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RESPONSE OF INTEGRATED NUTRIENT SUPPLY ON YIELD OF WHEAT AND PHYSICAL-CHEMICAL PROPERTIES OF SOIL

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ABSTRACT
The treatment with application of 50% NPK + 50% FYM (T_6) registered higher crop yield (32.61 q ha^{-1}) relative to control (T_1). The soil parameters; organic carbon content (0.87%), cation exchange capacity (13.80 Cmolkg^{-1}) and available Nitrogen (746.4 kg ha^{-1}) and Phosphorus (48.3 kg ha^{-1}) were statistically different from that of control (T_1). The findings of the trial suggested that crop yield and soil properties may be improved significantly by application of organic with inorganic for longer time. Hence, instead of using chemical fertilizer alone, the integrated use could be more effective and sustainable for environment and agriculture.

INTRODUCTION

Over a period of time, for higher production, growers are totally dependent upon the use of chemical fertilizers. As the higher cost of fertilizers and the low purchasing capacity of peasants, restrict the use of costly fertilizers. Along with that intensive use of these chemical fertilizers have resulted into numerous problems like micro-nutrient deficiencies, nutrient imbalance in soil and plant system, increased pest infestation, environmental degradation, deterioration of soil health and stagnation of crop yield. Integrated nutrient supply is the systematic approach to nutrient management as the combined application of organic and in organic sources, improves the soil fertility and crop productivity (Shree *et al.*, 2014).As these sources have been reported to contribute 15-45 kg nitrogen and 10-25 kg potassium per hectare (Zingore *et al.*, 2007). Organic carbon is the main building block of soil fertility and combined application of mineral with inorganic fertilizers showed higher organic carbon content (Nkonya *et al.*, 2005; Marin *et al.*, 2007).Remarkable increase in nutrient uptake and yield by integrated nutrient supply have also been reported by (Mohanty *et al.*, 2013).High yielding Wheat (*Triticum aestivum L.*) varieties and chemical fertilizers were introduced in India with the advent of Green revolution. Since then, there was a continuous increase in fertilizer consumption. As these fertilizers were applied to Wheat as blanket recommendations for similar climatic regions and land forms. Globally, annual agricultural growth decline from 2.2 per cent over the last 30 years to 1.5 per cent over the next 30 years. (Chen *et al.*,2011).That, too, is a matter of concern for our next generation, as, to secure the future of our next generation we have to adopt those agricultural technologies and methodologies which can improve the production of crop without deteriorating soil health. So, keeping these points in mind, the study was undertaken to know the beneficial effects of organic manures such as FYM, GM and WCS with inorganic manures on wheat yield and properties of soil.

MATERIALS AND METHODS

Field trial was conducted at Bhadiarkhar farm of University located at 32º6'N latitude and 76º3' E longitude with an elevation of 1290.8 m amsl in North-West Himalayan region of India. The soil of the experimental site was acidic in reaction and silty clay loam in texture. Categorized as higher in available Nitrogen (675.3 kg/ha) and Phosphorus (21.9 kg/ha) and medium in available Potassium (221.0 kg/ha) and Organic carbon content (0.60%). The experiment was laid out in randomized block design having twelve treatments replicated four times. Recommended doses of fertilizer for Wheat 120:90:30 kg/ha. One third of N and entire amount of P and K were applied as basal dose through urea, superphosphate and murate of potash. The remaining two-third amount of N was applied in two equal splits at tillering and grain filling stages. In, 50% N through FYM (21.37t/ha), 25% N through FYM (10.66t/ha), 50% N through WCS (7.66t/ha), 25%N through WCS (3.83t/ha), 50% N through GM (9.02t/ha), 25%N through GM (4.51t/ha). However, in farmer's practice 40% of recommended dose of fertilizer and 5 tonnes of FYM/ha was applied. Wheat crop was sown during the second fortnight of November and harvested at maturity in the first fortnight of May. Soil analysis was done by taking composite samples of 0-15cm depth, from individual plot of each replication, then desiccated and run through 2mm mesh and kept for physical and chemical analysis. For estimation of Bulk density procedure followed as suggested by Singh (1980). Organic carbon and cation exchange capacity analysis was done as outlined by Piper (1966). The available nitrogen, phosphorous and potassium contents were estimated by using alkaline potassium permanganate method (Subbiah and Asija, 1956), ascorbic acid in accordance with Murphy and Riley (Watanable and Olsen, 1965) and flame photometer (Merwin and Peech, 1951). For total uptake of nitrogen, phosphorus and potassium procedures followed were modified kjeldahl method (Jackson,1967), Vanadomolybdate phosphoric yellow colour method (Jackson, 1967) and Flame photometric method (Black, 1965). Data on crop yield was recorded after crop harvest. The Statistical analyses of the data recorded in all observations were carried out by the method prescribed by Gomez and Gomez (1984) and comparisons of the treatments were made with the help of critical differences.

Treatments Details Treatments	
T_1	Control
T_2	50% NPK
T_3	50% NPK
T_4	75% NPK
T_5	100%NPK
T_6	50% NPK + 50% FYM
T_7	75% NPK + 25% FYM
T_8	50% NPK+ 50% WCS
T_9	75% NPK + 25% WCS
T_{10}	50% NPK + 50% GM
T_{11}	75% NPK + 25% GM
T_{12}	40% NPK + 5 t/ha FYM(Farmers' practice)

RESULTS AND DISCUSSION

Nitrogen, phosphorus and potassium uptake and yield of wheat crop

Significantly higher uptake of NPK was obtained in the treatment receiving 50% NPK+50% FYM (Table 1). The percent increase in N, P and K content over control is 0.71%, 0.75% and 0.32%.This increase in uptake of nutrients may be due to added supply of NPK and because of good proliferation of root system and balanced nutrient application, thereby resulting in better adsorption of nutrients (Nayek *et al.* (2014). During mineralization organically bound nitrogen converts into inorganic form which results into higher nitrogen content. Better availability of phosphorus in rhizosphere increases the phosphorus content, whereas, decomposition of organic and green manures results into solubilisation of certain organic acids which results into higher potassium content. The results of present investigation in terms of nutrient uptake are in concordance with the findings reported earlier by Mohanty *et al.* (2013) in rice; Yadav *et al.* (2014) in wheat.

Results (Table1) revealed that the combined application of organics with inorganic fertilizers significantly increased the crop yield. Higher yield (32.61 q $ha^{-1}$and 30.20 q ha^{-1}) was recorded under treatment (T_6) where 50% NPK+50% FYM was applied, followed by 75% NPK+ 25% FYM (T_7). Minimum wheat yield (14.42q ha^{-1}) was recorded under control treatment. Percent increase in wheat yield (T_6 and T_7) over control treatment (T_1) was 1.26% and 1.09%. The increase in yield may be due to the reason that there may be a greater availability of macro and micro nutrients, which participate in carbon assimilation, starch formation, photosynthesis and translocation of protein. These results are also in conformity with the findings of Bayu *et al.* (2006) in sorghum; Urkurkar *et al.* (2010) in rice-wheat; Egodawatta *et al.* (2012); kumar *et al.* (2014) in rice.

Physical-chemical properties of experimental soil

The data pertaining to various observations like bulk density, cation exchange capacity, available nutrients have been shown in (Table 2). Results revealed that bulk density was found to be lower in the treatments where combined applications of organic and inorganic fertilizers were applied. Higher bulk density 1.28gcm^{-3} and 1.28gcm^{-3}wasnoted with treatments ($T_2$and T_3) where equal dose of chemical fertilizer as 50% NPK and 50 % NPK were applied. These findings are in close agreement with those reported earlier by More (1994) in rice-wheat; Sarkar *et al.* (2003) in rice-lentil; Das *et al.* (2014) in

Table 1: Response of integrated nutrient supply on N, P, K uptake and Wheat Yield.

Treatments	Nutrient uptake (Kg ha^{-1})			Wheat Yield (q ha^{-1})
	Nitrogen	Phosphorus	Potassium	
T_1	40.11	11.99	83.38	14.42
T_2	57.38	16.46	88.66	24.46
T_3	62.20	16.53	93.91	26.61
T_4	59.07	18.38	93.17	27.51
T_5	65.02	18.90	100.11	29.66
T_6	68.64	21.02	110.14	32.61
T_7	61.43	20.12	92.91	30.20
T_8	64.97	16.06	84.81	29.48
T_9	62.52	17.08	88.31	26.34
T_{10}	54.82	19.92	107.56	28.49
T_{11}	63.81	20.20	99.34	28.67
T_{12}	66.42	16.46	83.88	21.41
CD 5%	6.08	1.38	11.55	7.97

Table 2: Response of integrated nutrient supply on physical-chemical properties of soil

Treatments	Bulk Density(gcm^{-3})	O.C(%)	CEC(Cmol kg^{-1})	Available nutrients (Kg ha^{-1}) Nitrogen	Phosphorus	Potassium
T_1	1.27	0.56	11.32	551.8	14.4	210.4
T_2	1.28	0.67	12.75	612.8	26.1	248.2
T_3	1.28	0.69	13.25	628.6	40.5	244.0
T_4	1.25	0.67	13.22	636.4	40.8	227.2
T_5	1.23	0.66	13.12	675.7	46.3	224.4
T_6	1.21	0.87	13.80	746.4	48.3	216.0
T_7	1.19	0.63	12.68	628.6	37.7	203.4
T_8	1.22	0.72	13.00	620.7	39.9	230.0
T_9	1.21	0.70	11.70	605.0	40.8	203.4
T_{10}	1.19	0.70	13.68	691.2	37.7	252.2
T_{11}	1.20	0.67	11.82	667.9	46.5	224.2
T_{12}	1.20	0.70	11.65	683.6	38.8	209.0
CD 5%	0.04	0.10	1.22	93.8	8.3	NS

rice-wheat. A contiguous relationship existed in functional matter, microbial population and soil aggregation, micro-organisms might have resulted into considerable increase in polysaccharides and microbial gum synthesis in the soil. These microbial decomposition products acted as soil particle binding agents and thereby help in soil aggregation. Dhoot *et al.* (1974).

The soil organic carbon content was significantly different with different treatments. Highest organic carbon 0.87% recorded in treatment with 50% NPK+50% FYM (T_6), followed by 0.72% in 50% NPK+50% WCS (T_8) and 0.70% in 50% NPK+50% GM(T_{10}) Similar results were reported by Tripathi and Singh(2004) in rice-wheat; Rasool *et al.* (2008) in maize-wheat and Sodhi *et al.* (2009) in rice-wheat. Increased organic carbon in the organic with inorganic applied treatments is in consistent with the increased yield and the external organic carbon inputs through FYM, WCS and GM (Bandyopadhyay, 2010).Results further revealed that there was a significant effect of treatments on cation exchange capacity of soil. The percent increase in cation exchange capacity 50% NPK+50% FYM (T_6) over control 0.22%. The increase in cation exchange capacity is due to the addition of FYM, as formation of humus supplies shelter to exchangeable cations. Results were in conformity with the findings of Sharma *et al.*,(2014) in maize-wheat. Among the different treatments there was a significant increase in available Nitrogen and Phosphorus content of soil. Higher nitrogen (746.4 kg ha^{-1} and 691.2 kg ha^{-1} respectively) was noted with the application of 50% NPK + 50% FYM (T_6) as well as 50% NPK + 50% GM (T_{10}), while the minimum nitrogen was observed in control treatment(T_1). The percent increase in nitrogen content over control was noticed to be 0.35% and 0.25%.These results of present investigation are in accordance with the findings reported earlier by Sharma *et al.*, (2001) in rice-wheat; Tolanur and Badanur, (2003) in pearlmillet pigeonpea. The increase in nitrogen content, might be due to the better growth and there by more mineralization of nitrogen in soil (Gill and Melu, 1982). Higher soil phosphorus (48.3 kg ha^{-1}) in treatment (T_6),with the application of 50% NPK + 50% FYM. The percent increase in available P over control (T_1) was 2.35%. This increase might be due to applied P which gets fixed in the soil as Al and Fe-P, as these acid soils are opulent in sesquioxides and thus get role up and every bit promotes as a group of available phosphorus in soil. Results summarized above, in respect to, available phosphorus are closely in consonance with findings reported earlier by Chang *et al.* (2004) in rice, Jakhar *et al.* (2006) in pearl millet; Subhaia *et al.* (2013) in rice-wheat. Though available potassium content have shown non significant effect among all the treatments, but slight increase was noted with 50% NPK + 50% GM (T_{10}), this increase may be a collectible addition of K forensic through fertilizer along with green manure and solubilising effect of sealed organic acids composed by green manure decomposition and its higher ability to guard potassium in available form. The results were in conformity with the findings of Tandon, (1988).

From the above results, it may be concluded that combined application of organic with inorganic sources proved to be a viable option in restoring the fertility of soil, improving organic carbon content, cation exchange capacity, and sustain the crop yield and nutrient uptake.

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