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Effect of Integrated use of Organic, Inorganic and Bio-Fertilizers on Soil Fertility and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil

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ABSTRACT

The present experiment was conducted during rabi season of year 2020-21 at the Research Farm of Kulbhaskar Ashram Post graduate College, Prayagraj to study the Effect of Integrated use of Organic, Inorganic and Bio-Fertilizers on Soil Fertility and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil. The experiment was laid out in Randomized Block Design (RBD) with three replications and eleven treatments viz. T1-100% RDF (120:60:40 NPK), T2-75% RDF + 3 t/ha FYM + Azospirillum, T3-50% RDF + 6 t/ha FYM + Azospirillum, T4-25% RDF + 9 t/ha FYM + Azospirillum, T5-75% RDF + 2.5 t/ha WH + Azospirillum, T6-50% RDF + 5 t/ha WH + Azospirillum, T7-25% RDF + 7.5 t/ha WH + Azospirillum, T8-75% RDF + 1 t/ha VC + Azospirillum, T9-50% RDF + 2 t/ha VC + Azospirillum, T10-25% RDF + 3 t/ha VC + Azospirillum and T11-control. The results revealed that application of balanced fertilizers in wheat crop increased the growth, yield, yield attributing characters and protein content in grain. Integrated use of organic manure with chemical fertilizers and bio-fertilizers improved the soil properties in respect of pH, ECe, organic carbon, available N, P and K. The maximum reduction in pH and ECe was recorded with the treatment T10-25% RDF + 3 t/ha VC + Azospirillum and T3-50% RDF + 6 t/ha FYM + Azospirillum respectively. The organic carbon, available N, P and K were found maximum in treatment T8-75% RDF + 1 t/ha VC + Azospirillum.

Keywords: INM, Soil Fertility, Productivity, Wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most stable food crops and second most important cereal crops in India after rice. It is known as “king of cereals”. Wheat is belonged to family Poaceae and generally grown in *rabi* season. It is used for making bread, pasta, cake, crackers, and flours and some wheat is used by industry for the purpose of the production of starch, fat, malt dextrose, alcohol and other products. Wheat is an excellent source of carbohydrates (68%), protein (12%), fat (2%), and it is also source of dietary fiber, iron, vitamins and minerals. The importance of fertilizers uses to boost food grain production is well recognized from quite a few decades, but intensity of fertilizers use is in wide variations in regions in respect of their use and consumption to get more and more yield. Farmers are inclined to the excess use of chemical fertilizers, but the decision on fertilizer use requires knowledge of the expected crop yield response to the nutrient application. The continuous application of fertilizers in imbalance way decreasing productivity and quality of crops as well as deteriorating soil fertility in great extent. This implication for the yield response the fertilizers as it decreases crop quality and adversely affected over all soil fertility and productivity in recent year. Energy crisis, higher fertilizer cost and concerned for sustainability and ecological stability in relation to chemical fertilizers use have emerge as important issues. Soil fertility maintenance requires a balanced application of inorganic and organic nutrient sources to sustain soil fertility and crop productivity thus, balanced and integrated application of chemical and organic fertilizers is a key factor. Maintenance of soil fertility is a foundation for long time sustain agriculture and organic manure can play a vital role in sustaining soil fertility and crop production. The most significant results are obtained, when we use organic manures in combination of chemical fertilizers. Nitrogen is major structural nutrients of the cell along with P and K. It was help in building up vegetative growth of plant. The integrated nitrogen management under such condition seems to be more beneficial for wheat cultivation with respect to yield, uptake and utilization of nitrogen along with improvement of soil health.

Considering the above facts present investigation was carried out to find “Effect of Integrated use of Organic, Inorganic and Bio-Fertilizers on Soil Fertility and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil” with the following objectives.

1. Effect of integrated use of organic, inorganic and bio-fertilizers on growth, yield and yield attributing characters of wheat and

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2. Effect of integrated use of organic, inorganic and bio-fertilizers of properties of soil.

MATERIALS AND METHODS

The present experiment was conducted during *rabi* season of year 2020-21 at the research farm of Kulbhaskar Ashram Post graduate College, Prayagraj, Uttar Pradesh. The Rainfall at Prayagraj generally decreases from the South-East to North West. About 88 percent of the annual rainfall is received during the monsoon Season. July and August both the month receive maximum rainfall. The normal rainfall in Prayagraj is 1042 mm annual. The eleven treatments i.e. T₁-100% RDF(120:60:40 NPK), T₂-75% RDF + 3 t/ha FYM + Azospirillum, T₃-50% RDF + 6 t/ha FYM + Azospirillum, T₄-25% RDF + 9 t/ha FYM + Azospirillum, T₅-75% RDF+ 2.5 t/ha WH + Azospirillum, T₆-50% RDF + 5 t/ha WH + Azospirillum, T₇-25% RDF + 7.5 t/ha WH + Azospirillum, T₈-75% RDF + 1 t/ha VC + Azospirillum, T₉-50% RDF + 2 t/ha VC + Azospirillum, T₁₀-25% RDF + 3 t/ha VC + Azospirillum, and T₁₁-control were selected and tested in Randomized Block Design (RBD) with three replications.

The crop wheat is taken as test crop and variety of UP2338. The fertilizers were applied @120 kg N, 60 kg P₂O₅, and 40 kg K₂O per ha through urea, di-ammonium phosphate and muriate of potash respectively. Half dose of Nitrogen and full dose of phosphorus and potassium were applied as basal dose at the sowing time in all treatments except control. The remaining half dose of nitrogen was top-dressed after first irrigation of wheat crop. Azospirillum was applied as seed treatment. The treatmentwise doses of FYM, water hyacinth (WH) and vermicompost (VC) were applied on the basis of nitrogen content in it. The calculated amount of FYM, water hyacinth and vermicompost was applied in the field 15 days before sowing of wheat crop at the rate of 3, 6, & 9 t/ha, 1, 2 and 3 t/ha and 2.5, 5 and 7.5 t/ha respectively. The seed 100 kg/ha of wheat variety UP-2338 was sown at a row distance of 20 cm in the experimental plots. Plants parameters like plant height, no. of spikes/m², spike length, no. of grains/spike, yield, soil properties etc., was observed. The protein content was calculated after analyze the N content in grain and value was multiplied with 6.25. The experiment data were analyzed using “Analysis of Variance Techniques” in Randomized Block Design (RBD).

Table 1: Mechanical and chemical analysis of soil

Component	Percentage	Method
Sand	45.07	Hydrometer method ^[1]
Silt	31.20	
Clay	23.31	
Texture	Sandy loam	
Parameters	Value	
pH (1:2.5)	8.36	By pH meter
OC (%)	0.31	Walkley & Black method ^[2]
ECe (dS/m)	0.40	By Electrical Conductivity meter
Available N (kg/ha)	227.30	Alkaline Per magnate method ^[3]
Available P ₂ O ₅ (kg/ha)	16.35	0.5M NaHCO ₃ (8.5 pH) extractable P (Olsen’s methods) ^[4]
Available K ₂ O (kg/ha)	258.72	1N NH ₄ OAc extractable K using Flame Photometer ^[5]

RESULT AND DISCUSSION

Plant growth & Yield attributing characters

The application of 100% RDF produced maximum plant height at all the stages which was at par with 75% RDF + 1 t/ha vermicompost + Azospirillum. The maximum plant height at 30 DAS was observed in 100% RDF (T₁) which was at par with treatment 75% RDF + 3 ton/ha FYM + Azospirillum (T₂) and significantly superior over rest of the treatments. At 60 DAS the maximum plant height was noticed in treatment 100% RDF (T₁) which was significantly superior over T₄, T₇, T₁₀ and T₁₁. At 90 DAS the plant height was observed in treatments 100% RDF (T₁) which was significantly superior over control at par with rest of treatment. The Plant height at maturity (120 DAS) was observed at par with all treatments except control (T₁₁). Similar results of increased plants height were also reported that by ^[6]. The use of organic manure and bio-fertilizer enhance the plant height over control. The increased in plant height with the combined application of organic and inorganic sources of nutrients have also been reported by ^[7, 8]. The data revealed that the maximum spike length, number of spikelets per spike, no. of grains per spike and test weight were observed in treatments T₁ (100% RDF) which was at par with all the treatments except control (T₁₁). The improvement in yield attributes of wheat may be due to balance nutrient application particularly, nitrogen play a vital role in cell division and elongation as well as increase sink size which provide feedback to sources for production of higher amount of photosynthates. Use of high amount of nutrients improved the fertility level of soil and create conducive

environment of soil for better growth and development result better yield attributes. These results are in agreement with the finding of ^[9, 10].

Yield & Harvest Index

The yield is the final assessment of treatment in any agronomic investigation. Grain Yield was significantly influenced by nutrient management practice. Adoption of nutrient management practices increased the grain yield significantly over control. The maximum grain yield (44.78 q/ha) observed with the application of 100% RDF which was statistically at par with 75% RDF + 1 ton/ha vermicompost + Azospirillum and significantly higher over remaining treatment. Lowest grain yield (26.23 q/ha) was recorded in control. The yield was increased (41.42%) in the treatment T₁ (100%RDF) over control. The highest straw yield (63.26 q/ha) was recorded with the application of 100% RDF which was found statistically at par with 75% RDF + 1 ton/ha vermicompost + Azospirillum and significantly higher over the rest of treatments. Lowest straw yield (42.00 q/ha) was recorded in control (T₁₁). It could due to integrated use of NPK fertilizers along with vermicompost and bio-fertilizers in the field crops not only influenced growth of the plant but increases production of wheat crops. Similar results were observed by ^[7, 11]. The maximum (43.61 %) harvest index was observed in the T₁₀ (25% RDF + 3 ton/ha vermicompost + Azospirillum) balance use of chemical fertilizer fallowed by T₇ (25% RDF + 7.5 ton/ha Water hyacinth + Azospirillum). Similar results were reported by ^[12].

Protein

Application of 100% RDF has proven the best with 12.46% protein it was statistically at par with 75% RDF + 1ton/ha vermicompost + Azospirillum. The result indicates that all the integrated plots receiving chemical fertilizer, vermicompost and bio-fertilizer improve the protein content in grain over control. Similar results have been reported by [13].

Soil properties

pH, EC & OC

The maximum reduction in PH was recorded in the treatment T₁₀ and maximum was found in control. The maximum Reduction in Electrical Conductivity was recorded in T₃ (50% RDF + 6 ton/ha FYM + Azospirillum) followed by T₆ (50% RDF + 5 ton/ha WH + Azospirillum). The highest Electrical Conductivity was noted with treatment T₁ (100% RDF kg/ha) treatment. Results are in confirmation with [14, 15]. The highest organic carbon content (0.57%) in soil recorded with

application 75% RDF + 1 ton/ha Vermicompost + Azospirillum was statistically at par with 100% RDF (T₁) and 50% RDF + 2-ton Vermicompost + Azospirillum (T₉) and significantly superior over the rest of treatments. It may be due to nature of organic manures with improvement in physical, chemical and biological properties of soil. The results closely corroborate with findings by [15].

Available Nitrogen, Phosphorous and Potassium

It was observed that maximum available NPK in soil was analyzed in treatment T₈ (75% RDF + 1 t/ha vermicompost + Azospirillum) which was at par with treatments T₁, T₄ and T₇. The combined application of chemical fertilizers with FYM or vermicopost and bio-fertilizers improve the available NP&K content in soil. Application of FYM, vermicopost with chemical fertilizers improved the soil health along with organic carbon available NPK Content in soil. Similar results were reported by [16, 17].

Table 2: Effect of integrated use of organic, inorganic and bio-fertilizer on plant height

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	120 DAS
T ₁	17.20	44.50	71.21	80.50
T ₂	15.60	43.50	69.60	79.30
T ₃	13.10	40.20	66.30	77.30
T ₄	10.70	38.50	64.60	74.10
T ₅	12.69	41.50	66.70	77.80
T ₆	11.10	39.10	65.20	75.40
T ₇	10.20	38.10	63.80	75.02
T ₈	15.80	44.10	70.70	79.90
T ₉	13.22	42.90	68.60	78.70
T ₁₀	11.60	38.20	64.22	76.90
T ₁₁	9.30	30.20	51.20	61.20
SEm±	1.02	1.90	2.86	3.41
CD at 5%	3.00	5.61	8.44	10.06

Table 3: Effect of integrated use of organic, inorganic and bio-fertilizer on yield attributing characters, protein content and yield of wheat

Sl. No.	Spike Length (cm)	No. of Spikelet's Spike ⁻¹	No. of grains spike ⁻¹	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Protein content (%)
T ₁	10.40	16.60	37.70	37.80	44.78	63.26	41.45	12.46
T ₂	9.90	15.80	36.60	36.80	41.86	61.54	40.48	11.65
T ₃	9.60	14.60	35.20	34.80	39.63	60.82	39.45	10.90
T ₄	9.20	13.80	33.20	33.60	37.45	51.36	42.16	10.21
T ₅	9.70	15.10	35.20	35.60	40.94	60.94	40.18	11.15
T ₆	9.30	14.01	33.80	34.40	38.48	60.71	38.79	10.46
T ₇	9.00	13.40	32.70	32.80	36.94	49.36	42.80	10.09
T ₈	10.10	16.30	37.10	37.40	43.36	61.90	41.19	12.10
T ₉	9.80	15.20	36.20	36.30	41.45	61.15	40.39	11.40
T ₁₀	9.40	14.60	34.60	35.50	39.45	51.35	43.61	10.53
T ₁₁	6.80	10.60	28.80	30.50	26.23	42.00	38.44	8.28
SEm±	0.71	1.03	0.87	0.83	2.28	3.45	2.86	0.44
CD at 5%	2.10	3.03	2.57	2.45	6.75	10.18	N.S.	1.30

Table 4: Effect of integrated use organic, inorganic and bio-fertilizers on soil properties

Sl. No.	Soil pH (1:2.5)	ECe (1:2.5)	Organic Carbon (%)	Nitrogen (Kg ha ⁻¹)	Phosphorous (Kg ha ⁻¹)	Potassium (Kg ha ⁻¹)
T ₁	8.14	0.41	0.55	239.38	15.64	184.35
T ₂	7.90	0.39	0.54	227.25	13.58	175.25
T ₃	7.85	0.36	0.50	221.18	12.85	172.70
T ₄	7.41	0.39	0.49	230.34	14.30	178.35
T ₅	8.06	0.36	0.55	223.76	13.00	173.76
T ₆	7.69	0.35	0.50	216.36	12.39	170.66
T ₇	7.38	0.34	0.49	230.50	14.80	180.25
T ₈	7.65	0.39	0.57	240.71	16.14	185.06
T ₉	7.15	0.40	0.53	225.64	13.33	174.19
T ₁₀	7.04	0.38	0.53	218.75	12.52	172.05
T ₁₁	8.15	0.36	0.47	194.23	9.88	160.45
SEm±	0.05	0.15	0.03	4.11	0.69	2.74
CD at 5%	0.13	0.45	0.13	12.12	2.05	8.07

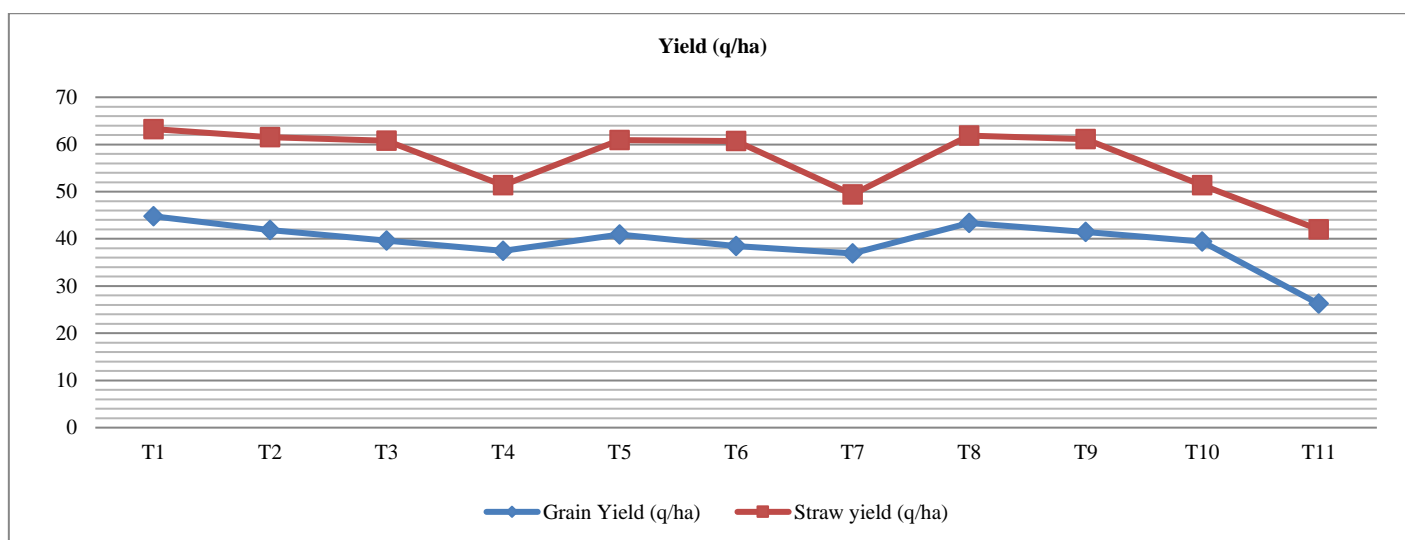


Figure 1: Effect of integrated use organic, inorganic and bio-fertilizers on grain & straw yield of wheat

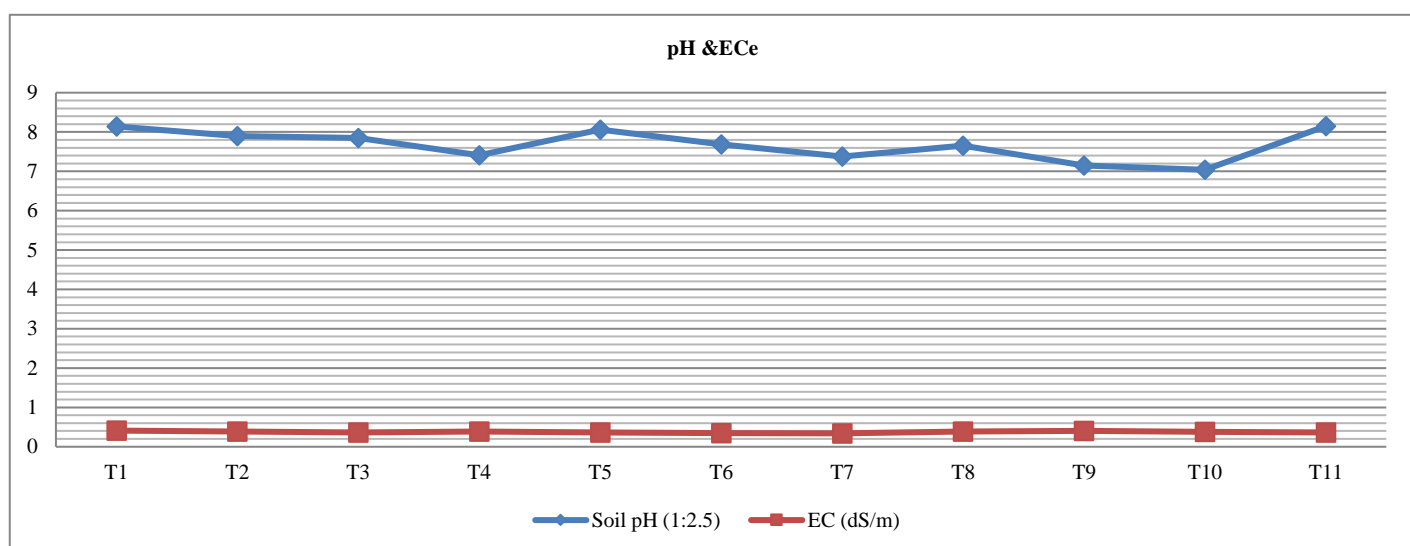


Figure 2: Effect of integrated use organic, inorganic and bio-fertilizers on soil pH & ECe

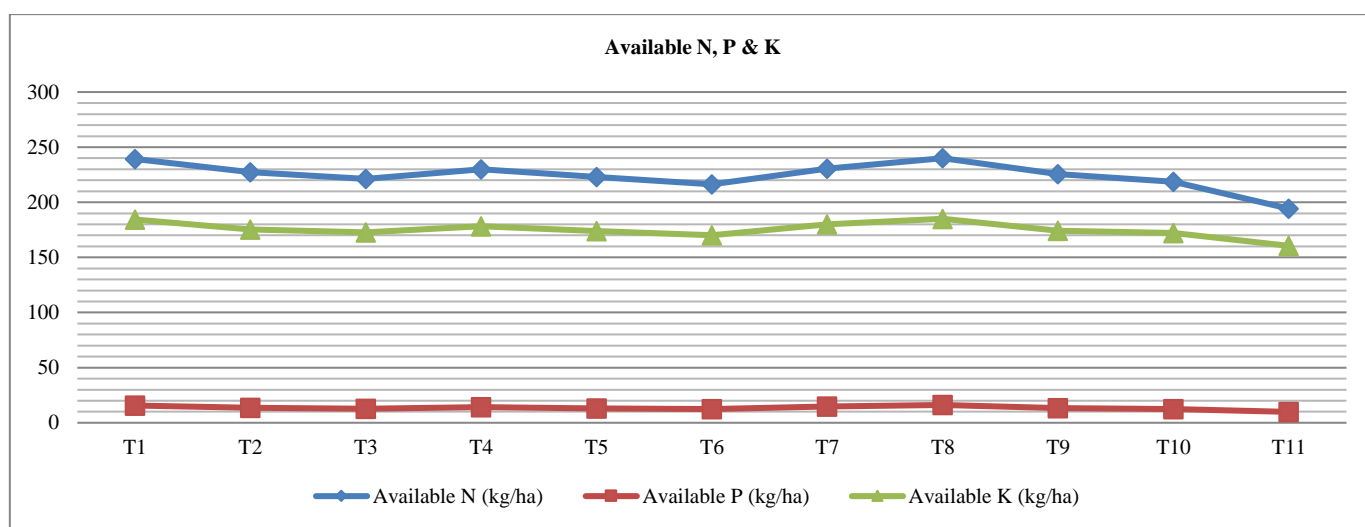


Figure 3: Effect of integrated use organic, inorganic and bio-fertilizers on available N, P₂O₅ & K₂O (kg/ha) in soil after the harvest of crop

CONCLUSION

On the basis of experimental findings following conclusion could be drawn.

1. Use of 100% Recommended Dose of Fertilizers (RDF) increased the growth, yield attributing characters and yield of wheat as compared to rest of the treatments.
2. Integrated use of organic manures, bio-fertilizers with chemical fertilizers improved properties of soil in respect to soil pH, ECE and organic carbon, available nitrogen, phosphorous and potassium.
3. The treatment T₁ (100% RDF) followed by integrated use of organic manures, bio-fertilizers and chemical fertilizers proved better in respect of wheat yield and improved soil properties and it may be recommended for the farmers.

Conflict of Interest

None declared.

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None declared.

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