Research Article

Determine the Macro-Micro Nutrients and Some Physico-Chemical Properties of Soil Case Study of Jamshoro Distric Sindh, Pakistan

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Abstract | Pakistan is one of the agriculture countries in world and about 80% population depend upon agriculture. Soil is an important medium on which crops grow and obtain nutrients for their growth and improvement. For determination of macro-micronutrients and some physico-chemical properties of soil, samples were collected from different area of Jamshoro (Soman, Murad, Abadnear Kotrai Jamshoro). These nutrients are so important for crops yield and human being. The results explain that soil have low organic matter, pH is near to 7, copper content ranged was 5.82 - 8.2µ g/g, Maganese 6.7 - 8.3 µg/g and Zinc had values of 0.12 to 1.2µ g/g respectively. The conclusions are that the values of Zn, Fe, Cu and Mn are adequate. If the value of Zn is low than Zn fertilization is recommended for better crop production.

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1. Introduction

Soil is main medium in which plants grow and obtain nutrients for their growth and development (Ghulam et al., 2014). Fundamental minerals such as Fe, Cu, Zn and Z are important for human health in the form of organic compound for examples vitamins, carbohydrates, fats and proteins etc. The everyday diet of young adult range is 2-3 mg (mili gram) of Cu and 10 - 60 mg (mili gram) of Fe (Imtiaz et al., 2010). The above described minimum values should be taken if they are not cause slow physiological processes. For the optimum growth and increase the production rate of agricultural crops these 16 important elements O, C, H, N, P, K, Mg, Ca, S, Fe, Cu, B, Mn, Mo, Zn and Cl are needed. They are divided into two type micronutrients nutrients and macronutrients nutrients. The micronutrients are chlorine, iron, copper, molybdenum, boron other are also potassium, sulfur, nitrogen, calcium, phosphorous and magnesium are known as macronutrients. (Brady and Weil, 2005).

1.1 Nutrients in Pakistani soil

The total 80 million hectares (Mha) physical areas of Pakistan, 22 million hectares are used for agricultural purpose from total (Alam et al., 2010). The agricultural land of the country is derived from river soil and loess which have low organic matter (Organic Matter) as well as other important nutrients. The higher yield of crops production and its growth rate were introduced in the era of Green Revolution. Therefore, the nutrients present in soil demand are increasing which go to their deficiencies. The application of fertilizer in Pakistan is mostly consist of Phosphorus (P) and Nitrogen (N) only, potassium use is limited.

Some crops need high amount of Potassium (K) like as sugar cane and potatoes (Imtiaz et al., 2010). Many introduced crop varieties are more susceptible to micronutrient deficiencies than landraces (Rashid et al., 2002; Imtiaz et al., 2006). First time in Pakistan early 1970s the deficiency of Zinc (Zn) micronutrient was recognized due to Hadda disease in rice. In 1980, micronutrient deficiencies were identified in a wide range of soils, fruits and crops in all regions of Pakistan along with Azad Jammu and Kashmir (Rashid and Qayyum, 1990). The deficiency of Zinc (Zn) was identified and the research has been caring out since 40 years on micronutrient deficiency in soil and wide effect on crops as well as human being. Consequently, the deficiencies of Boron (B), Zinc (Zn) and Iron (Fe) were recognized in many field and agricultural crops. There are commonly soil of Pakistan have 70 % Zinc (Zn) deficiency. The Zinc (Zn) deficiencies are notice in wheat, cotton, rice, sugar cane, brassica, maize, potato, sunflower, sugar cane, and in various other crops along with citrus and deciduous fruits. Another key deficiency is Boron (B) which largely affects on sugar beet, peanut, cotton, wheat, rice, citrus and many fruits. Iron (Fe) is a 3rd field-scale confusion which effect cotton, citrus, chickpea, peanut, and large number of trees species. Manganese (Mn) and Copper (Cu) deficiencies are occurring in small amount. The survey of crops growth in Pakistan has a 70 % low level deficiency of nutrients (Rashid, 1996). The deficiency of Zinc (Zn) in crops or plants did not reduce the production rate but also effect on the nutritional quality of grains.

1.2 Effect of micronutrient deficiencies on human health

Micronutrient is also called hidden hunger which affects more than one-half of the world's population, mainly small children and women in developing countries (Welch and Graham, 2014). The function of micronutrients such as Iron (Fe), vitamin A, Zinc (Zn), and Iodine (I) in individual diet had been established more than last decade. The influences of micronutrients on physiological difficulties involving in many physical functions. The deficiency of Zinc (zn) has significant for human health like as: injury of the immune system which show result to increase the occurrence of small children infection, pneumonia, diarrhea, children and impaired maternal health, impaired growth and development of infants and pregnancy outcome (Michael Martin, 2004). Report from World Health Organization (WHO) that 800,000 deaths are due to the Zinc (Zn) deficiency all over the world every year and more than 28 million health life yeas lost. The deficiency of Zinc (Zn) is projected that affects one-third of the world's population. Pakistan has also been affected by the malnutrition of both these elements. Iron and Zn deficiencies are extremely high in pregnant/lactating women as well as in very young children.

2. Materials and Methods

Soil samples were collected from Jamshoro distract to determine the macro-micro nutrients and checked some phyico-chemical properties of soil. These samples were taken under the 8th inches depth from soil surface, properly mixed and put in polyethylene bags.

These samples were air dried, ground and passed through a 2 mm sieve and kept in polyethylene bags for analysis of macro-micro nutrients along with some physico-chemical properties in Soil Science Department of Nuclear Institute Tandojam. Ph meter (Jenway 3510. U K) was used for the determination of soil sample Ph. 20 g Air dried soil mixed with 50 ml D.I water (2:5 ratios) in bottle. For proper mixing shaker was used, the shaker speed adjusted 250 RPM for 30 min. After mixing filter the sample with the help of filtration media in a flask and calculated the Ph of soil sample. Electrical conductivity meter (WTW LF 530, Inolab. Germany) was used for the calculating the EC of soil sample. Check the EC meter accuracy by 0.01 N KCL solutions which should give reading of 1.413 dsm^{-1}. Same sample were prepared for test method of Ph and EC. Organic matter (OM) was calculated by the standard titration method. One gram air dried 2mm soil mixed with 10 ml $K_2Cr_2O_7$. The $K_2Cr_2O_7$ was extracted the organic matter (OM) from soil. H_2SO_4 was used to increase the reaction. Some drop of orthophosphric acid,10-15 drops of diphenylamine was used and sample was titrated with 0.5 M Ferrous ammonium sulfate. When colour changed from earthyto green then calculated organic matter (OM). Nitrogen in soil was calculated by digestion process with the help of Foss Kjeldhal system (kjeltec2200, Sweden). 4 gram air dried soil added in a minute quantity of selenium black powder mixed with potassium sulphate and some other chemical were used for reaction. The samples were put on a hot plate whose temperature was adjusted to 400 ^{0}c for 30 minutes. After that distillation process was used on Foss kjeldhal system which extract Nitrogen from soil sample and titration this with con.

Table 1: Macro-Micro Nutrient and some properties of soil concentration (µg g^{-}_{1}).

Macro Nutrient and some properties of soil concentration (µg g^{-}_{1})							
S. no	Soil type	Ec ds/m	pH	OM %	N %	P ppm	K ppm
1	Non saline soil	o.393	7.1	1.09	0.072	4	160
2	Medium saline soil	4.11	6.9	0.8	0.058	4	174
3	Strongly saline soil	10.54	6.7	1.2	0.055	5	260
Micro Nutrient of soil concentration (µg g^{-}_{1})							
S. no	Soil type	Zn	Cu	Fe	Mn		
1	Non saline soil	0.12	8.2	10.24	8.32		
2	Medium saline soil	0.632	6.12	5.22	6.7		
3	Strongly saline soil	1.12	5.82	4.65	5.2		

H_2SO_4 to calculated % of Nitrogen. Ammonium bicarbonate ethylene triaminepenota acetic acid method (Soltanpour, 1985) was used for multi elements soil test. 20 gram air dried 2 mm soil was carried out in a bottle mixed with 40 ml de-ionized (D.I) water. For proper mixing bottles were loaded on shaker at 180 RPM speed for 15 minutes. After mixing the samples were filtered with the help of filtration media in the flask and put sample into test tube. Micro-nutrient, P and K of the soil tests were carried out through this way. Flame photo meter is used for calculation of K in soil. The Phosphorus in soil was calculated by Spectronic 21 (Bausch and Lomb). Micro-nutrients were determined by Atomic Absorption Spectrophotometer. The standard solutions of these metals were made in the extracting solution. (Figure 1)

Standard solution for Zn, Cu, Mn, Fe = 1, 2.0, 3.0, 4.0, 5.0

Zn, Mn, Cu, Fe = Zn, Mn, Cu, Fe ppm × dilution factor

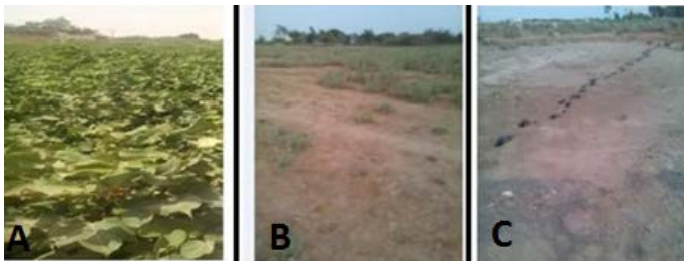

Figure 1: Collected soil samples. (A) Non saline soil, (B) Medium saline soil, (C) Strongly saline soil.

3. Results and Discussion

The main composition of soil is air, water, organic and inorganic matter. Organic matter range is 3- 4% but proper range is 0.86 to 1.29% (Soltanpour, 1985). There are low organic matters (OM) in Pakistani soil which is not suitable for fertility rank and not high sufficient to improve the yield of different crops (Zaka et al., 2004). The main causes of low organic matter are low rainfall, high temperature and removal of all the crops residues except the roots. The growth rate and yield production of crops are increasing due to the organic matter (OM) raised. Chemical fertilizer is used on crops to increase the yield of crops for a short time (Sarwar et al., 2010). Electrical conductivity (EC) is correlated with particle size and texture of soil. EC of normal soil is Less than 4 (Hach, 1992). EC of soil was decreased by the application of organic amended with gypsum and municipal waste (Kanwal et al., 2014). The ideal values of Ph is 6.5-7.5 for crop (Hach Company USA, 1992). The proper range of Nitrogen % is 0.10-0.15 (Estefn et al., 2013). The good quantity of Phosphorus present in soil can help crops yield more fruits and create healthier stocks and root system. Normal range of Phosphorous in soil is 4 to 75 (Estefn et al., 2013). Potassium is a primary macro-nutrient so important in crop production. The normal range of potassium is 60-120 in soil (Table 1).

Conclusions and Recommendations

It was concluded that macro and micro nutrients are so importance for crop yield and soil fertility. They played a vital role in human life and to maintain the values of nutrient in soil use organic and inorganic fertilizer. Mineral fertilizer increased the organic matter of soil. Organic amendment such as straw manure, peat and pig manure increased the micro-nutrient like as Zn, Cu, Mn and Fe. NPK is used to maintain the macro-nutrients of soil.

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Authors Contribution

Mr. Jaffar Hussain is research Scholar and Syed Farman Ali Shah, Zaneet M. Ali University supervisor. Co-supervisor Javed Ahmed is senior scientist Nuclear Institute of Agriculture(NIA), Tando Jam, Sindh helped this research to analysed the soil sample. This research work is carried out with the collaboration of Mehran University and NIA.

Conflict of Interest

The authors have declared no conflict of interest.

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