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Evaluation of soil fertility status of fruit orchards of Gilgit district, Gilgit Baltistan

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Abstract

The productivity of fruit trees orchards mainly relies on soil fertility and nutrient requirements. For best growth and production, essential nutrients are required optimally. To restore productivity soil characteristics and nutrient status of orchards must be determined. A multi locational orchards survey was conducted to assess the nutrient status (apple, almonds, walnut, fig, lokad, permission and stone fruits) of fruit orchards in district Gilgit, Pakistan. Samples were collected from the canopy area of the fruit trees at depth, *viz*, 0-20 cm using a stainless auger and analyzed for pH, EC, soil texture, organic matter, available phosphorus and potassium, AB-DTPA micronutrients. Results showed soil texture varied from sandy loam to silt loam. 56 % of samples were sandy loam with slightly neutral to alkaline pH. Non-saline soils having medium to high organic matter, Phosphorus levels varied from 0.57 to 39.7 mg kg^{-1}, and total nitrogen was inadequate in 60% of the soil samples, however adequate K was found due to K bearing minerals. Soil micronutrient (Cu, Fe, and Mn) except Zn was sufficient in all fruit's orchards. 77 % of samples were low in Zn content where 4% of samples were in marginal range and 19% of samples were in the adequate range. Most of the fruit's orchards were low in Zn and total nitrogen. The chemical soil conditions in fruit orchards are often poor, emphasizing that integrated nutrient management through fertilization regulation and soil property monitoring is essential for long-term fruit production in Gilgit district.

Keywords: Gilgit, Macronutrients, Micronutrients, Orchards, Stone fruits

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Introduction

Gilgit Baltistan (GB) covers a total area of 72,496 km^{-2}. Most of the area, i.e., 90% is mountainous, 04% is under forest and 4.2 % is cultivable waste. Cultivated land accounts for approximately 1.2% of total land area. (IFAD, 2015). The climate of high-altitude mountainous area of Pakistan are responsible for its soil physico chemical properties and soil fertility. The soil loss due to altitude and topography differences was observed which cause soil fertility losses (Cihacek & Swan, 1994). Gilgit Baltistan economy is depends on the fruits and agriculture. Soil and climatic conditions are favorable specifically for fruits and vegetables. Almond, Apricot, Cherry, and other fruits are growing in the area. Therefore, major source of income of the native people is fruit and vegetable production (Zain, 2010). The total area under stone fruits in GB is 16332 hectares. Out of a total of 348,377 tons of stone fruits produced in Pakistan during 2015-16, the share of GB was 123,939 tons. Farmers around the world normally take care of the application of soil macro and micronutrients to balance the plant nutrition for good crop yield (Rattan & Sharma, 2004). The high altitude and climate of Gilgit Baltistan is the main reason for different soil mineralogy and texture. The soil organic matter mainly depends on the climate and altitudinal difference in the area (Babar et al., 2004) these differences directly affect the fertility of soil i.e., pH, EC, SOM, macro, and micronutrients show differences across the fruit orchards in Gilgit Baltistan. Plant macro and micronutrient availability are removed faster rate than ever before due to many extrinsic and intrinsic factors (Shah & Shahzad, 2008). The availability of the micronutrients Fe, Cu, Zn, and Mn in soils varies greatly with seasonal variations in temperature, moisture, and microbial activity. These nutrients are more soluble in the pH range of 5.0 to 6.0. (Hodgson, 1963).

Plants require trace amounts of copper, iron, manganese, and zinc. In soils, Cu is significantly less prevalent than Zn (Lindsay, 1979). Despite the widespread cultivation of orchards in Gilgit District, Gilgit Baltistan, there is a lack of comprehensive studies on the assessment of soil fertility status in these orchards. To the best of our knowledge there is limited availability of data and scientific literature regarding nutrient levels, pH, organic matter, and other essential soil properties specific to orchards in this region. Understanding soil fertility status is critical for sustainable orchard management, improved crop productivity and informed decision making by farmers and policy makers.

Hence, soil fertility and its resources must be followed for the crop and fruit productions. Therefore, to reduce the gap, the main objectives of our present investigation were to: i) appraise the nutrients status (macro- and micronutrients) in the soil of fruit orchards, ii) evaluate soil physico chemical properties (pH, Electrical conductivity, and texture) of fruit orchards in district Gilgit, Gilgit Baltistan (GB), and iii)

compare the soil fertility status among different fruit orchards within the district. This study will provide a baseline for future research and fertility management and recommendation in the fruit orchards of district Gilgit (GB).

Materials and Methods

Study area

The district Gilgit is the capital of Gilgit Baltistan located at 74.46° longitude and 35.88° latitude. It has an average elevation of 1,500 m. The average elevation covers an area of 38,000 km^2. Climatic conditions are suitable for growing fruit orchards. The temperature typically varies from *16ºC-35 ºC* whereas the average rainfall is 136 mm in district Gilgit (IUCN, 2003).

Soil Sampling and analysis

A total of 103 soil samples were collected from fruit orchards in district Gilgit that is divided into six union councils per unit, which were collected from the canopy area of the fruit trees at different depths, *viz*, 0-20 cm using a stainless auger. The samples were air-dried, crushed to pass through a 2mm sieve, mixed to make a composite sample, labelled, and stored in plastic bags and transported to the laboratory of soil science, Institute of Soil Science, PMAS Arid Agriculture University Rawalpindi. The University of Agriculture, Peshawar, Pakistan. Standard laboratory methods were used for physical and chemical characterization,e.g., for the determination of soil pH and EC the 1: 2 soil suspension method was adopted. (Gupta, 2006) Organic matter was determined by using potassium dichromate titration method (Nelson & Sommers, 1996). The hydrometer method is used for the determination of soil texture after dispersion with sodium hexametaphosphate solution (Gee & Bauder, 1986). Total nitrogen by the digestion method through the Kjeldhal apparatus (Dangl & Jones, 2001). AB-DTPA Extractable Phosphorus was determined by spectrophotometer. Potassium in soil, extracts were determined using a standard curve through a flame photometer. This AB-DTPA soil extract was also used to measure concentrations of micronutrients by the atomic absorption spectrophotometer.

Statistical analysis

The recorded data were subjected to simple arithmetic means and standard deviation by using Microsoft. Excel 2007.

Results and Discussion

The physicochemical and soil fertility status of fruit orchards was different by different union councils of district Gilgit. The results of 103 soil samples across the district are divided into 6 union councils.

Physicochemical soil properties

Soil texture

The overall soil texture in the surveyed area is sandy loam. The dominant textural class is sandy loam across all six union councils of district Gilgit. It was observed that altitudinal difference differs soil texture in the surveyed area, which is predominantly silt and loam. The union council of Sharot and Shikyout dominant textural class is sandy loam with average values of 67.7±9.1, 10.1±3.06, 22.1±7.2 % sand, silt and clay respectively.The union council of Municipal Area have sandy loam texture with mean values of 64.22±11.85, 11.6±3.84, and 24.1±10.0 sand, silt and loam respectively.Rahim Abad union council has 48.10±5.05, 11.7±4.57, 40.1±6.45 % sand, silt and clay respectively with loam texture. Nomal has 50.7±13.23, 13.9±4.94 and 2.9±11.4 % sand, silt and clay respectively with sandy loam texture. The union council of Danyore has sandy loam texture with 3.14±8.90, 1.19±3.38 and 3.59±10.1 % sand, silt and clay respectively. Jalalabad's union council having silt loam texture with mean values of 2.60±6.8, 12.28±3.5 and 45.78±8.8 % sand, silt and clay respectively (Table 1). The textural class of UC Sharot and Shikyout showed that sand is higher as compared to silt and clay deposition due to its parents' material. Loamy soil types are the most ideal for farming and fruit plants.

Table 1 Soil textural categories and particle size distribution of different union councils of Gilgit district

S. No.	Union council	Sand %	Silt%	Clay%	Textural class
1	Sharot & Shikyout	67.73±9.18	10.1±3.06	22.1±7.21	Sandy Loam
2	Municipal Area	64.22±11.85	11.6±3.84	24.1±10.0	Sandy Loam
3	Rahim Abad	48.10±5.05	11.7±4.57	40.1±6.45	Loam
4	Nomal	50.7±13.23	13.9±4.94	2.9±11.4	Sandy Loam
5	Danyore	3.14±8.90	1.19±3.38	3.59±10.1	Sandy Loam
6	Jalalabad	2.60±6.8	12.28±3.5	45.78±8.8	Silt Loam

Data are shown as means ± SD (n = 3).

Soil type pH, EC, and organic matter concentration in Union Councils' District Gilgit

Soil pH shows variations and a chemical indicator, which shows soil health and nutrient cycle. The pH values of union councils of district Gilgit Sharot & Shikyout, Municipal Area, Rahim Abad, Nomal, Danyore, and Jalal Abad ranged from 7.51-8.5, 7.04-8.28, 7.06-7.98, 7.64-8.03, 7.58-8.08, and 7.6-8.11 with the mean value of 7.92±0.26, 7.67±0.28, 7.61±0.29, 7.79±0.11, 7.87±0.13 and 7.82±0.14. (Table 2, 3, 4, 5, 6, 7) The surveyed area was mostly varying alkaline to slightly alkaline in reaction. This difference indicates different variations of soil parameters of calcium carbonate and organic matter.The EC in surveyed area of union councils of Sharot & Shikyout, Municipal Area, Rahim Abad, Nomal, Danyore and Jalal Abad 0.11-0.80, 0.12-0.61, 0.12-0.61, 0.11-0.60, 0.003-2.89 and 0.15-0.61 dSm^{-1} with mean values of 0.38±0.22, 0.26±0.11, 0.26 ±0.11,

0.35±0.15, 0.937±0.937 and 0.353±0.15 (Tables 2, 3, 4, 5, 6, and 7).

Table 2 Soil status of union council of Sharot and Shikyout

Sampling Sites	Textural class	pH (1:2)	EC dSm^{-1}	O.M (%)
Sharot (Thignai)	Silt Loam	7.7	0.28	0.9
Sharot (MajiniFari)	Sandy Loam	7.5	0.59	2.1
Sharot (MajiniFari)	Sandy Loam	7.7	0.44	2.2
Sharot (Kae Fari)	Sandy Loam	7.8	0.75	2.7
Sharot (kaeFari)	Loamy Sand	8.1	0.18	1.2
Sharot (Zero point)	Sandy Loam	7.9	0.24	1.5
Sharot (Main Ghizer Road)	Sandy Loam	8.0	0.22	1.5
Sharot (Farm Area)	Sandy Loam	7.9	0.28	1.1
Sharot (Farm Area)	Sandy Loam	8.2	0.12	1.7
Skarkui (Diamer Colony)	Sandy Loam	8.5	0.68	1.2
Skarkui (Pathan Colony)	Sandy Loam	7.9	0.56	2.9
Skarkui (Farm Area)	Loamy Sand	7.5	0.81	2.9
Skarkui (Farm Area)	Loamy Sand	7.8	0.15	2.7
Skarkui (Farm Area)	Sandy Loam	8.1	0.25	0.9
Skarkui (Farm Area)	Sandy Loam	7.9	0.46	1.5
Skarkui (Farm Area)	Sandy Loam	8.3	0.20	1.7
Average ± SD		7.9±0.26	0.39±0.23	1.8±0.70

The results revealed that the surveyed area has no salinity problem. Low electrolyte matter concerns the regulation of soil nutrients to the plants. SOM plays an important role in the nutrient from soil to plants. Results showed that different mean value range of organic matter in different union councils of UC Sharot & Shikyout, Municipal Area, Rahim Abad, Nomal, Danyore, and Jalalabad fruit orchards in district Gilgit ranged from 1.79±0.69, 2.11±1.09, 1.92±0.87, 2.16±0.87, 2.45±0.93, and 1.70±0.67. (Table 2, 3, 4, 5, 6, 7) Results were close to (Ishaq et al., 2015) who studied in district Hunza Altit GB where SOM ranges from 2–3%. It may be high due to the use of excess organic fertilizers, dung, and animal manure. SOM percentage varied within the study area of Altit. SOM in fruits orchards mainly due to leaves decomposition on surface area and excess application of animal dung, farmyard manure. In our study, most fruits orchards were adequate in SOM due to the proper application of animal manure with best farming practices. However, in some areas marginal SOM was also recorded. This may be a result of high temperatures, more organic matter breakdown, and less natural vegetation.

Table 3 Soil status of union council of Municipal area

Sampling Sites	Textural class	pH (1: 2)	EC dSm^{-1}	OM (%)
Baseen (Usman Abad)	Sandy Loam	7.8	0.62	2.7
Baseen (Faqeer Abad)	Sandy loam	7.5	0.34	0.5
Baseen (Aman Colony)	Sandy Loam	7.6	0.29	2.3
Baseen (Abbas Town)	Sandy Loam	7.5	0.38	0.2
Baseen (Pathan Colony)	Sandy Loam	7.6	0.25	2.7
Baseen (Zero point)	Sandy Loam	7.8	0.18	2.1
Baseen (Masoom Abad)	Sandy Loam	7.6	0.16	1.7
Baseen (Abuzar Gafari)	Loam	8.0	0.19	0.9
Baseen (pathan Colony)	Sandy Loam	7.9	0.19	1.9
Baseen (Zero point)	Loamy Sand	7.6	0.22	3.0
Gilgit City (Khomar)	Sandy Loam	7.9	0.22	2.3
Gilgit City (KhomarDamot)	Sandy Loam	7.7	0.51	3.3
Gilgit City (Sonikot)	Sandy Loam	7.2	0.27	0.4
Gilgit City (Yadgar Chowk)	Sandy Loam	7.5	0.35	4.9
Gilgit City (Nagaral)	Sandy Loam	7.7	0.20	3.3

Upper Jutial (Majinimahla)	Loamy Sand	7.2	0.13	1.9
Upper Jutial (Domiyal)	Loam	7.7	0.13	1.1
Upper Jutial (Puniyal Road)	Loam	7.4	0.19	1.7
Upper Jutial (Jutial)	Sandy Loam	7.6	0.14	1.2
Upper Jutial (Upper Jutial)	Silt Loam	7.4	0.18	2.4
Upper Jutial (Public Chowk)	Sandy Loam	7.3	0.15	1.7
Upper Jutial (Noor Colony)	Loam	7.7	0.31	2.1
Upper Jutial (Wahdat Colony)	Sandy Loam	7.0	0.22	4.9
Zulfiqar Abad (Sakwar)	Sandy Loam	7.9	0.29	1.1
Zulfiqar Abad	Sandy Loam	8.2	0.39	2.2
Zulfiqar Abad (Prince Colony)	Sandy Loam	8.3	0.47	1.8
Zulfiqar Abad (Karim Town)	Sandy Loam	7.8	0.23	2.0
Zulfiqar Abad (Ameen Abad)	Sandy Loam	7.9	0.22	2.7
Zulfiqar Abad (Darkot Colony)	Sandy Loam	7.8	0.18	2.6
Zulfiqar Abad (Khomar Yarkot)	Loamy Sand	8.0	0.23	1.7
Average ± SD		7.7±0.3	0.26±0.12	2.1±1.1

Table 4 Soil status of union council of Rahim Abad

Sampling Sites	Textural class	pH (1:2)	EC dSm^{-1}	OM (%)
Rahim Abad (Khun)	Loam	7.9	0.28	0.3
Rahim Abad (Khun)	Silt Loam	7.5	0.40	1.9
Rahim Abad (Hukaring)	Sandy Loam	7.6	0.50	1.7
Rahim Abad (Hukaring)	Loam	7.7	0.32	2.3
Rahim Abad (Khaie)	Loam	8.0	0.23	1.8
Rahim Abad (Khaie)	Loam	7.8	0.39	2.6
Rahim Abad (Topi)	Loam	7.5	0.61	3.3
Rahim Abad (Topi)	Sandy Loam	7.1	0.11	1.5
Average ± SD		7.6±0.3	0.35±0.2	1.9±0.9

Table 5 Soil status of union council of Nomal

Sampling Sites	Textural class	pH (1:2)	EC dSm^{-1}	OM (%)
Nomal (Madinant-ul-karim)	Silt Loam	7.8	0.22	1.9
Nomal (Madinant-ul-karim)	Sandy Loam	7.7	0.65	2.0
Nomal (Madinant-ul-karim)	Sandy Loam	7.9	0.59	1.3
Nomal (Sadrudin abad)	Sandy loam	7.7	0.41	1.9
Nomal (Sadrudin abad)	Silty Loam	7.7	0.26	0.8
Nomal (batoot)	Loam	7.6	0.41	2.6
Nomal (Batoot)	Loam	7.9	2.66	2.3
Nomal (Ameen Abad)	Silt Loam	7.7	0.35	2.2
Nomal (Ameen Abad)	Sandy Loam	7.7	0.22	2.6
Nomal (Ameen Abad)	Loam	7.7	0.62	2.5
Nomal (Mehdi Abad)	Loam	7.9	0.16	2.5
Nomal (Mehdi Abad)	Loam	8.0	0.10	2.1
Nomal (Majini Fahri)	Sandy Loam	7.8	0.21	1.2
Nomal (Majini Fahri)	Sandy Loam	7.8	0.23	2.1

Nomal (Jutoot)	Loam	7.8	0.15	1.8
Nomal (Jutoot)	Sandy Loam	8.0	0.38	4.9
Average ± SD		7.8±0.1	0.48±0.6	2.2±0.9

Table 6 Soil status of union council of Danyore

Sampling Sites	Textural class	pH (1:2)	EC dSm^{-1}	OM (%)
Danyore (Skarkui)	Sandy Loam	7.9	0.51	3.1
Danyore (Skarkui)	Silt Loam	7.8	2.02	2.1
Danyore (Majokal)	Sandy Loam	7.8	0.73	3.0
Danyore (Tokihet)	Silt Loam	7.8	0.99	1.4
Danyore (Tokihet)	Sandy Loam	7.9	2.89	0.9
Danyore (ChikasKot)	Loam	7.9	0.00	2.7
Danyore (ChikasKot)	Sandy laom	7.8	0.33	1.8
Danyore (Mehdi Abad)	Sandy Loam	7.6	0.20	3.8
Danyore (Mehdi Abad)	Sandy Loam	8.1	0.78	3.1
Average ± SD		7.8±0.1	0.94±0.9	2.5±0.9

Table 7 Soil status of union council of Jalalabad

Sampling Sites	Textural class	pH (1:2)	EC dSm^{-1}	OM (%)
Jalal Abad (Farm Area)	Sandy Loam	7.7	0.37	1.9
Jalal Abad (Sheikpura Area)	Loam	7.9	0.62	2.0
Jalal Abad (Bilshar Area)	Loam	7.8	0.45	1.4
Jalal Abad (Maniamal Area)	Silt Loam	7.6	0.42	0.8
Jalal Abad (Alamdar Chowk)	Silt Loam	8.1	0.15	1.3
Jalal Abad (Alamdar Chowk)	Loam	7.8	0.37	1.2
Jalal Abad (MughliHati)	Silt Loam	7.8	0.26	2.3
Jalal Abad (Powerhouse Area)	Silt Loam	7.9	0.18	2.9
Average ± SD		7.8±0.1	0.35±0.2	1.7±0.7

Soil macro and micronutrient concentrations in union council's district Gilgit

Soil status of union council of Sharot and Shikyout

Nitrogen has a vital role in proper crop production and development, which also helps in photosynthesis. For ease, the total nitrogen data is converted to mg soil N kg^{-1} on a w/w basis. Total nitrogen, Potassium, Phosphorus, Zinc, Iron, copper, and Manganese range fell within a range from 700-8400, 56.7-265.4, 6.4-26.3, 0.03-1.85, 1.12-9.96, 0.12-4.07, and 0.72-9.88 with the mean value of 3456±2145, 156.2±57.9, 15.1±6.9, 0.49±0.4, 4.87±2.6, 1.15±1.0 and 4.16±2.2 (Table 8). The union council of Sharot and Shikyout of fruit orchard data showed that Total N is low to adequate ranged whereas 31.25% samples were low, 50% samples were in the marginal range and 31.25% samples were in the high range. According to (Babar et al., 2004), similar results were shown in Gilgit Baltistan where total nitrogen ranged from (0.01-0.17%) with an average value of 0.06%.

Table 8 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Sharot and Shikyout

Sampling Sites	Potassium	Phosphorous	Nitrogen	Zinc	Iron	Copper	Manganese
				mg kg^{-1}			
Sharot (Thignai)	56.7	6.4	4200	0.23	4.46	1.66	2.64
Sharot(MajiniFari)	124.7	18.2	3500	1.85	8.86	1.85	9.88
Sharot(MajiniFari)	108.6	9.0	4900	0.03	6.20	0.56	4.85
Sharot (Kae Fari)	157.1	7.1	4200	0.39	6.06	1.37	5.91
Sharot (kaeFari)	211.5	22.6	3500	0.67	2.00	0.92	0.72
Sharot (Zero point)	152.4	26.3	1400	0.35	9.96	0.80	0.99
Sharot (MainGhizer Road)	121.4	25.8	2800	0.41	4.22	0.77	5.19

Sharot (Farm Area)	128.6	14.7	1400	0.17	4.26	0.12	4.00
Sharot (Farm Area)	196.0	10.6	700	0.36	5.43	2.28	6.90
Skarkui (Diamer Colony)	214.5	10.1	8400	0.28	1.12	1.73	3.32
Skarkui (Pathan Colony)	265.4	20.4	4900	0.33	1.82	4.07	4.57
Skarkui (Farm Area)	77.3	8.0	3500	0.49	8.25	0.61	4.31
Skarkui (Farm Area)	102.0	24.0	7000	0.91	1.84	0.21	2.33
Skarkui (Farm Area)	213.9	16.3	1400	0.46	5.22	1.12	3.88
Skarkui (Farm Area)	159.9	8.7	2100	0.29	4.75	0.17	2.70
Skarkui (Farm Area)	209.0	12.6	1400	0.55	3.48	0.16	4.40
Means± SD	156.2±57.9	15.1±6.99	3456.3±2145.68	0.49±0.4	4.87±2.6	1.15±1.0	4.16±2.2

Most of the soils were deficient in nitrogen due to different physical characteristics of soils with different parental material, which was mostly originated, from the alluvial river deposits having different minerals in which silt and sand texture soils were commonly found in the area. Data obtained from the area showed that samples were ranged from medium to low concentration are available in the study area. While phosphorus concentration in the area showed that 43.75% is high, 37.5% of samples were marginal, and 18% of samples were low. This figure explains that phosphorus was adequate in the fruit orchards of the union council of Sharot and Shikyout. In Pakistan phosphorus is a deficient element due to high pH and formation of insoluble calcium salt, which leads non-availability of phosphorus in Pakistan soil. The findings were in line with those of (Hussain et al., 2019), who worked in the several union councils of Skardu & Shigar GB. AB-DTPA extractable phosphorus of the soils of Shigri Khurd, Skardu Khas and Shigri Kalan union councils ranged from, 1.27-12.1, 0.16-11.8 and 0.47-13.7 mg kg-1 and mean value of 3.4±0.3, 5.6±0.4, and 0.9±44 mg kg-1, respectively whereas 43% samples were deficient, 10% samples were adequate and 10% were high in all three-union council of Skardu & Shigar district GB. The potassium range is from moderate to high in the study where 37% of samples were high, and 50% of samples were in low range due to high organic matter and mica minerals in these soils. According (Babar et al., 2004) where extractable potassium values ranged from (27.19-129.48 mg kg-1) with a mean value of 82.58 mg kg-1. Its concentration was low at 17.5, medium in 72.5, and adequate in 10% of soil samples in the Gilgit Baltistan.

Micronutrients were important for the growth, development, and biological processes of plants. In the Union council of Sharot and Shikyout, micronutrients varied with locations and orchards. According to micronutrients guideline values of (FAO, 1980-1992), It is observed that Zinc is a deficient nutrient ranged from (0.03-1.85) whereas 6.25% sample were marginal, and 93% samples were low in all the all-fruits orchards of union councils of Sharot and Shikyout in district Gilgit. The remaining other micronutrients Iron, Copper, and Manganese ranges were (1.11-9.95), (0.11-4.06), and (0.717-9.87) mg kg-1 which were moderate to a high concentration in the different union councils of district Gilgit. Results of the study area were close to (Babar et al., 2004) who found that Cu varied from (0.2-7.05 mg kg-1), Fe ranged for (0.6-5.95 mg kg-1), Mn varied from (0.25-8.33 mg kg-1, and Zn range for (1.71-2.62 mg kg-1) respectively. Mostly micronutrients were marginal ranged in Gilgit Baltistan due to high altitudinal difference, soil pH and temperate dense forest and marginal organic matter content. The results of macro and micronutrients were consistent with those stated by (Babar et al., 2004) and (Jabeen et al., 2017) the difference in Total Nitrogen, Extractable phosphorus, and potassium at different sites of union councils were mainly differences in altitudinal variances, organic matter contents. Moreover, cropping pattern, drainage and slope also affects the availability of macro and micronutrients. Furthermore, (Whiteman, 1985) discovered that regosol-derived soils in GB have less structured and low organic content and emphasized that intensive agriculture without appropriate fertilizer management could affect soil fertility directly. Our study showed that most of the soil nutrients were recorded deficient and guided adoption of nutrient management system in farming for better results and sustainability.

Soil status of union council of Municipal area

The soil samples of the orchards of the union council of Municipal area were evaluated for their fertility status. The results indicated that the total nitrogen, Potassium, Phosphorus, Zinc, Iron, copper, and Manganese range fell within range from 700-12600, 50.7-218, 0.6-34.6, 0.03-3.19, 0.08-18.86, 0.005-4.0 and 0.33-6.53 with mean value of 4176± 2537, 117.3± 42.8, 12.6± 6.7, 0.96± 0.9, 8.25±4.8, 0.74±0.8 and 2.36±1.8 mg kg^{-1}respectively (Table 9).

Table 9 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Municipal area

Sampling sites	Potassium	Phosphorous	Nitrogen	Zinc	Iron	Copper	Manganese
			mg kg^{-1}				
Baseen (Usman Abad)	180.5	20.9	2800	0.97	8.63	2.07	3.86
Baseen (Faqeer Abad)	89.7	10.7	1400	1.35	9.02	0.99	3.40
Baseen (Aman Colony)	58.4	6.6	6300	0.12	9.37	0.03	4.30
Baseen (Abbas Town)	115.4	9.1	7000	0.37	1.44	0.01	1.70
Baseen (Pathan Colony)	139.2	18.0	4200	0.82	0.08	0.94	1.92
Baseen (Zero point)	140.8	17.6	6300	0.69	8.25	0.32	1.05

Baseen (Masoom Abad)	175.3	34.7	5600	2.23	11.84	0.86	0.34
Baseen (Abuzar Ghafari)	79.3	10.4	2800	0.32	6.19	0.21	0.88
Baseen (Pathan Colony)	98.7	0.6	2800	1.34	4.17	0.36	0.59
Baseen (Zero point)	84.2	6.9	3500	1.76	13.66	1.31	3.57
Gilgit City (Khomar)	166.1	15.4	3500	2.51	10.51	0.92	1.25
City (KhomarDamot)	138.1	16.5	4200	0.80	10.67	0.45	6.00
City (Sonikot)	170.4	15.9	4200	0.48	0.88	0.74	0.39
City (Yadgar Chowk)	113.0	9.2	4200	1.41	13.29	0.13	0.59
City (Nagaral)	57.1	7.0	2800	0.16	8.31	4.00	6.53
UpperJutial (Majinimahla)	91.6	6.5	2800	0.03	0.40	0.10	1.45
U. Jutial (Domiyal)	58.0	7.6	2800	0.39	15.28	0.41	2.66
U. Jutial (Puniyal Road)	50.7	3.0	2800	0.39	9.47	0.17	1.79
U. Jutial (Jutial)	62.6	6.2	12600	0.27	5.01	0.09	0.57
U. Jutial (Upper Jutial)	58.9	11.2	2800	0.43	13.97	0.83	0.59
U. Jutial (Public Chowk)	120.9	15.2	4200	0.39	9.87	0.22	2.60
U. Jutial (Noor Colony)	139.4	15.0	2800	0.03	14.92	0.47	0.49
U. Jutial (Wahdat Colony)	112.6	8.4	4200	0.42	18.86	1.28	3.84
Zulfiqar Abad (Sakwar)	144.7	9.8	700	0.13	3.58	1.27	3.28
Zulfiqar Abad (Z.Abad)	121.4	18.1	2800	1.70	5.33	0.66	1.35
Z. Abad (Prince Colony)	218.0	14.6	11200	0.25	1.78	0.01	0.70
Z. Abad (Karim Town)	119.0	18.6	1400	0.61	7.39	0.87	4.93
Z. Abad (Ameen Abad)	121.4	20.8	4200	2.34	10.57	0.99	5.84
Z. Abad (Darkot Colony)	137.9	14.4	4200	3.19	6.98	0.78	2.54
Z. Abad (Khomar Yarkot)	155.9	10.1	4200	2.81	7.81	0.62	1.84
Means± SD	117.3±42.8	12.6±6.7	4176.7±2537.1	0.96±0.9	8.25±4.8	0.74±0.8	2.36±1.8

The soil data of the union council of the Municipal area indicated that the concentration of potassium varied from low to high levels in different orchards. The results indicated that 30% of orchard samples have low potash level and 63% has marginal while only 6.6% orchards samples have high levels of potassium. The high concentration of K might be attributed to the high soil organic matter as a result of the addition of local FYM (Sadiq, 1986) indicated that most Pakistani soil has a K content of 150 mg kg^{-1}, which is sufficient for various crop cultivation.(Ishaq et al., 2015) also revealed that the mean exchangeable potassium was high in village Gulmit upper district Hunza (87.7 mg kg^{-1}) and low in Shishkat (65.8 mg kg^{-1}).Similarly, the results of soil phosphorus revealed that 26.6% of orchard soil samples have low phosphorus concentrations and 43.3% have a marginal level but 30% samples have a high concentration of phosphorus in the soil samples. Different parent materials, SOM, high sand and silt proportions, and other variables could all be responsible for phosphorus in soils. (Ishaq et al., 2015) also reported phosphorus from the analysis of soils in Gilgit Baltistan as 2.49 mg kg^{-1}in Shishkat and 2.45 mg kg^{-1} in Gulmit. The soil samples of the study area were analyzed for total nitrogen then the results of that analysis showed that 13.3% of samples have a low range of nitrogen, 73.3% have a marginal level while 13.3% orchard samples have a high concentration of nitrogen. When compared to reported values, the data from the current study clearly indicated a low and medium concentration of total N. (Havelin and Soltanpour, 1981; Hesse, 1971 and Soltanpour, 1977). In five-peat soil samples, Amponsah et al, (2000) found total N levels ranging from 14400 to 27900 mg kg^{-1}. Nitrogen is a mobile element, and it has low uptake recovery and its losses through different mechanisms i.e., NH_3volatilization, chemical and microbial fixation, denitrification, leaching and runoff results in residual/available N becomes poor in soils (De Datta & Buresh, 1989).

The micronutrient in soil samples varied strongly among different orchards of the union council of Municipal areas. The Zn concentration is low in 63% of orchards, 13% has marginal levels but 23.3% orchards have high Zn concentration. Similarly, copper concentration also varied as 76.6% orchards have a high level, 3.3% has marginal while 16.6% has low levels of copper. Iron concentration is low in 23.3% of orchard samples, orchards have a marginal level of iron as 66.6% while 10% has a high concentration of iron. The manganese concentration in orchard samples indicated that orchards have 30%, 26%, and 43.3% of low, marginal, and high levels of manganese respectively. Cu concentrations in soil solutions were determined by using various methods from various soils ranged from 3 to 135 mg kg^{-1} (Hodgson et al., 1966). Cu, Fe, Mn, and Zn contents in Dir district KPK soils were determined to be 1.88, 17.25, 8.58, and 1.9 mg kg^{-1}, respectively (Adil, 1987).

Soil status of union council of Rahim abad

The selected samples from orchards of the union council of Rahim Abad have varied levels of macro and micronutrients. The results of the analysis revealed that the Total nitrogen, Potassium, Phosphorus, Zinc, Iron, copper, and Manganese range lied within the range from 700-7000, 68.8-213.7, 8.4-39.8, 0.13-3.15, 1.59-14.6, 0.12-1.89, and 0.69-5.59 with the mean value of 3675±2074, 153.4±53.2, 22.9±10.4, 0.95±1.3, 9.05±4.6, 0.57± 0.6 and 2.34±1.7 mg kg^{-1}respectively (Table 10) The union councils of Rahim Abad have different levels of macronutrients. It varies from location to location. The range of nutrients fell into different levels. It is indicated that 12.5%, 50%, and 37.5% orchards have low, marginal, and high levels of potassium respectively. 87.5% of orchards have a high P concentration and 12.5% have marginal levels. The N levels indicated that 25% was high, 12.5% has low and 62.5% has marginal concentrations. In the Ashanti area of Ghana, soils with natural forests exhibited an increase in nitrogen (N) from 2000 to 3000 mg kg^{-1} as the altitude and moisture gradient increased. Colorado soil K values varied from 36 to 1250 mg kg^{-1} (Havlin&Soltanpour, 1981). The micronutrient levels also differed among different locations. The results found that 62.5% and 37.5% of orchards have a low and high range of Zn respectively. 87.5% orchards have a high copper level, and 12.5% orchards have low Cu level. The iron concentration also varied, and results indicated that 50% was high, 12.5% was marginal and 37.5% has a low range of iron. The range of manganese showed that 25% of orchards have low, 37.5% has high and marginal levels occurred in 37.5% orchards. Surface soil samples from Swat, Dir, and Malakand Agency, NWFP have values of Cu, Fe, Mn, and Zn ranging from 2.01 to 14.81, 22.5 to 39.9, 45.8 to 48.1, and 0.39 to 5.69 mg kg^{-1}, respectively.

Table 10 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Rahim Abad

Sampling Sites	Potassium	Phosphorous	Total nitrogen	Zinc	Iron	Copper	Manganese
			mg kg^{-1}				
Rahim Abad (Khun)	137.4	8.4	2800	0.47	1.59	1.89	1.50
Rahim Abad (Khun)	68.8	16.7	2800	0.13	9.28	0.28	3.12
Rahim Abad (Hukaring)	107.3	19.3	6300	0.14	14.69	0.16	5.59
Rahim Abad (Hukaring)	125.3	20.3	2800	0.43	11.48	0.14	1.97
Rahim Abad (Khaie)	202.8	23.1	7000	3.15	4.17	0.57	0.94
Rahim Abad (Khaie)	213.7	36.8	700	0.34	10.10	0.12	1.22
Rahim Abad (Topi)	160.6	39.8	2800	2.61	13.93	0.54	3.70
Rahim Abad (Topi)	211.2	19.1	4200	0.36	7.16	0.86	0.69
Means± SD	153.4±53.2	22.9±10.4	3675.0±2074.8	0.95±1.2	9.05±4.6	0.57±0.6	2.34±1.7

Soil status of union council of Nomal

The samples taken from different orchards of the union council of Nomal have different levels of nutrients (NPK and micronutrients). The results showed that the Total nitrogen, Potassium, Phosphorus, Zinc, Iron, copper, and Manganese concentration occurred within range from 700-8700, 48.3-248, 6.3-23.5, 0.05- 0.91, 0.04-16.45, 0.01-2.68 and 0.42-10.09 with mean value of 3956±2267, 148.7±50.3,13.3±5.8, 0.37±0.2, 6.58±4.4, 1.14±0.8 and 3.60±2.5 mg kg^{-1} respectively (Table 11). The nutrients range varied among locations in the union council of Nomal and the results found that potassium range was low in 12.5%, Marginal in 62.5%, and high in 25% of orchards. Likewise, the P concentration was low in 25%, marginal in 25% and 50% orchards have a high concentration. The N concentration indicated that 12.5% orchards have low, 62.5% has marginal and 25% orchards has a high level of N. Total N and P levels in Muzaffarabad, Azad Kashmir soils were 20,000 and 10 mg kg^{-1}, respectively. Micronutrient deficiency can cause severe depressions in yield and crop quality. The micronutrient represents parental material and the pedogenic process (White & Zasoski,1999). Principal sources of micronutrients include parent material, sewage sludge, municipal waste, FYM, and SOM (Nazif et al., 2006). All the orchards of the union council of Nomal have low Zn concentration (100%).75% of orchards have a high Cu level while 25% has low range.37.5% orchards have low Fe concentration but 56.2% has high range. Manganese level was low at 12.5% orchards and high in 87.5% (Babar et al., 2004). The reason behind the Zinc deficiency is mainly due to high pH and $CaCO_3$.Cu and Zn contents in orchard soils around Chungju Lake, Korea, averaging 5.6 and 13.7 mg kg^{-1}, respectively.

Table 11 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Nomal

Sampling sites	Potassium	Phosphorous	Nitrogen	Zinc	Iron	Copper	Manganese
			mg kg^{-1}				
Nomal(Madinant-ul-karim)	138.1	9.3	1400	0.33	8.31	1.99	5.25
Nomal(Madinant-ul-karim)	145.8	17.4	6300	0.38	8.38	1.93	2.19
Nomal(Madinant-ul-karim)	200.6	23.2	4200	0.37	5.99	2.68	3.69
Nomal (Sadrudin abad)	248.0	9.8	4900	0.49	4.67	1.87	5.83

Nomal (Sadrudin abad)	48.3	6.4	4200	0.38	4.89	2.28	3.71
Nomal (Batoot)	126.7	10.4	4200	0.34	0.04	0.21	1.51
Nomal (Batoot)	200.1	12.2	7000	0.38	1.80	0.01	2.47
Nomal (Ameen Abad)	115.9	7.6	6300	0.48	0.20	0.99	1.43
Nomal (Ameen Abad)	134.2	23.5	3500	0.41	10.81	0.75	3.31
Nomal (Ameen Abad)	155.7	15.6	3500	0.91	10.87	1.14	10.09
Nomal (Mehdi Abad)	126.9	13.4	700	0.25	6.11	0.04	0.79
Nomal (Mehdi Abad)	200.2	18.0	8700	0.14	7.14	0.25	4.43
Nomal (Majini Fahri)	115.6	20.4	2800	0.73	16.45	1.14	4.44
Nomal (Majini Fahri)	186.3	6.3	2800	0.03	8.19	0.63	0.42
Nomal (Jutoot)	78.2	13.1	1400	0.25	9.98	1.46	1.79
Nomal (Jutoot)	159.3	7.0	1400	0.05	1.51	0.89	6.31
Means± SD	148.7±50.3	13.3±5.8	3956±2267	0.37±0.2	6.58±4.4	1.14±0.8	3.60±2.5

Soil status of union council of Danyore

The soil analysis results of samples taken from different orchards of the union council of Danyore showed different concentrations. It was found that the Total nitrogen, Potassium, Phosphorus, Zinc, Iron, copper, and Manganese ppm concentration occurred within the range from 1400-8400, 29.3-244.7, 2.9-23.2, 0.29-4.18, 0.16-13.26, 0.10-9.40, and 0.45-8.28 with the mean value of 4200±2886, 151.1±79.1, 16.1±6.1, 1.15±1.3, 7.32±4.5, 3.94± 3.8 and 4.70±2.8 mg kg^{-1}respectively (Table 12). Different orchards in the union council of Danyore have different levels of nutrients. The results of the analysis expressed that 33.3% of orchards have low, 33.3% marginal and 33.3% have a high level of potassium. K levels in the soils of Turkey's Erzincan plain ranged from 61 to 731 mg kg^{-1} (Guleryuz et al., 1999). K-bearing minerals may be responsible for adequate K concentrations at study site.77.7% orchards have a high P range while 11.1% has low as well as (11%) marginal level. 44.4% of orchards have high N concentration, 22.2% has marginal but 33.3% has low N concentration. The micronutrients (Zn, Cu, Fe, and Mn) also varied among different locations, and it was found that Zn was high in 22.2% while low in 77.7%, orchards. 77.7% of orchards have a high Cu level, 11.1% has low and 11.1% has marginal Cu concentrations. Iron concentration showed that low in 22.2% orchards, marginal also in 22.2%, and high in 55.5% orchards. 88.8% of orchards have high manganese concentrations while 11.1% has a low level of manganese. Mn and Zn levels in the soils of Turkey's Erzincan plain ranged from 3.9 to 15.0 mg kg^{-1} and 1.2 to 3.6 mg kg^{-1}, respectively (Guleryuz et al., 1999). In surface soil, mean levels of iron, manganese, zinc, and copper were found to be 56.77, 42.43, 1.12, and 2.27 ppm, respectively, according to (Ganai et al., 2018).While the Cu, Mn and Zn concentrations in the soils of Madison country, Missouri (USA) ranged from 1 to 450, 17 to 1227 and 14 to 142 mg kg^{-1}, respectively (Davies &Wixon, 1985).Soil Mn levels typically range from 20 to 3000 mg kg^{-1} (Mitchell, 1964).

Table 12 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Danyore

Sampling Sites	Potassium	Phosphorous	Nitrogen	Zinc	Iron	Copper	Manganese
			mg kg^{-1}				
Danyore (Skarkui)	29.3	16.3	1400	0.91	4.81	8.31	7.75
Danyore (Skarkui)	71.4	10.4	1400	0.40	12.83	9.40	5.53
Danyore (Majokal)	220.9	18.5	5600	0.49	9.61	7.33	7.33
Danyore (Tokihet)	244.7	23.2	2800	0.86	9.02	5.36	5.54
Danyore (Tokihet)	200.7	20.2	8400	0.36	1.97	0.10	2.52
Danyore (ChikasKot)	182.6	19.3	5600	0.29	0.16	0.20	2.39
Danyore (ChikasKot)	51.1	2.9	1400	0.43	8.11	3.77	2.51
Danyore (Mehdi Abad)	187.4	17.5	2800	4.18	13.26	0.57	8.28
Danyore (Mehdi Abad)	171.9	17.0	8400	2.40	6.08	0.38	0.45
Means± SD	151.1±79.1	16.1±6.1	4200±2886	1.15±1.3	7.32±4.5	3.94±3.8	4.70±2.8

Soil status of union council of Jalal Abad

The soil samples collected from different locations of the union council of Jalal Abad were analyzed. The results found that the Total nitrogen, Potassium, Phosphorus, zinc, iron, copper, and manganese range fell within the range from 2100-7000, 48.3-191, 7.6-36.9, 0.25-1.66, 1.85-11.2, 0.04-4.42, and 0.62-5.04 with the mean value of 3500±1673, 111.1±55.0, 18.8±9.1, 0.53±0.5, 7.47±3.3, 2.10±1.4 and 3.10± 1.5 mg kg^{-1}respectively (Table13) The soil analysis results indicate that K concentration varied from low to marginal levels as low in 62.5% and marginal in 37.5% orchards. Similarly, 87.5% of orchards have high P and 12.5% have low P levels. N levels in orchards showed that 87.5% lie in marginal level while 12.5% have high N levels. Attar & Joolka, (2015) reported the soil fertility status in different locations of apple belts in India, and showed soil Nitrogen, Phosphorus, Potassium, had the values ranged from 95.1-202.5, 8.03-68.0, 53.1-278.0 mg kg^{-1}, respectively. The micronutrient level in the soil also showed variations among different locations. Zn concentration was high in 12.5% orchards while low in 87.5%. All the orchards have a high copper concentration (100%). 87.5% of orchards have high Fe and 12.5% have a low level of Fe concentration. Similarly, manganese indicated that 87.5% of samples have high while 12.5% have low concentration. Micronutrient variability (Cu, Fe, Zn, and Mn) and mycoflora were evaluated (Azhar et al., 2016). The mean concentrations of Cu, Fe, Mn, and Zn in potato growing soil in Bagrote valley were determined to be 3.58, 7.43, 7.66, and 0.96 mg kg^{-1}, respectively.

Table 13 Concentrations of soil total N and extractable P, K, Cu, Fe, Mn and Zn concentrations in Jalal Abad

Sampling Sites	Potassium	Phosphorous	Nitrogen	Zinc	Iron	Copper	Manganese
			mg kg^{-1}				
Jalal Abad (Farm Area)	77.1	7.6	2100	1.66	11.20	3.24	3.88
Jalal Abad (Sheikpura Area)	174.0	14.7	2100	0.30	7.52	4.42	3.66
Jalal Abad (Bilshar Area)	48.3	36.9	4200	0.41	1.85	0.04	1.98
Jalal Abad (Maniamal Area)	153.8	10.4	3500	0.36	8.97	1.71	2.49
Jalal Abad (Alamdar Chowk)	54.4	21.4	4200	0.27	3.18	2.20	2.62
Jalal Abad (Alamdar Chowk)	104.2	22.2	2100	0.25	8.73	0.82	0.62
Jalal Abad (MughliHati)	85.7	21.7	2800	0.45	10.47	1.29	4.53
Jalal Abad (Powerhouse Area)	191.0	15.6	7000	0.50	7.88	3.07	5.04
Means± SD	111.1±55.0	18.8±9.1	3500±1673	0.53±0.5	7.47±3.3	2.10±1.4	3.10±1.5

Conclusions

The conclusion from the results revealed that the soil texture of all union councils of Gilgit district varied from sandy loam to silt loam, with neutral to slightly alkaline pH 7.04 to 8.5. No salinity issues were in the study area. These soils were medium to high organic matter, Phosphorus from 0.572 to 39.72 mg kg^{-1}, and low total nitrogen was found in fruits orchards, where potassium range was adequate in the surveyed area due to the availability of K bearing minerals. Soil micronutrients (Cu, Fe, and Mn) except Zn was enough in all fruit orchards in the surveyed areas. Results showed that 77% of samples were low in Zn content where 4% of samples were in marginal range and 19% of samples were in the adequate range. Most of the fruit's orchards were low in Zn and total nitrogen. The nitrogen deficiency might be the leaching due to sandy texture and decomposition of organic matter at different sites. It is recommended that by applying different fertilizers, especially N and P, for better fruit production of orchards in GB. Orchards should also be managed properly for better earnings.

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