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Efficiency of Integrated Nutrient Management to Improve Soil Health Growth Parameters and Yield Attributes of Rice (*Oryza sativa* L.) Var:Bpt-5204

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A B S T R A C T

Combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that can ensure food production with high quality area under the rice cultivation is high but the productivity is low due to various interaction factors like the imbalance usage of fertilizers is one of the main factors responsible for the low productivity and also the continuous use of inorganic fertilizers resulted in declining of soil fertility. The present investigation on field experiment of "Efficiency of Integrated Nutrient Management to improve soil health growth parameters and yield attributes in Rice (*Oryza sativa* L.)" was carried out in Kharif during 2019 in sandy loamy soil with organic matter, available NPK and pH, EC are recorded as 0.52%, 280.24 kg ha^{-1}, 35.50 kg ha^{-1}, 175.14 kg ha^{-1}, 7.33, 0.04 dSm^{-1} respectively at the research farm of SSAC, NAI, SHUATS Prayagraj. The experiment consisted of 9 treatment combinations and which were replicated thrice and laid out in a randomized block design. The results showed that progressive increase the growth (plant height(cm) and number of tillers) and yield (panicle length, number of seeds per panicle, grain yield and straw yield) in application of T_7- (@50% RDF+ Poultry Manure @ 5 t ha^{-1}) in rice were to be found the best treatment combinations.

Introduction

The green revolution had gradually turned into a 'greedy revolution' as evident in the indiscriminate use of inorganic inputs to attain higher productivity (Swaminathan, 2002). Rice (*Oryza sativa* L.) is a tillering plant belongs to the family Gramineae Chromosome no. of rice is 2n=24. Rice production in India is an important part of the national economy. India is the world's 2nd largest producer after china accounting for 22% of the world's rice production.

Rice is one of the three most important food grain crops in world, forms the staple diet of 2.7 billion people. Its cultivation is of immense importance to food security of Asia,

where more than 90% of the global rice is produced and consumed. Rice belongs to the genus *Oryza*, sub tribe oryzineae of the family Gramineae. There are 21 recognized species in genus *Oryza*. Rice production in India during 2019-20 is 117.47 million tonnesit is higher by 9.67 million tonnes than the average five years production and the rice cultivating area in India is 43.97 m ha^{-1}(The economics time magazine 2019). Rice is grown in Uttar Pradesh during kharif season from June to October/November. Uttar Pradesh is the second largest rice producing state after west Bengal with the production of 11.62 million tonnes and the rice cultivated land in Uttar Pradesh is 5.86 m ha^{-1} (The economics time magazine 2019).

Uttar Pradesh is one of the major rice growing state in the country. It accounts about 14.54 percent of total rice production in the country (2018-19) all types of soils are mostly suited for its cultivation. the traditional rice farming systems in India broadly include wetland {lowland and upland} system. the life cycle can be divided into 3 important phases, *i.e.* vegetative, reproductive and ripening.

Rice is an important and extensively cultivated food crop which feeds more than half of the world's population. in Asia alone, more than 2 billion people obtain 60 to 70 percent of their energy intake from rice and its derivatives per capita requirement of rice in India is 130 kg per annum (FAO 2017) and Rice is a nutritious crop and it produces 32-59 percent of the dietary energy and 25-40 percent of dietary protein in 39 countries. consumption of 100 g cooked rice can supply 111 kilo calories energy, 0.9 g total fat, 43 milli gram potassium, 23 g carbohydrates,1.8 g dietary fibre and 0.4 g sugar India has the largest area among rice growing countries and it stands second in production next to China (Udhyakumar and Ramasamy, 2016).

Materials and Methods

The experiment was conducted on the research farm of department of soil science and agricultural chemistry, NAINI, SHUATS, Prayagraj. it is on the bank of Yamuna river, the experimental site was located in the sub-tropical region with 25.43^0 N latitude, 81.84^0 E longitude and 98 m above from the MSL. the soil of experimental area falls in order of Inceptisols and soil is a alluvial in nature, texture sandy loam, it consist of 9 treatments which were replicated thrice and laid out in a randomised block design. The treatment combinations are T_1- (@ absolute control), T_2–(@ 100% RDF), T_3– (@ 50% RDF + FYM@ 5 t ha^{-1}), T_4–(@50%RDF + Vermicompost @ 5 t ha^{-1}), T_5– (@50%RDF + Rice straw @ 5 t ha^{-1}), T_6- (@25%RDF + Vermicompost@ 2.5 tha^{-1}+ FYM @ 2.5 tha^{-1} + Rice Straw @2.5 tha^{-1}), T_7-(@ 50% RDF+ Poultry manure @ 5 t ha^{-1}), T_8-(@ 25% RDF + FYM @ 2.5 tha^{-1} + PSB @ 1Kgha^{-1} +Vermicompost @ 2.5 tha^{-1}),T_9-(@ 25% RDF + Rice straw @ 2.5 tha^{-1} + Poultry Manure @ 2.5 tha^{-1} + PSB @ 1 kg ha^{-1}) the fertilizers, organic manures and biofertilizer are applied in each plot according to treatment combinations. the seedlings was given to each plot in equal quantity based on general requirement and fertilizer doses are calculated and applied in each plot. The general recommended dose of NPK is 120:60:60. Methods which are used to analyse soil physical and chemical parameters given in table.

Organic manures are taken in this field experiment and they having different nutrient compositions they are discussed below

Results and Discussion

As depicted data presented in table 4 showed that the maximum bulk density was observed in the treatment combination T_1– (@ absolute

control) there was non-significant variation between various treatment combinations there was a non-significant effect on bulk density and solid space.in case of soil properties there was a significant effect on water holding capacity and a non-significant effect on soil pH and soil EC by different treatment combinations. But in case of plots treated with organic manures showed slight increasing in pH and EC. There was a significant difference between treatment combinations in the case of organic carbon. the maximum organic carbon content water holding capacity available nitrogen and available potassium (0.72 %, 375.94 and 187.25 kg ha^{-1}) was recorded in the treatment combination T_7-(@50 % RDF + Poultry manure @ 5 t ha^{-1}) but the maximum available Phosphorus in soil (45.72 kg ha^{-1}) was recorded in the treatment combination T_9-(@ 25% RDF + Rice straw @ 2.5 tha^{-1} + Poultry Manure @ 2.5 tha^{-1} + PSB @ 1kgha^{-1}). T_9- (@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1kg ha^{-1}) is noticed as second best treatment after T_7- (@ 50 % RDF + Poultry manure @ 5 t ha^{-1})when compared with treatment combination T_1-(@ absolute control) similar findings had been reported by Ayalew and Dejene (2012) stated that integrated nutrient management is the best approach to supply adequate and balanced nutrients and increase crop productivity in an efficient and environmentally benign manner, without sacrificing soil productivity of future generations.it is also found that byHassan Shokri Vahed and Fatemeh Heydarnezhad (2012) Nandinidevi (2013), the maximum P uptake was noted when 75% RDF with vermicompost at the rate of 1 t ha^{-1} and PSB followed by the integration of 75% RDF with vermicompost at the rate of 1 t ha^{-1} (Fig. 1–4 and Table 1–7).

Table.1 List of soil physical parameters and methods used to analyse

S. No.	Particulars	Method used Scientist Year
1	Particle Density(Mg m^{-3})	Graduated cylinder method Muthuaval *et al*., 1992
2	Bulk Density (Mg m^{-3})	Graduated cylinder method Muthuaval *et al*.,1992
3	Pore space (%)	Graduated cylinder method Muthuaval *et al*., 1992
4	Water Holding capacity	Graduated cylinder method Muthuaval *et al*.,1992
5	Soil texture	Bouyoucos hydrometer method G JBouyoucos1927
6	**S**oil colour	Munsell colour chart method Albert H Munsell1905

Table.2 List of soil chemical parameters and methods used to analyse

S. No.	Particulars	Method used Scientist Year
1	pH (1:2)	Glass Electrode pH Meter Jackson1954
2	EC (dS m^{-1} at 25°C)	Conductivity Bridge Meter Wilcox1950
3	Organic carbon (%)	Wet-oxidation method Walkley and Blackman 1947
4	Available N ($kgha^{-1}$)	Alkaline Permanganate Method Subbiah and Asija 1956
5	Available P ($kgha^{-1}$)	Olsen's Method Olsen *et al.*, 1954
6	Available K (kg ha^{-1})	Flame Photometer Method Toth and Prince1949

Source:(Jaiswal 2006)

Table.3 List of nitrogen, phosphorus and potassium composition in different organic materials

S. No.	Name of material	N : P : K (%)
1.	Poultry manure (PM)	3.03 : 2.63 : 1.40
2.	Rice straw (RS)	0.80 : 0.40 : 0.30
3.	Vermicompost (VC)	3.00 : 1.00: 1.50
4.	Farm yard manure (FYM)	0.50 : 0.20 : 0.50

Source:(Reddy andReddy2016)

Table.4 Interaction effect of integrated nutrient on bulk density particle density and moisture content of the soil in Rice Var:Bpt-5204

Treatment	Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	Pore space (%)
T_1- [(@ absolute control]	1.28	2.74	56.39
T_2- [@ 100% RDF]	1.06	2.50	59.31
T_3- [(@ 50% RDF + FYM @ 5 t ha^{-1}]	1.12	2.78	57.92
T_4- [@ 50% RDF + Vermicompost @ 5 t ha^{-1}]	1.11	2.85	61.77
T_5- [@ 50% RDF + Rice straw @ 5 t ha^{-1}]	1.05	2.78	62.47
T_6- [@ 25% RDF + Vermicompost @ 2.5 t ha^{-1} + FYM @ 2 .5 t ha^{-1} + Rice Straw @ 2.5 t ha^{-1}]	1.11	2.78	61.77
T_7- [(@ 50% RDF + Poultry manure @ 5 t ha^{-1}]	1.05	2.57	54.73
T_8- [(@ 25% RDF + FYM @ 2.5 t ha^{-1} + PSB @ 1Kg ha^{-1} + Vermicompost @ 2.5 t ha^{-1}]	1.11	2.73	60.73
T_9- [(@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1 kg ha^{-1}]	1.24	2.50	55.97
f-test	NS	S	NS
S.Em.(±)	-	0.064	-
CD at 5%	-	0.192	-

Table.5 Interaction effect of integrated nutrient on solid space, specific gravity and water holding capacity of the soil in Rice Var:Bpt-5204

Treatment	Solid space (%)	Specific gravity (Mg m^{-3})	Water holding capacity (%)
T_1- [(@ absolute control]	42.27	2.58	65.38
T_2- [@ 100% RDF]	39.61	2.29	60.89
T_3- [(@ 50% RDF + FYM @ 5 t ha^{-1}]	40.74	2.43	67.45
T_4- [@ 50% RDF + Vermicompost @ 5 t ha^{-1}]	39.6	2.24	66.38
T_5- [@ 50% RDF + Rice straw @ 5 t ha^{-1}]	36.78	2.58	61.14
T_6- [@ 25% RDF + Vermicompost @ 2.5 t ha^{-1} + FYM @ 2 .5 t ha^{-1} + Rice Straw @ 2.5 t ha^{-1}	38.54	2.36	65.72
T_7- [(@ 50% RDF + Poultry manure @ 5 t ha^{-1}]	43.6	2.37	62.78
T_8- [(@ 25% RDF + FYM @ 2.5 t ha^{-1} + PSB @ 1Kg ha^{-1} + Vermicompost @ 2.5 t ha^{-1}]	39.28	2.31	63.39
T_9- [(@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1 kg ha^{-1}]	43.36	2.14	62.03
f-test	NS	NS	S
S.Em.(±)	1.172941	-	0.594087
CD at 5%	3.516476	-	1.781073

Table.6 Interaction effect of integrated nutrient on soil pH, electrical conductivity and organic carbonin Rice Var:Bpt-5204

Treatment	pH	EC (dS m^{-1})	OC (%)
T_1- [(@ absolute control]	7.33	0.036	0.50
T_2- [@ 100% RDF]	7.68	0.033	0.61
T_3- [(@ 50% RDF + FYM @ 5 t ha^{-1}]	7.72	0.033	0.69
T_4- [@ 50% RDF + Vermicompost @ 5 t ha^{-1}]	7.64	0.036	0.65
T_5- [@ 50% RDF + Rice straw @ 5 t ha^{-1}]	7.69	0.033	0.63
T_6- [@ 25% RDF + Vermicompost @ 2.5 t ha^{-} + FYM @ 2 .5 t ha^{-1} + Rice Straw @ 2.5 t ha^{-1}]	7.74	0.036	0.62
T_7- [(@ 50% RDF + Poultry manure @ 5 t ha^{-1}]	7.67	0.036	0.72
T_8- [(@ 25% RDF + FYM @ 2.5 t ha^{-1} + PSB @ 1Kg ha^{-1} + Vermicompost @ 2.5 t ha^{-1}]	7.73	0.033	0.69
T_9- [(@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1 kg ha^{-1}]	7.69	0.036	0.62
f-test	NS	NS	S
S.Em.(±)	-	-	0.030
CD at 5 %	-		

Table.7 Interaction effect of integrated nutrient on available nitrogen, phosphorus and potassium of the soil in RiceVar:Bpt-5204

Treatments	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
T_1- [(@ absolute control]	224.80	24.13	139.42
T_2- [@ 100% RDF]	330.83	43.70	188.31
T_3- [(@ 50% RDF + FYM @ 5 t ha^{-1}]	337.85	29.48	149.86
T_4- [@ 50% RDF + Vermicompost @ 5 t ha^{-1}]	325.75	35.50	176.89
T_5- [@ 50% RDF + Rice straw @ 5 t ha^{-1}]	329.03	37.32	149.86
T_6- [@ 25% RDF + Vermicompost @ 2.5 t ha^{-1} + FYM @ 2 .5 t ha^{-1} + Rice Straw @ 2.5 t ha^{-1}]	341.75	41.26	149.86
T_7- [(@ 50% RDF + Poultry manure @ 5 t ha^{-1}]	375.94	39.67	187.25
T_8- [(@ 25% RDF + FYM @ 2.5 t ha^{-1} + PSB @ 1Kg ha^{-1} + Vermicompost @ 2.5 t ha^{-1}]	350.60	35.55	176.94
T_9- [(@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1 kg ha^{-1}]	355.65	45.72	176.89
f-test	S	S	S
S.Em.(±)	1.534	0.322	1.510
CD at 5%	4.598	0.968	4.527

Fig.1 Interaction effect of integrated nutrient on soil bulk density, particle density and pore space in Rice Var:Bpt-5204

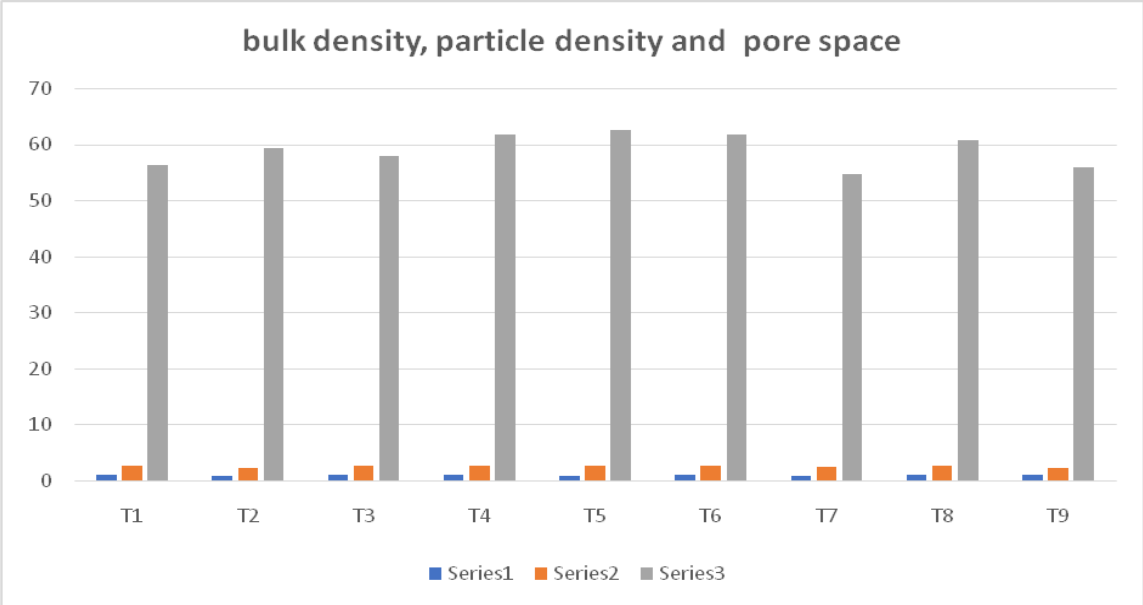


Fig.2 Interaction effect of integrated nutrient on solid space, water retaining capacity and specific gravity of soil in RiceVar:Bpt-5204

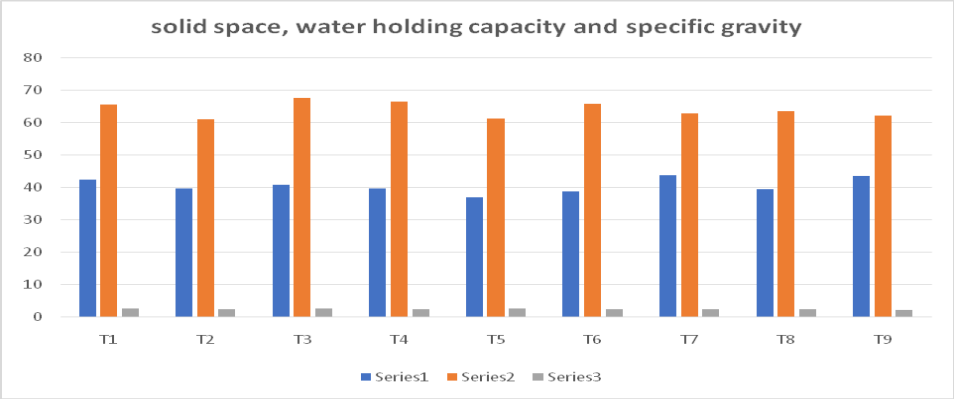


Fig.3 Interaction effect of integrated nutrienton soil pH,electrical conductivity andorganic carbon in RiceVar:Bpt-5204

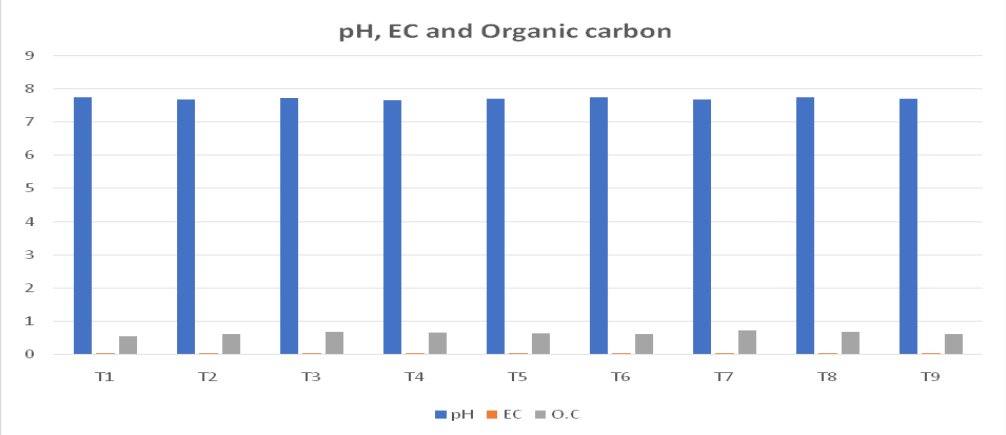
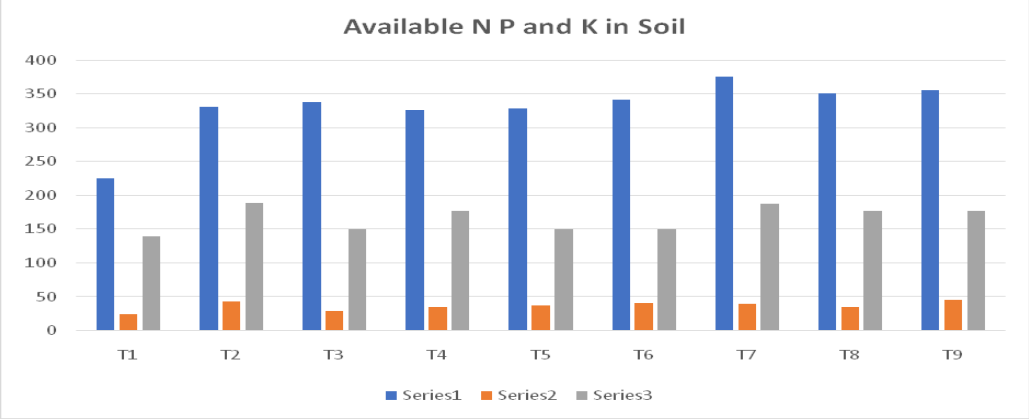


Fig.4 Interaction effect of integrated nutrient on available nitrogen, phosphorus and potassium of soil in RiceVar:Bpt-5204



The treatments were allocated in a randomized block design with three replications. the treatments consisted of combination of different levels of NPK, organic manures and a bio-fertilizer. the crop was transplanted on 20th July 2019 with a seed rate of 25 kg ha^{-1} and harvested on 13thNovember 2019.The observation taken on different plant characters during the crop growth period and at crop harvest. in the terms of soil quality parameters like soil organic carbon content, available NPK, pH, EC and growth parameters like plant height number of tillers panicle length number of seeds per panicle grain yield Straw yield of Rice *etc*., treatment combination T_7–[@50% RDF + Poultry manure @ 5 t ha^{-1}] showing the better result from the economical point of view the same treatment combination gave the maximum profit of Rs. 77,708.00 $Rs.ha^{-1}$ with C:B ratio of 1:3.03 and it was very closely followed T_9-[@ 25% RDF + Rice straw @ 2.5 t ha^{-1} + Poultry Manure @ 2.5 t ha^{-1} + PSB @ 1kg ha^{-1}]as they compared with treatment combination T_1-(@absolute control). Poultry manure supplies continuous slow release organic matter and increased more available nutrients, which aided in better growth parameters of Rice.

It was concluded from the trail the treatment T_7-[@50% RDF + Poultry manure @ 5 t ha^{-1}] particularly poultry manure @ 5 t ha^{-1} in combination with @50% RDF from inorganic sources was given the significant results and this combination gave the better soil health parameters and yield than the inorganic fertilizers alone.

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