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Comparison of balanced nutrition and farmer's fertilization practice using rice as a test crop on tribal farmer's field

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Abstract
The present investigation entitled "Comparison of balanced nutrition and farmer's fertilization practice using rice as a test crop on tribal farmer's field" was conducted in 2020 at Telgara village, Kanker, C.G. The experiment was laid out in independent t-Test having two treatments, which replicated twenty times. The treatment consisted of two different treatments *viz*. T_1: Farmer's fertilizer dose [N:P_2O_5:K_2O::65: 46: 30 (kg/ha)], T_2: Balanced fertilizer dose [N: P_2O_5: K_2O: 120: 60:40 (kg/ha)]. The experiment was conducted under tribal sub-plan (TSP) of AICRP on Long Term Fertilizer Experiment (LTFE). The LTFE has been continued since 1999 at Raipur and amongst 10 treatments of LTFE after 2 decades of experimentation, the optimum balanced (N: P_2O_5: K_2O: 120: 60: 40 kg/ha) recommended dose of nutrients for rice crop had been identified as an optimum treatment to produces sustainable rice yield without compromising the soil properties. To aware the farmers of Kanker district, this sustainable balanced dose of nutrients treatment had been introduced to compare the yield gaps between 2 treatments or indirect approaches to increase the farmer's income through an increase in rice yield. With this idea and/or aim the present experiment was framed with a specific and minimum set of treatments on rice crop during the Kharif season.

As regards the effect of fertilization on Physicochemical properties of soil such as pH, EC & OC recorded significant differences among each other. The farmer's practice dose (FPD) had a mean value of pH (6.33), EC (0.14 dSm^{-1}) & OC (0.67%) and balanced fertilizer dose (BFD) had the mean value of pH (6.22), EC (0.13 dSm^{-1}) & OC (0.69%) was noted amongst 20 farmer's fields.

The data on major nutrient content in the soil revealed that the available N was significantly differed and recorded the highest (252 kg/ha) available N in BFD and the lowest (223 kg/ha) value was recorded under the FPD. The available phosphorus significantly increased among the treatments (FPD & BFD) and ranged from 11 to 14 (kg/ha). The significantly higher available P (14 kg/ha) was recorded in BFD and lower available P (11 kg/ha) was noted in FPD. Similarly, higher available K (419 kg/ha) was recorded in balanced fertilizer dose (BFD) and lower available K (302 kg/ha) was noted in farmer's practice dose.

The data recorded on micro-nutrient status in soil showed non-significant differences among both (FPD & BFD) treatments. The available Cu varied from 0.82 to 0.89 (mg/kg) in FPD and 0.83 to 0.89 (mg/kg) in BFD amongst 20 farmer's field. The available Fe varied from 10.2 to 10.9 (mg/kg) in FPD & 10.0 to 10.9 (mg/kg) in BFD amongst 20 farmer's field. The available Mn ranged from 7.2 to 7.9 (mg/kg) in FPD and 7.0 to 9.9 (mg/kg) in BFD amongst 20 farmer's field. The highest (0.90 mg/kg) total Zn content was recorded in balanced fertilizer dose (BFD) and the lowest (0.80 mg/kg) total Zn content was recorded in farmer's practice dose (FPD) in farmer's field.

The effect of fertilization on harvesting index of rice ranges from 41.88 to 43.65 (q ha^{-1}) among the treatments balanced fertilizer dose (BFD) and farmer's practice dose (FPD). The harvesting index of rice was significantly influenced. The highest H.I. (43.65 q ha^{-1}) of rice was obtained with the application of FPD which was significantly superior over the treatment BFD (41.88 q ha^{-1}).

Keywords: Balanced dose of fertilization, farmers practice dose, electrical conductivity, major nutrients, micro-nutrients, harvesting index

Introduction
Rice is one of India's most important food crops, feeding more than 60% of the country's population. The region under rice crop grew from 30.81 million hectares in 1950-51 to 43.78 million hectares in 2019-20, a nearly 143% increase. Rice production has increased significantly from 20.58 million tonnes in 1950-51 to 118.4 million tonnes in 2019-20, a nearly 6-fold increase. Rice is cultivated in 27 districts of Chhattisgarh. Out of which one district is under high productivity (>2500 kg/ha) group, 2 districts are in medium productivity

(>2000-2500 kg/ha) group, 5 districts are in medium-low productivity (1500-2000 kg/ha) group, 17districts are in low productivity (1000-1500 kg/ha) group and 2 districts are under very low productivity (<1000 kg/ha) group. Balanced fertilization is directly concerned with the application of essential plant nutrients, particularly the major plant nutrients like nitrogen (N), Phosphorous (P) and Potassium (K) plus some other nutrients like magnesium (Mg), sulphur (S) and lots of micro-nutrients. These nutrients were required in optimum amount and their application through the correct method. The most important thing is a time of application at correct and adequate proportion as determined by the soil tests and on the requirement of the crop. In a wider sense balanced fertilization of rice is not only the supply of a single or couple of nutrients but rather to provide a crop (rice) a better and right amount of nutrients at the appropriate time to achieve its goal of production and productivity. Balanced fertilization of rice has many benefits further; it increases the yield of the crop. Balanced fertilization increases the quality of the produce.

A balanced dose of fertilization improves the farming business and makes it more profitable. Balancing the nutrients ultimately improves the soil conditions and maintains its fertility. There are lots of benefits from balanced fertilization of crops as it also improves the quality of the environment. Sometimes an excessive amount of few nutrients causes the death of the plants, which is economically non-profitable for farmers. On the contrary, balanced fertilization makes sure that the supply of nutrients is in a proper way which further results in the proper growth and development of crops. Balanced fertilization in rice has also shown that it boosts the yield and makes the production profitable for farmers without compromising the properties of soil.

Materials and Methods

The present experiment entitled "Comparison of balanced nutrition and farmer's fertilization practice using rice as a test crop on tribal farmer's field" was conducted in 2020 at Telgara village, Kanker, C.G. The long-term fertilizer experiment (LTFE) has been conducted at Raipur, C.G. since 1999. Among 10 treatments of LTFE experiment one treatment i.e., application of balanced fertilizer dose in rice was identified as optimizing a sustainable yield of rice for continuous 2 decades. To aware the farmers of Chhattisgarh, this balanced dose of fertilization treatment has been popularized amongst farmers. With this objective this experiment was conducted, and the balanced fertilizer dose compares with the farmer's practice dose to get the maximum yield of rice without deteriorating the soil physical and chemical properties. soil analysis of pH, electrical conductivity (EC) organic carbon (OC) available nitrogen, available phosphorus, available potassium available and micronutrients (Fe, Mn, Zn and Cu) plant analysis nitrogen content, phosphorus content, potassium content was investigated during the experiment.

Results and Discussion

The result of experiment pertaining to different experiment were discussed below:

pH

The data on pH as affected by balanced fertilizer dose (BFD) and farmer's practice dose (FPD) was tabulated in Table 1. The FPD had a mean value of pH, 6.33 amongst 20 farmer's field. Similarly, the BFD had the mean value of pH i.e., 6.22 amongst 20 farmer's field. The independent t-Test: Two samples assuming equal variance, showed the significant mean value of pH, 6.33 in FPD. The minimum difference or at par differences obtained during the calculation of the data are shown to have significant differences with each other at 5% level of significance. BFD amongst 40 farmer's field.

Electrical Conductivity

The EC of the soil ranged from 0.11 to 0.20 (dSm^{-1}) among the treatments FPD & BFD (Table 1). The FPD had a mean value of EC, 0.14 amongst 20 farmer's field. Similarly, the BFD had the mean value of EC i.e., 0.13 amongst 20 farmer's field. The highest (0.20 dSm^{-1}) EC was recorded in FPD and the lowest (0.11 dSm^{-1}) value was recorded in the BFD amongst 20 farmer's field in each fertilization practice. Further, the data presented in Table 1 revealed that the mean value of EC of initial soil was 0.17 dSm^{-1}. The EC varied from 0.12 to 0.20 dSm^{-1} in FPD and same was ranged from 0.11 to 0.16 (dSm^{-1}) in BFD amongst 20 farmers field in each fertilizer dose with an average mean of EC from 0.11 to 0.20 (dSm^{-1}) amongst 40 farmers' field.

Organic Carbon

The data on soil organic carbon (SOC) tabulated in Table 1 which indicated that the soil gradually increased SOC due to the application of balanced fertilization. The SOC ranged from 0.63 to 0.73 (%) and showing significantly higher SOC in BFD (0.73%) whereas, the lowest SOC (0.63%) was noted in FPD amongst 40 farmer's field. However, the two-sample independent t-Test assuming equal variance of SOC amongst two treatments means.

Table 1: Effect of balanced fertilizer dose and farmer's practice dose physicochemical properties of soil

Particulars	pH		EC (dSm^{-1})		Organic Carbon (%)	
	FPD	BFD	FPD	BFD	FPD	BFD
Mean	6.33	6.22	0.14	0.13	0.67	0.69
Initial mean value	6.43		0.17		0.62	
Lower & Higher range amongst 20 farmers field	6.2-6.6	6.1-6.4	0.12-0.20	0.11-0.16	0.63-0.71	0.64-0.73
Lower & Higher value amongst 40 farmers field	6.1-6.6		0.11-0.20		0.63-0.73	
Variance	0.028	0.012	0.0002	0.0003	0.0004	0.00044
Observations	20					
DF	38					
t Stat	2.44		3.93		3.40	
P(T<=t) two-tail	0.019		0.008		0.001	

Major nutrient (N, P & K) content in the soil

Available N

The mean value of available N in the soil ranged from 223 to 252 (kg/ha) amongst 20 farmers. The highest (252 kg/ha) available N was recorded in BFD and the lowest (223 kg/ha) value was recorded in the FPD. Further, the data presented in Table 2 revealed that the mean value of available N of initial soil was 178 kg/ha. The available N varied from 176 to 250 (kg/ha) in FPD and the available N ranged from 188 to 301 (kg/ha) in BFD with an overall range of available N from 176 to 301 (kg/ha). The difference or at par differences obtained during the calculation of the data are shown to have significant differences with each other at 5% level of significance.

Available P

The available phosphorus significantly increased amongst the various treatments and ranged from 11 to 14 (kg/ha). The significantly higher available P (14 kg/ha) was recorded in BFD. Whereas significantly lower available P (11 kg/ha) was noted in FPD. Further, the data presented in Table 2 revealed that the mean value of available P of initial soil was 11.19 kg/ha. The available P varied from 11 to 13 (kg/ha) in FPD and the available P ranged from 12 to 14 (kg/ha) in BFD with an overall range of available P from 11 to 14 (kg/ha). The minimum difference or at par differences obtained during the calculation of the data are shown to have significant differences with each other at 5% level of significance.

Available K

The available potassium gradually increased with the nutrient application treatments, and it ranged between 302 to 419 (kg/ha). Significantly higher available K in 419 kg/ha was recorded in balanced fertilizer dose (BFD). Whereas, significantly lower available K 302 kg/ha was noted in farmer's practice dose, respectively. The FPD had a mean value of available K 376 kg/ha amongst 20 farmers, however; the BFD had the mean value of available K 385 kg/ha amongst 20 farmers. The difference or at par differences obtained during the calculation of the data are shown to have significant differences with each other at 5% level of significance.

Table 2: Effect of balanced fertilizer dose and farmer's practice dose on available major nutrients in soil

Particulars	Major nutrients content (kg/ha)					
	N		P		K	
	FPD	BFD	FPD	BFD	FPD	BFD
Mean	223	252	12.21	13.22	376	385
Initial mean value	178		11.19		363	
Lower & Higher range amongst 20 farmers field	176-250	188-301	11-13	12-14	318-419	322-427
Lower & Higher value amongst 40 farmers field	176-301		11-14		318-427	
Variance	628	727	0.568	0.749	1292	1334
Observations	20					
DF	38					
t Stat	3.581		3.937		0.7958	
P(T<=t) two-tail	0.0009		0.0003		0.4310	
t Critical two-tail	2.024					

Micro-nutrient (Cu, Fe, Mn & Zn) status in soil

Cu

The available Cu varied from 0.82 to 0.89 (mg/kg) in FPD and same ranged from 0.83 to 0.89 (mg/kg) in BFD amongst 20 farmers field with an overall range of available Cu from 0.82 to 0.89 (mg/kg) in both the treatments amongst 40 farmers' field. In comparison between two treatments mean T1 (farmer's practice dose) and T2 (balanced fertilizer dose), the result was non-significant at 5% level of significance.

Fe

The available Fe varied from 10.2 to 10.9 (mg/kg) in FPD and same ranged from 10.0 to 10.9 (mg/kg) in BFD amongst 20 farmers with an overall range of available Fe from 10.0 to 10.9 (mg/kg) in both the treatments among 40 farmers' field. In comparison between two mean T1 (farmer's practice dose) and T2 (balanced fertilization dose), the result was non-significant at 5% level of significance.

Mn

The available Mn varied from 7.2 to 7.9 (mg/kg) in FPD and the available Mn ranged from 7.0 to 7.9 (mg/kg) in BFD amongst 20 farmers field with an overall range of available Mn from 7.0 to 7.9 (mg/kg) in both the treatments among 40 farmers' field. In comparison between two treatment means T1 (farmer's practice dose) and T2 (balanced fertilizer dose), the result was non-significant at 5% level of significance.

Table 3: Effect of balanced fertilizer dose and farmer's practice dose on micronutrients status in soil

Particulars	Micro nutrient status (mg/kg)							
	Cu		Mn		Fe		Zn	
	FPD	BFD	FPD	BFD	FPD	BFD	FPD	BFD
Mean	0.861	0.859	7.59	7.51	10.59	10.51	0.851	0.849
Initial mean value	0.88		7.64		10.64		0.88	
Lower & Higher range amongst 20 farmers field	0.82-0.89	0.83-0.89	7.2-7.9	7.0-7.9	10.2-10.9	10.0-10.9	0.80-0.92	0.80-0.97
Lower & Higher value amongst 40 farmers field	0.82-0.89		7.0-7.9		10.0-10.9		0.80-0.97	
Variance	0.0002	0.0003	0.038	0.070	0.038	0.070	0.0009	0.001
Observations	20							
DF	38							

t Stat	0.369	1.100	1.090	0.170
P(T<=t) two-tail	0.714	0.283	0.282	0.865
t Critical two-tail	2.024			

Zn

The highest (0.97 mg/kg) total Zn content was recorded in balanced fertilizer dose (BFD) in surface soil. The available Zn varied from 0.80 to 0.92 (mg/kg) in FPD and the available Zn ranged from 0.80 to 0.97 (mg/kg) in BFD amongst 20 farmers field with an overall range of available Zn from 0.80 to 0.97 (mg/kg) in both the treatments among 40 farmers' field. While the lowest (0.80 mg/kg) total Zn content was recorded in farmer's practice dose (FPD) in the surface soil. In comparison between two mean T1 (farmer's practice dose) and T2 (balanced fertilizer dose), the result was non-significant at 5% level of significance.

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