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Impact of chemical fertilizers and integrated nutrient management on properties of soil and production of wheat crop *(Triticum aestivum L.)*

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Abstract
Wheat (*Triticum aestivum* L.) is major agronomical crop grown in the winter session in India . The experimental wheat crop was grown at experimental site of Kulbhashkar Ashram P.G. College , Prayagraj ,India to test the various combinations of nutrient sources for sustaining crop production and improvement of soil health . The 9 nutrient combinations were either zero fertilizers , chemical fertilizer alone, organic alone or in combined with organic (pressmud, vermicompost, FYM) and chemical fertilizers tested in Randomized Block Design (RBD) which was replicated thrice . At the conclusion of the experiment, it was discovered that the combined application of chemical fertilizers and organic nutrient sources increased wheat crop yield and productivity while also improving soil health in terms of electrical conductivity. pH, available nitrogen , phosphorus and potassium .
Key Words: wheat , soil properties , INM , wheat production .

Introduction

Integrated nutrient supply is the systematic approach to nutrient management in which the combined application of organic manures and chemical fertilizers sources improves the soil fertility and crop productivity **(Shree *et al.* 2014).** Wheat crop emerged as the back bone of India's food security and its dwarf verities require more nutrients and have posed a great threat to long term sustainability of crop production due to exhaustive nature. High yielding wheat (*Triticum aestivum* L.) With the beginning of the green revolution, chemical fertilizers and cultivars were brought to India. The use of fertilizer expanded steadily after then. We must use agricultural management techniques and technology that will enhance productivity of crops and environmental diversity without compromising soil health if we are to secure the future of our future generation.

Maintaining soil health and supporting sustainable production have made the simultaneous application of inorganic fertilizers and organic manures crucial. The last thirty years have seen a significant depletion of soil nutrients in India due to modern intensive agriculture that uses high-yielding wheat cultivars. Additionally, the crop's production and soil health have decreased due to farmers' uneven application of artificial fertilizers.

It is crucial to take on the idea of integrated nutrient management methods due to the ongoing decline in crop output and the degradation of soil health caused by the ongoing use of chemical fertilizers. The food and nutritional security of India depends critically on preserving and improving soil health in order to increase and sustain agricultural productivity. The use of fertilizers and organic manures, among other more abundant and effective nutrient sources, can help address this difficulty.

Continuously cultivation and soil fertility depend on readily available organic sources of nutrients, such as vermicompost, Farm Yard Manuar (FYM), and others. In order to improve soil quality, input usage efficiency, and crop yield, integrated plant nutrient supply and management techniques are crucial for ensuring food and nutritional security in Indian agriculture. Swaup (2010) retaining . In light of this, the current study was conducted to investigate the "**Impact of chemical fertilizers and integrated nutrient management on properties of soil and production of wheat crop *(Triticum aestivum L.)"***

Materials and Methods

The present study was carried out on wheat crop (variety) in year 2022 – 2023 at instructional farm of Kulbhashkar Ashram P.G.College Prayagraj, India consisting 9 treatments T_1 (Absolute Control),T_2 (RDN + RDF) T_3, (75% RDN + 25% RDN through FYM + RDF) **T_4**(75% RDN + 25% RDN through PMC + RDF) **T_5** (75% RDN + 25% RDN through VC + RDF) **T_6 (**50% RDN + 50% RDN through FYM + RDF) **T_7** (50% RDN + 50% RDN through PMC + RDF) **T_8 (**50% RDN + 50% RDN through VC + RDF) T_9 (100% RDN through (33% FYM + 33% PMC + 33% VC) + RDF) were taken in various combinations of organic alone or in combined with chemical fertilizers with one control in which no chemical fertilizers were applied. These treatments were statistically tested in Randomized Block Design (RBD) . The initial and post harvest soil samples where collected (0 – 15cm depth) and examined using standard scientific methods. The initial soil characteristics and test values of experimental plots are given Table no. 1.1 ,1.2. The organic sources of nutrients e,g FYM , vermicompost and pressmud were applied 15 days before sowing of wheat crop and phosphorus and potassium and half dose of nitrogen fertilizers were applied at the time of sowing of wheat crop . The rest of nitrogenous fertilizer applied at top dressing. The four irrigation and manual weeding where done as per requirement.

Table -1.1 Mechanical analysis of soil

Components	Percentage	Methods used
Sand	56	Hydrometer method **(Bouyoucos, 1936)**
Silt	34	
Clay	20	
Texture	Sandy loam	

Table- 1.2 Chemical analysis of soil

Parameters	Value	Methods used
pH (1:2.5)	8.20	By Glass Electrode pH meter.
Organic carbon (%)	0.47	**Walkley & Black's, (1934)** Rapid Titration method **(Jackson,1973)**

EC (dSm^{-1})	0.39	By Electrical Conductivity meter.
Available Nitrogen (Kg ha^{-1})	236	Alkaline Potassium Permanganate method **(Subbiah &Asija, 1956)**
Available Phosphorus (Kgha^{-1})	27	Olsen's methods **(Olsen *et al.* 1954)**
Available Potassium (Kg ha^{-1})	220	Neutral- N- Ammonium Acetate using Flame Photometer **(Jackson, 1973)**

Result and Discussion

Production of wheat crop

The influence of Integrated nutrient management practices on grain yield of wheat was founded better on control. The grain yield was higher with 25% RDN through followed by same percent through VC & FYM over the recommended dose of chemical fertilizers. The treatment T_4 (75% RDN + 25%RDN through PMC + RDF) produced maximum (43.77 qha^{-1}.) grain yield of wheat which was significantly superior over the treatments T_1 (Control), T_6(50% RDN + 50% RDN through FYM + RDF), T_7 (50% RDN + 50% RDN through PMC + RDF), T_8 (50% RDN + 50% RDN through Vermicompost + RDF),$T_9$100% RDN through (33% FYM +33% PMC + 33% VC) and at par with treatments T_2 (RDN +RDF), T_3 (75% RDN + 25%RDN through FYM + RDF) and T_5 (75% RDN + 25% RDN through Vermicompost + RDF). Data furnished in table 2 showed that all plots receiving integrated nutrient, significantly increased straw yield of wheat over the control. The plot receiving 75% RDN + 25%RDN through PMC + RDF produced maximum straw yield (62.59 qha^{-1}) which was significantly superior over the treatments T_1 (Control), T_6(50% RDN + 50% RDN through FYM + RDF), T_7 (50% RDN + 50% RDN through PMC + RDF), T_8 (50% RDN + 50% RDN through Vermicompost + RDF),$T_9$100% RDN through (33% FYM +33% PMC + 33% VC) and at par with treatments T_2 (RDN +RDF), T_3 (75% RDN + 25%RDN through FYM + RDF) and T_5 (75% RDN + 25% RDN through Vermicompost + RDF). All the integrated plots produced higher straw yield of wheat as

compared to plot receiving no fertilizers and 100% chemical fertilizers. The higher grain and straw yield in the combined use of chemical fertilizers and organic sources of nutrient in the treated plots might be attributed to better supply of nutrients by conducive physical environment leading to better root activity and higher nutrient absorption, which resulted in better plant growth and superior yield.(**Acharya *et al.* 2012, Shahid et al. 2013 and Tamboli *et al.* 2016).**

Table 2. Impact of Organic and INM on Grain yield and Straw yield of wheat.

	Treatment	**Grain yield (qha^{-1}.)**	**Straw yield ($q\ ha^{-1}$.)**
T_1	(Absolute Control)	19.34	26.65
T_2	RDN + RDF	41.17	60.95
T_3	75% RDN + 25% RDN through FYM + RDF	41.35	61.32
T_4	75% RDN + 25% RDN through PMC + RDF	43.77	62.59
T_5	75% RDN + 25% RDN through VC + RDF	41.98	60.99
T_6	50% RDN + 50% RDN through FYM + RDF	37.04	50.35
T_7	50% RDN + 50% RDN through PMC + RDF	38.23	54.17
T_8	50% RDN + 50% RDN through VC + RDF	37.74	51.99
T_9	100% RDN through (33% FYM + 33% PMC + 33% VC) + RDF	36.21	45.39
S.Em ±		**0.873**	**0.592**
CD at 5%		**2.64**	**1.79**

*RDN- Recommended Dose of Nitrogen

*RDF - Recommended Dose of Fertilizers

Properties of soil

Soil pH :

It is obvious from the data in respect to soil pH, EC and OC presented in table 3. The result revealed that application of (FYM, PMC & VC) combined with chemical fertilizer reduce pH of soil after harvest the wheat crop. The reduction in soil pH was found non - significant. The maximum reduction (7.71) in soil pH was observed in treatment T_6 as compared to control and chemical fertilizer alone. The reduction in soil pH might be due to release of organic acids during the decomposition of organic manures **(Katkar *et al.* 2011 and Singh *et al.* 2015)** .

Electrical conductivity (ECe)

Application of inorganic fertilizers and manures had significantly effect on electrical conductivity of soil. The highest value (0.40) ECe was recorded in control. While maximum reduction in soil EC was noticed in the treatment T_6 (50% RDN + 50% RDN through FYM + RDF). The reduction in ECe of soil might be due to the addition of organic manures which produced organic and inorganic acids during decomposition, which was responsible for leaching of salts **(Udayasoorian *et al.* 2009).** Similar findings are reported by **(Prasad *et al.* 2010)** and **(Kumar *et al.* 2012).**

Organic Carbon (%)

The data related to organic carbon content (%) has been presented in Table:3 The combined application of chemical fertilizers with organic manures (FYM,PMC,VC) increased the organic carbon content over use of chemical fertilizer, organic manure alone and control. The organic carbon content varies from 0.48 to 0.57 %. However, maximum organic carbon content was recorded in treatment T_4 (75% RDN + 25% RDN through PMC + RDF) (0.57%) which was significantly superior over the control (0.48%) and treatment T_2 (RDN +RDF) (0.50%) andT_9 100% RDN through (33% FYM + 33% PMC + 33% VC) (0.49%). The integrated use of PMC with chemical fertilizer (3:1 ratio) enhanced maximum organic carbon content followed by the same combination with VC and FYM. The increase in organic carbon content with combined application of PM and chemical fertilizer might be due to better growth and activities of micro organism resulting in better production of biomass crop stubbles and residues. **(Krishnaveni and Elumalai, 2020).**

Available Nitrogen

A perusal of Table 3 indicated that the available nitrogen content (kg ha^{-1}) in soil significantly increased due to direct effect of INM treatments. The significantly highest available nitrogen in soil after harvest the wheat crop was noticed with treatment **T_4** in which 75 % RDN with 25% nitrogen by PMC and RDF was given followed by consequent combination of VC and FYM. The available nitrogen ranged from 164.84 kg ha^{-1} (Control) to 180.48 kg $ha^{-1}T_4$ (75% RDN + 25% RDN through PMC + RDF). The increase in available nitrogen in soil might be due to direct addition of nitrogen from the decomposition of organic matter leads to mineralization of organically bound nitrogen. The result are in agreements with the findings of many researchers **(Baishya *et al.* 2015 , Singh *et al.* 2015, Gogoi *et al.* 2015 and Kumar *et al.* 2017).**

Available Phosphorus

The results regarding to available phosphorus content in soils of wheat crop have been presented in table 3 The maximum available phosphorus content 30.23 (kg ha^{-1}) in soils of wheat was recorded with T_4 treatment being at par with T_3 ,T_5,T_7 and T_8 and significantly higher than rest of treatments. The higher value of available phosphorus was recorded with combined application of pressmud with chemical fertilizers which might be because pressmud is a rich source of Ca and phosphorus.**(Thai *et al.* 2015)**.Pressmud having soil ameliorating properties which boosts the crop yields and known to be excellent source of NPK, Ca and Zn than other organic material tested **(Raman *et al.* 1999), (Kumar *et al.* 2017).**

Available Potassium:

Data pertaining to available potassium status in soil has been presented in table 3 Results showed that available potassium content in soil after harvest the wheat crop varied significantly during crop season. The highest available potassium content 278.87 (kg ha^{-1}) in soils was observed in treatment T_4 in 75% RDN + 25% nitrogen through PMC + RDF was applied which was significantly superior over T_1 and T_9 and at par with rest of treatments. The higher available potassium was noticed in all Integrated plots as compared to Control (T_1), chemical fertilizer alone (T_2) and Organic manure alone (T_9). The increase in potassium availability was due to higher microbial activities in soil. Which influenced the release of non - exchangeable or fixed potassium forms into available forms. The favourable effect of INM on increasing available potassium in soil were reported by **(Baishya *et al.* 2015 and Mondal *et al.* 2016).**

Table 3: Impact of chemical fertilizers, organic sources of nutrients and INM on chemical properties of soil.

	Treatment	pH (1:2.5)	EC (dSm^{-1})	Organic Carbon(%)	Available Nitrogen ($kg\ ha^{-1}$)	Available Phosphorus ($kg\ ha^{-1}$)	Available Potassium ($kg\ ha^{-1}$)
T_1	(Absolute Control)	7.81	0.40	0.48	164.84	22.43	253.10
T_2	RDN + RDF	7.79	0.37	0.50	171.28	26.25	270.22
T_3	75% RDN + 25% RDN through FYM + RDF	7.72	0.36	0.53	175.50	28.58	273.42
T_4	75% RDN + 25% RDN through PMC + RDF	7.73	0.34	0.57	180.48	30.23	278.87
T_5	75% RDN + 25% RDN through VC + RDF	7.75	0.35	0.55	178.98	29.48	276.16
T_6	50% RDN + 50% RDN through FYM + RDF	7.71	0.31	0.52	173.07	25.84	271.88
T_7	50% RDN + 50% RDN through PMC + RDF	7.73	0.33	0.56	178.25	29.14	275.12
T_8	50% RDN + 50% RDN through VC + RDF	7.76	0.33	0.54	178.12	27.74	273.92
T_9	100% RDN through (33% FYM +33% PMC + 33% VC)	7.72	0.34	0.49	166.65	24.32	264.01
S.Em ±		**0.055**	**0.01**	**0.009**	**2.75**	**1.13**	**4.29**
CD at 5%		**NS**	**0.03**	**0.03**	**8.32**	**3.43**	**12.96**

Conclusion

Given experimental results on wheat crop production and soil properties using different combinations of nutrient sources in the field, it was determined that replacing 25% of chemical fertilizers with pressmud as a nutrient source improved wheat grain and straw yield. In terms of maintaining crop output and soil characteristics such as organic carbon and available N, P, and K, treatment T4 (75% RDN + 25% RDN via PMC + RDF) performed better. Although the greatest decrease in soil pH was examined in treatment T6 (50% RDN + 50% RDN via FYM + RDF), there was no discernible change in soil pH. Significant differences in the soil's electrical conductivity were seen in treatments when a 1:1 chemical ratio was used.

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