sup>-1</sup>. Patel *et al.*, (2017) reported that the plant height of wheat was significantly more under 75% NPK with 10 t FYM ha<sup>-1</sup> as compare the use of recommended dose of NPK.

#### Soil pH

The lowest pH was observed (7.12) were recorded in treatment T<sub>8</sub>((150:15:150 NPK kg ha<sup>-1</sup> +FYM 10 t ha<sup>-1</sup>) and (7.17) recorded in treatment T<sub>3</sub>(120:60:40 NPK kg ha<sup>-1</sup> +FYM 5 t ha<sup>-1</sup>) in 1<sup>st</sup> year. These results were neutral in soil pH due to addition of FYM (Table 2). The study on soil pH of analysed soil samples varied from 7.12-7.27,7.50-7.60 and 7.35-7.42%, respectively, at 1<sup>st</sup> year and 2<sup>nd</sup> year and on pooled basis (2020-2021 and 2021-2022).

Bhatt *et al.*, (2017) reported that the soil pH. was significantly influenced when applied with inorganic fertilizers and organic fertilizers. This result corroborates the finding of Malik and Chaman (2016) who reported the, among various treatments, soil pH (7.5 - 7.8) of harvested soil sample recorded from the plot receiving 100% NPK was applied through incorporation

of farm yard manure. In a study conducted by Sephya *et al.*, (2012) related with the application of 100% NPK (50% NPK + 50% N through farmyard manure) to wheat was the best practice than the rest of the treatment for improving the soil pH. Similar results were obtained by Kumar *et al.*, (2012).

### 1000 grains weight(g)

Grain weight of wheat was significantly influenced by different level of fertilizers and manure application based on STCR approach. Maximum grain weight viz.46.66,46.66 and 46.52g was recorded in 1<sup>st</sup> year (2020-2021) with treatment (T<sub>3</sub>), (T<sub>7</sub>) and (T<sub>9</sub>) respectively (Table 3). Chaturvedi *et al.*, (2006) also reported that 125 kg N ha<sup>-1</sup> significantly increased the 1000 grain weight (48.1g &49.8 g) of wheat. Yogesh *et al.*, (2007) who reported that the wheat cultivar PBW-343 recorded the highest 1000-grain weight (41.01 g), while cultivar HD-2329 recorded the lowest 1000-grain weight (31.83 g) on sandy loam soil texture class.

**Table.1** Effect of STCR-based fertilizers and manure recommendation on plant height of wheat in pooled (2020-2021 and 2021-2022)

Treatment	Treatment combination	Plant height(cm)			
		30DAS	60DAS	90DAS	120DAS
T1	Farmers practice (80:57:0 NPK kg ha <sup>-1</sup> )	24.44	49.44	94.10	104.27
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha <sup>-1</sup> )	24.49	50.22	95.44	104.16
T3	GRD+FYM 5 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	25.82	54.60	98.60	104.38
T4	GRD+FYM 10 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	25.72	54.60	96.99	104.10
T5	GRD+FYM 15 t ha <sup>-1</sup> (120:60:40 NPK kg	26.22	54.00	96.83	105.44

	ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>				
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha <sup>-1</sup> )	26.94	55.61	97.33	106.88
T7	STB+FYM 5 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	26.55	53.55	100.05	105.72
T8	STB+FYM 10 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	26.99	51.16	99.38	105.38
T9	STB+FYM 15 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>	26.88	51.10	99.99	105.16
F-test		S	S	S	S
C.D. Value 0.5%		0.51	0.24	0.91	0.68
S.Ed.(±)		1.09	0.50	1.92	1.44

**Table.2** Effect of STCR-based fertilizers and manure recommendation on post-harvest soil pH (2020-2021 and 2021-2022)

Treatment	Treatment combination	pH		
		1 <sup>st</sup> year	2 <sup>nd</sup> year	Pooled
T1	Farmers practice (80:57:0 NPK kg ha <sup>-1</sup> )	7.23	7.50	7.36
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha <sup>-1</sup> )	7.27	7.57	7.42
T3	GRD+FYM 5 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	7.17	7.60	7.38

T4	GRD+FYM 10 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	7.27	7.57	7.42
T5	GRD+FYM 15 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>	7.20	7.50	7.35
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha <sup>-1</sup> )	7.20	7.50	7.35
T7	STB+FYM 5 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	7.21	7.53	7.35
T8	STB+FYM 10 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	7.12	7.57	7.42
T9	STB+FYM 15 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>	7.23	7.53	7.38
F-test		NS	NS	NS
C.D. Value 0.5%		0.13	0.08	0.84
S.Ed.(±)		0.27	0.18	1.78

**Table.3** Effect of STCR-based fertilizers and manure recommendation on grain weight of wheat in pooled (2020-2021 and 2021-2022)

Treatment	Treatment combination	1000 grain weight (g)		
		1 <sup>st</sup> year	2 <sup>nd</sup> year	Pooled
T1	Farmers practice (80:57:0 NPK kg ha <sup>-1</sup> )	45.66	45.46	45.56
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha <sup>-1</sup> )	45.96	46.20	46.08
T3	GRD+FYM 5 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	46.66	46.65	46.65

T4	GRD+FYM 10t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	46.50	47.11	46.80
T5	GRD+FYM 15 t ha <sup>-1</sup> (120:60:40 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>	45.96	46.80	46.38
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha <sup>-1</sup> )	46.48	46.91	46.69
T7	STB+FYM 5 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 5 t ha <sup>-1</sup>	46.66	47.00	46.83
T8	STB+FYM 10 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 10 t ha <sup>-1</sup>	46.21	46.88	46.54
T9	STB+FYM 15 t ha <sup>-1</sup> (150:15:150 NPK kg ha <sup>-1</sup> )+FYM 15 t ha <sup>-1</sup>	46.52	47.01	46.76
F-test		S	S	S
C.D. Value 0.5%		0.19	0.39	0.13
S.Ed.(±)		0.41	0.82	0.29

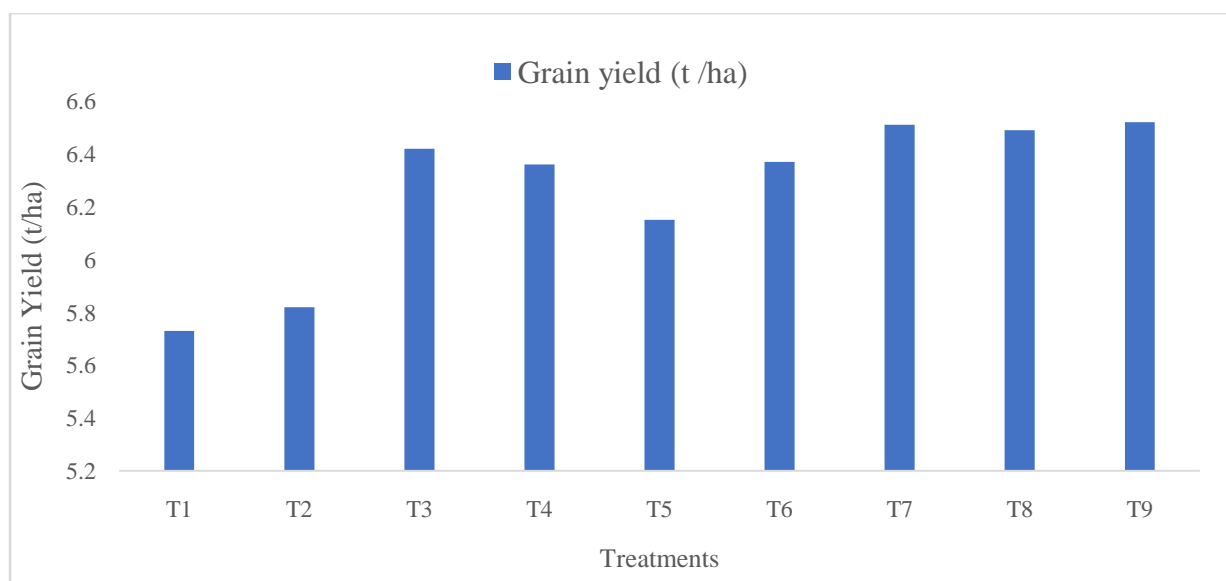


Figure: 1 Effect of STCR-based fertilizers and manure recommendation on grain yield of wheat (2021-22)

#### 4. Conclusion

On the basis of above finding, it is concluded that application of STCR **in treatment combination** (T9) gave the maximum growth, yield, benefit cost ratio and physical, chemical and nutrient uptake was found best result of wheat. As it is result of on the two years study, it is concluded that prescription-based fertilizer application along with the application of FYM 15tha<sup>-1</sup> enhanced the soil properties and which will help enhancing yield for sustaining productivity and fertility of soil.

#### 5. Further Research

**The inclusion of pulses in cropping systems and other practices such as crop residues recycling, crop diversification etc. influences grain yields and improve soil quality.**

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