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Comparison of Physico-Chemical Properties of Soils under Various Chemical Fertilizers, IPNM and Organic Farming Practices Field in Dang

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Abstract

CerThis study was conducted in Dang district during 15 January 2015 to 12 June 2015. 25 soil samples were collected from 3 different nutrient management practices (T1- with chemical fertilizers only; T2- with IPNM; and T3- with organic manure only) for soil analysis. The comparative study of soil physical parameters i.e. soil texture, soil chemical parameters i.e. pH, OM, N, P and K content of all soil samples was done. The mean soil texture of all soil samples was found to be sandy loam. The value of N, P, K and OM was found higher in T3 thanT1. The mean pH value of T1 was 6.3, T2 was 6.65 and T3 was 6.7 where, differences in pH value between T1 & T2 as well as T1 & T3 were statistically significant at $p \leq 0.05$. Similarly, the mean value of OM was found to be 4.66% in T1, 4.25% in T2 and 6.62% in T3. Difference in OM content between T1 & T3 as well as between T2 & T3 were significant at $p \leq 0.05$. The mean value of total N was found to be 0.052% in T1, 0.071% in T2 and 0.092% in T3. Difference in N content between T1 & T3 was statistically significant at $p \leq 0.05$. Similarly, the mean value of available P was found to be 22.48 kg ha-1 P2O5 in T1, 38.42 kg ha-1 P2O5 T2 and 37.446 kg ha-1 P2O5 in T3. Differences in P content between treatments were not significant statistically. Mean value of K was found to be 286.83 kg ha-1 K2O in T1, 286.83 kg ha-1 K2O in T2 and 554.74 kg ha-1 K2O in T3. Difference in K2O content between T1 & T2 as well as between T1 & T3 were significant at $p \leq 0.05$. The study was found that fertility status of organic field was found to be better in term of fertility and OM content than inorganic fields.

Keywords: Organic field, IPNM, organic matter, sustainable.

The challenge for agriculture over the coming decades will be to meet the world's increasing demand for food in a sustainable way. Declining soil fertility and mismanagement of plant nutrients have made this task more difficult. Population growth, urbanization and industrialization will compete for more lands from the agricultural lands. Hence, the projected yield increases have to be met with greater mobilization and efficient use of nutrients, of both inorganic and organic sources. Increasing food production and sustaining soil fertility in the smallholder farms is an enormous challenge in Nepal. Soil nutrient status is widely constrained by the limited use of mineral and organic fertilizers and nutrient loss mainly due to erosion and leaching. Many smallholder farmers do not have access to mineral fertilizers for reasons such as high price of fertilizers, lack of credit facilities, poor distribution and other socioeconomic factors. Consequently, crop yields are low, in fact decreasing in many areas, and the sustainability of the current farming system is at risk (UNDP, 1992).

Soil fertility depends upon a number of physical, chemical and biological properties of soil: texture, structure, pH, water holding capacity, porosity, soil organic matter, soil nutrients, soil flora and faunas etc. plants are known to need at least 16 essential elements to grow; although more than 90 elements can be absorbed by plants (Miller and Donahue, 1995). From the air and water, plants utilize hydrogen, oxygen and carbon. The other macronutrients, those absorbed in large amounts from soil and fertilizers, are nitrogen, phosphorus, and potassium plus calcium, magnesium and sulfur. The micronutrients, those absorbed in lesser quantities are chlorine, copper, boron, iron, manganese, molybdenum and zinc. All of these elements which are essential for plants maintaining a balance between potassium and other nutrients (especially nitrogen, phosphorus, Ca and Mg) have important role in soil fertility (Brady and Weil, 2002). Therefore, the assessment of nutrient supplying capacity of the soil is nothing but soil fertility evaluation.

Another approach is to emphasize on lower input agriculture system that could be sustainable in the long run. It includes integrated systems of agricultural production that are less dependent in intensive management than conventional monoculture system. These low input systems maintain or increase net income for the farmers and are ecologically desirable and protective for the environment. Most of the authors dealing with sustainable agriculture such as Swift and Womer (1993) and Bauer and Black (1994) have emphasized on low inputs agriculture that is organic farming.

The physical properties of soils determine their adaptability to cultivation and the level of biological activity that can be supported by the soil. Soil physical properties also largely determine the soil, water and air supplying capacity to plants. Many soil physical properties change with changes in land use system and its management such as intensity of cultivation, the instrument used and the nature of the land under cultivation, rendering the soil less permeable and more susceptible to runoff and erosion losses (Sanchez, 1976). Soil chemical properties are also important among the factors that determine the nutrient supplying power of the soil to the plants and microbes. The chemical reactions that occur in the soil affect processes leading to soil development and soil fertility build up.

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Materials and Methods

This study was conducted in Tulsipur Municipality of Dang district during 15 January 2015 to 12 June 2015. Soil samples were collected and used locally available tools to the depth up to 20 cm an attempt was made to collect 25 samples. In which 8 soil samples were collected from organic field, 8 soil samples were collected from chemical fertilizer applied field i.e. only chemical fertilizer were used for crop production and 8 soil samples were collected from integrated plant nutrient management field (IPNM) i.e. where all fertilizer were used (farm manure, organic fertilizer and as well as chemical fertilizer). And remaining 1 soil sample was from WOREC field which was also organic soil sample.

For the analysis of physical and chemical properties, soil samples were collected from 0-20 cm depth from the field with chemical fertilizer only (T1); field with IPNM (T2) and field with organic manure only (T3) were air dried, grinded and sieved through a 2 mm mesh wire net. The major part of the soil physical and chemical analysis was carried out at the soil laboratory of the HICAST. The following methods were used for soil parameter measurements:

Table 1. Method of soil parameter measurement

S.N.	Measurement	Method
1	Texture	Hydrometer
2	pH measurements	pH meter
3	Organic matter	Walkley black
4	Total nitrogen	Kjeldahl
5	Available Phosphorus	Modified olsen's
6	Available Potash	Flame photometer

The information collected from soil analysis was coded first and entered into the computer. Data entry and analysis was done by using computer software package, which were Statistical Package for Social Science (SPSS 20) and Microsoft Excel. Descriptive statistics like mean, standard deviation, coefficient of variation, percent, frequency and one way ANOVA were used to describe physicochemical properties of soil.

Results and Discussion

Physical and chemical properties of soil

Soil texture

The soil of the T1, T2 and T3 field were found to be sandy loam. The percentage of soil Particles and their texture have been summarized in table 2.

Table 2. Comparison of soil texture of farmers' field adopting T1, T2 and T3 at Dang, Nepal, 2015

Treatments	Sand (%)	Silt (%)	Clay (%)	Texture class
T_1	69.55	20.5	9.95	sandy loam
T_2	66.02	22.05	11.92	sandy loam
T_3	71.21	19.01	9.77	sandy loam

Soil pH

The average pH value of T1 was found 6.3, similarly the value of T2 was 6.65 and T3 was 6.7. It was found that the pH value of T3 was higher than the T1 and T2. This pH value indicates that both T3 and T2 were neutral in nature and T1 was slightly acidic in nature. There is significant difference ($p \leq 0.05$) between T1 & T2 and T3 & T1, no significant difference between T2 and T3.The lower pH value in the chemical farm soil than that of organic soil was also observed by Maskey et. al. 1994.

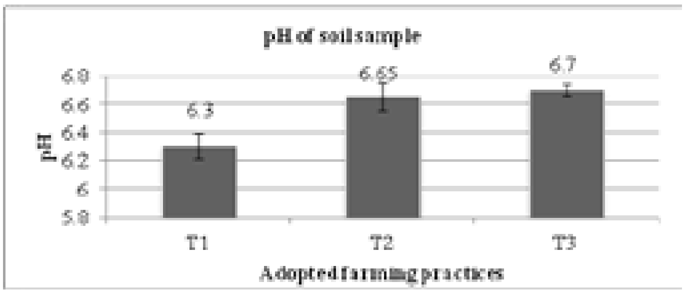


Figure 1. Soil pH of T1, T2 and T3 soil

Soil Organic Matter

The average organic matter content of T1 was found 4.66 percent; similarly the organic matter content of T2 and T3 was 4.25 percent and 6.62 percent respectively. Organic matter content was found to be medium in both T1 and T2 and high in T3. There is significant difference between T2 & T3 and T1 and T3 and no significant difference between T1 and T2. The soil organic matter of T3 was found to be higher than that of T1 and T2 due to application of organic manures since last several years. Maskey et al. (1994) also got the higher organic matter content in the field where organic manure and bio-fertilizers were used than that of other farmland. Amount of N, P, and K is found to be less in soils of low organic matter and high in soils of high organic matter (Chaudhuri, 1996). It may be due to the nutrients that are retained finer soil particles.

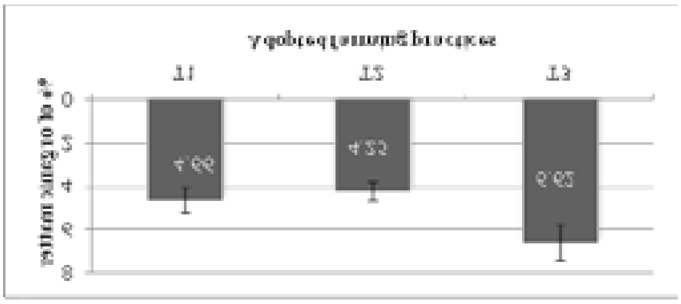
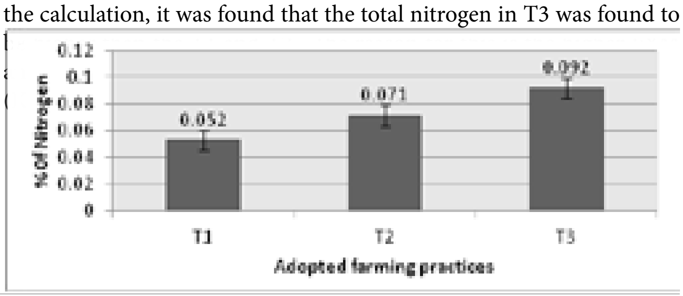


Figure 2. Organic matter content at T1, T2 and T3 soil

Total Nitrogen

Total N content of soils was affected by land use, soil depth and interaction of land use by soil depth. The average total nitrogen content of T1 was found 0.052 percent; similarly, the nitrogen value of T2 was 0.071 percent and T3 was 0.092 percent (Figure 3). It was found that the nitrogen status in research site was low in status. Statistical analysis revealed statistically significant difference at $p \leq 0.05$ between T1 and T3, no significant difference between T1 & T2 and T3 & T2. From the calculation, it was found that the total nitrogen in T3 was found to



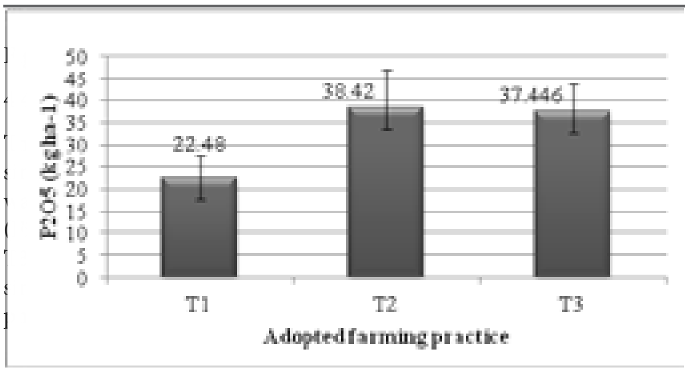


Figure 4. Available phosphorus content in the soil samples

4.4.6 Available Potassium

The average potassium content of T1 was 286.83 K2O (kg ha-1), similarly the potassium content of T2 and T3 was 554.74 K2O (kg ha-1) and 627.92 K2O (kg ha-1), respectively (Figure 5). Statistically analysis revealed statistically significant difference ($p \leq 0.05$) between T1 and T2, as well as between T3 & T1 and no significant difference between T2

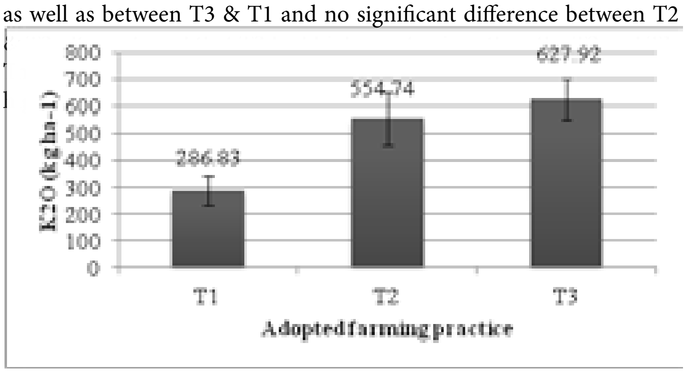


Figure 5. Potassium content in soil sample

Conclusion

The comparative study of soil physical parameters i.e. soil texture, soil chemical parameters i.e. pH, OM, N, P and K content of all soil samples was done. The mean soil texture of all soil samples was found to be sandy loam. The value of N, P, K and OM was found higher in T3 thanT1. The mean differences in pH value between T1 & T2 as well as T1 & T3 were statistically significant at $p \leq 0.05$. Similarly, difference in OM content between T1 & T3 as well as between T2 & T3 were significant at $p \leq 0.05$. The difference in N content between T1 & T3 was statistically significant at $p \leq 0.05$. Similarly, the differences in P content between treatments were not significant statistically. The difference in K2O content between T1 & T2 as well as between T1 & T3 were significant at $p \leq 0.05$. It was found that fertility status of organic field was found to be better in term of fertility and OM content than inorganic fields.

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