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 T11 (25% RDF +3 t/ha VC +Azospirillum), and T1- (50% RDF +6 t/ha FYM +Azospirillum), respectively. The organic carbon, available N, P and K were found maximum in treatment T3 (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...
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 environment of soil for better growth and development result better yield attributes. These results are in agreement with the finding of [9, 10].

**Table 1:** Mechanical and chemical analysis of soil

| Component | Percentage | Method |
|-----------|------------|--------|
| Sand      | 45.07      | Hydrometer method[51] |
| Silt      | 31.20      | By pH meter |
| Clay      | 23.31      | Walkley & Black method[52] |
| Texture   | Sandy loam | By Electrical Conductivity meter |
| pH (1:2.5)| 8.36       | Alkaline Per magnate method[53] |
| OC (%)    | 0.31       | 0.5M NaHCO3 (8.5 pH) extractable P (Olsen’s methods)[54] |
| ECe (dS/m)| 0.40       | 1N NH4OAc extractable K using Flame Photometer[55] |
| Available N (kg/ha) | 227.30 | |
| Available P2O5 (kg/ha) | 16.35 | |
| Available K2O (kg/ha) | 258.72 | |

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 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, T5, 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 pat with all treatments expects control (T12). Similar results of increased plants height were also reported that by [48]. 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, 9]. 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

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 treatment wise 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).

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 pat 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 follow by T3 (25% RDF +7.5 ton/ha Water hyacinth +Azospirillum), Similar results were reported by [12].
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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 T0 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), (T3) 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 [16].

Available Nitrogen, Phosphorous and Potassium
It was observed that maximum available NPK in soil was analyzed in treatment T3 (75% RDF +1t/ha vermicompost +Azospirillum), which was at par with treatments T1, T4 and T7. The combined application of chemical fertilizers with FYM or vermicompost and bio-fertilizers improve the available NP&K content in soil. Application of FYM, vermicompost 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 |
| T1         | 17.20  | 44.50  | 71.21  | 80.50  |
| T2         | 15.60  | 43.50  | 69.60  | 79.30  |
| T3         | 13.10  | 40.20  | 66.30  | 77.30  |
| T4         | 10.70  | 38.50  | 64.60  | 74.10  |
| T5         | 12.69  | 41.50  | 66.70  | 77.80  |
| T6         | 11.10  | 39.10  | 65.20  | 75.40  |
| T7         | 10.20  | 38.10  | 63.80  | 75.02  |
| T8         | 15.80  | 44.10  | 70.70  | 79.90  |
| T9         | 13.22  | 42.90  | 68.60  | 78.70  |
| T10        | 11.60  | 38.20  | 64.22  | 76.90  |
| T11        | 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 (%) |
|---------|-------------------|---------------------------|-----------------------|-----------------|-------------------|-------------------|------------------|--------------------|
| T1      | 10.40             | 16.60                     | 37.70                 | 37.80           | 44.78             | 63.26             | 41.45            | 12.46              |
| T2      | 9.90              | 15.80                     | 36.60                 | 36.80           | 41.86             | 61.54             | 40.48            | 11.65              |
| T3      | 9.60              | 14.60                     | 35.20                 | 34.80           | 39.63             | 60.82             | 39.45            | 10.90              |
| T4      | 9.20              | 13.80                     | 33.20                 | 33.60           | 37.45             | 51.36             | 42.16            | 10.21              |
| T5      | 9.70              | 15.10                     | 35.20                 | 35.60           | 40.94             | 60.94             | 40.18            | 11.15              |
| T6      | 9.30              | 14.01                     | 33.80                 | 34.40           | 38.48             | 60.71             | 38.79            | 10.46              |
| T7      | 9.00              | 13.40                     | 32.70                 | 32.80           | 36.94             | 49.36             | 42.80            | 10.09              |
| T8      | 10.10             | 16.30                     | 37.10                 | 37.40           | 43.36             | 61.90             | 41.19            | 12.10              |
| T9      | 9.80              | 15.20                     | 36.20                 | 36.30           | 41.45             | 61.15             | 40.39            | 11.40              |
| T10     | 9.40              | 14.60                     | 34.60                 | 35.50           | 39.45             | 51.35             | 43.61            | 10.53              |
| T11     | 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) | EC_e (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 & EC\(_e\)
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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REFERENCES
1. Bouyoucos GJ. Directions for making mechanical analysis of soils by hydrometer method. Soil science. 1936;42(3):225-30.
2. Walkley A, Black IA. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science. 1934;37:29-38.
3. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Current Science. 1956;25:259-60.
4. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United State Department of Agriculture circular. 1954;10:939.
5. Jackson ML. Soil chemical analysis, pentice hall of India Pvt. Ltd., New Delhi, India. 1973;498:151-4.
6. Yadav M, Rao VP, Suresh K. Nutrient uptake of micro sprinkler irrigated wheat cultivars under varying nitrogen levels. Journal of Research Acharya N. G. Ranga Agriculture University, 2013;41(2):131-34.
7. Patel TG, Patel KC, Patel VN. Effect of integrated nutrient management on yield attributes and yield of wheat (Triticum aestivum L.). International Journal of Chemical Studies. 2017;5(4):1366-69.
8. Fazlzy T, Thakral SK, Dhaka AK. Effect of integrated nutrient management on growth, yield attributes and yield of wheat. International Journal of Advances in Agricultural Science and Technology. 2021;8(1):106-18.
9. Singh MV, Kumar N, Singh B, Prakash V. Productivity and profitability of rabi maize hybrids under nutrient management practice. Annals of Plant and Soil Research. 2016;18(1):70-73.
10. Tejalben PG, Patel KC, Patel VN. Effect of integrated nutrient management on yield attributes and yield of wheat (Triticum aestivum L.). International Journal of Chemical Studies. 2017;5(4):1366-69.
11. Yadav KK, Singh SP, Nishant, Kumar V. Effect of integrated nutrient management on soil fertility and productivity on wheat crop. Journal of Experimental Agriculture International. 2018;24(2):1-9.
12. Sagar VK, Naresh RK. Effect of crop establishment methods and irrigation schedule on growth and yield of wheat (Triticum aestivum L.). Indian Journal of Agronomy. 2019;64(2):210-17.
13. Hasan MA, Kamal AM. Effect of fertilizers on grain yield and grain protein content of wheat. Journal of the National Science Foundation of Sri Lanka. 1998;25(1):1-8.
14. Puli MR, Katkar RN, Rao BS, Jayalakshmi M. Effect of long term fertilization on pH, EC and exchangeable Ca and Mg in vertosols under sorghum–wheat cropping sequence. International Journal of Applied Biology and Pharmaceutical Technology. 2013;4(4):431-33.
15. Bhatt MK, Labanya R, Joshi Hem C. Influence of long-term chemical fertilizers and organic manure on soil fertility. Universal Journal of Agricultural Research. 2019;7(5):177-88.
16. Pandey IB, Dwivedi DK, Pandey RK. Integrated nutrient management for sustaining wheat (Triticum aestivum) production under late sown condition. Indian Journal of Agronomy. 2009;54:306-309.
17. Kumar S, Dahiya R, Kumar P, Jhorar BS, Phogat VK. Long term effect of organic materials and fertilizers on soil properties in pearl millet-wheat cropping system. Indian Journal of Agricultural Research. 2012;46(2):161-66.

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