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NUTRIENT STATUS OF APPLE ORCHARDS' SOIL OF DISTRICT ZIARAT BALOCHISTAN.

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خلاصہ

سیب کی ناقص پیداوار اور بلوچستان کے سیب اگانے والے خطے میں غذائیت کی وسیع قلت کی وجہ کم نامیاتی ماڈے، نمکیات، الکلائنٹی، اور کیلکیورینس کے ساتھ ساتھ دستیاب میکرو اور مائیکرونیوٹرینٹس کی تعداد سمیت عوامل کے مجموعے سے منسوب ہے۔ بلوچستان کے علاقے زیارت میں سیب کے پچاس باغات کی مٹی کے میکرو اور مائیکرونیوٹرینٹ کے معیار کی تحقیق کے لیے ایک مطالعہ کا منصوبہ بنایا گیا تھا۔ ٹیسٹ کیے جانے سے پہلے، نمونوں کو ہوا سے خشک کیا گیا، pulverized کیا گیا، اور مٹی کی ساخت، مٹی کے نامیاتی مادے، pH، EC، میکرو نیوٹرینٹ یعنی N، P، اور K اور مائیکرونیوٹرینٹ یعنی Cu، Fe، Mn، اور Zn کے لیے چھلنی کی گئی۔ نتائج سے پتہ چلتا ہے کہ سیب کے باغ کی مٹی کی ساخت کی بنیاد پر تین اقسام میں درجہ بندی کی جاسکتی ہے: سلٹ لوم، سینڈی لوم، اور لوم، جس میں 82 فیصد نمونوں کا حصہ سلٹ لوم ہے۔ کل N کا ارتکاز اوسطاً 0.07 فیصد کے ساتھ 0.02 فیصد سے 0.15 فیصد تک تھا، جب کہ AB-DTPA نکالنے کے قابل غذائی اجزاء، جیسے P 0.26-9.41، K 21.0-203.60، Cu 0.21-1.35، Fe، 0.21-1.35، Mn، Fe. 0.41-65.97 اور Zn، 1.80-27.01 mgkg-1 تھے۔ باغات کی اکثریت (54%) میں کافی مٹی کا نامیاتی مادہ تھا، جب کہ باغات کی 46% مٹی میں TN کی سطح معتدل تھی۔

Abstract

Poor apple yields and widespread nutrient shortages in Baluchistan's apple-growing region are attributable to a combination of factors. Salinity, alkalinity, calcareousness, low organic matter, and macro- and micronutrients are the main determinants among these. A study was planned in the Balochistan region of Ziarat to investigate the soil macro and micronutrient quality of fifty apple orchards. Soil samples were taken from two tehsils i.e. Ziarat and Sanjavi. Textural class, organic matter percentage, pH, EC, soil macronutrients like nitrogen (N), phosphorus (P), and potassium (K), as well as micronutrients like copper (Cu), iron (Fe), manganese (Mn), and zinc(Zn) were determined for the samples. The findings revealed that apple orchard soil could be classified into three types based on texture: loam, silt and sandy loam with silt loam accounting for 82 % of the samples. The coefficient of variation showed narrow spread of electrical conductivity data and all 100% orchard soils were non-saline. The pH values illustrated that 92% soils were classified as moderately alkaline (7.9-8.4), 6% as slightly alkaline (7.4-7.8) and 2% as strongly alkaline. Total organic matter content was typical of our soils and was as low as 0.31% and as high as 2.91% with average values of fifty orchards as 1.39%. The results revealed that majority of 54% apple orchards had appropriate quantities of organic matter. Total N, AB-DTPA extractable nutrients i.e. P, K, Cu, Fe, Mn and Zn were in the range of 0.02-0.13%, 0.26-9.41, 21.0-203.60, 0.21-1.35,0.25-6.29, 0.41-65.97 and 1.80-27.01 mg kg^{-1} respectively. On percent basis, 38, 72, 50, 74 and 10 apple orchard soils were correspondingly low in N, P, K, Fe and Mn. While, 46%, 24%, 44%, 26%, 20% orchard soils were marginal in N, P, K, Cu and Fe. Only 16%, 4%, and each 6% were adequate in N, P, K and Fe. In case of Cu (74%) and Mn (90%), majority of the soils were adequate. While 100% was adequate in Zn.

Keywords: nitrogen, organic matter, phosphorus, potassium, apple orchards

Introduction

The apple is one of the most important fruit crop of Pakistan. It's a nutrient-dense fruit that's high in sugar (12%), fat (0.5%), protein (0.35%), carbs (15%), vitamins, and minerals. A 100-gram fresh apple includes 84.7 percent water, 0.8 grams of fiber, 14 grams of carbs, Protein: 0.5 grams, fat: 0.30 grams, and ash: 0.30 grams and 8 milligrams of sodium.100 g-1 vitamin C, 0.3 mg sodium (Na), 145 mg potassium (K), 7 mg calcium (Ca), 6 mg magnesium (Mg), 480 g iron (Fe), 12 mg phosphorus (P), and 2 g iodine (I) (Hussain, 2001).It comes third in terms of consumption behind citrus and banana due to its excellent nutritional value (Bokhari, 2002).

Apples are most commonly grown in mountainous regions. The major provinces recognized for cultivating apples in Pakistan are Balochistan and Khyber Pakhtunkhwa, both of which are located at a higher altitude. In Pakistan, 0.56 million tonnes of apples were produced from 0.089 million hectares in 2017-18. District Balochistan supplied 91 percent of the area and 87.1 percent of the production. While Khyber Pakhtunkhwa production had 12.3 percent with an area of 8.50 %. Punjab provided the last traces of apple production (Pakistan Bureau of Statistics, 2019).Worldwide 87.23 million metric tonnes of apple is produced per year. China is the world's top apple producer with the production of more than 40 million metric tonnes. The other major apple producing countries including United States (05 million metric tonnes), Turkey more than 2.5 million metric tonnes, Poland 3.28 million metric tonnes, Italy 2.5 million tonnes, India 2.18 million tonnes, and France with more than 1.5 million tonnes per year. Pakistan ranks 25th in the world for apple production 0.48 million tonnes (O'Rourke, 2016). The total area under apple cultivation fell approximately 7% from 4.9 million/hectares in 2017 to 5.2 million/hectares in 2016, resulting in a 7% drop in global apple production. Around 4.7 million hectares of land have been planted with apples around the world. Apple production fell by 2.5 percent as a result of the reduced space (USDA, 2019).

The soil's macronutrients should be present in the proper concentrations as they have a substantial impact on the health of apple plants. N play vital role for a tree's robust vegetative and floral growth (Reddy *et al*., 2000). Phosphorus is necessary for cell division, growth and sugar-phosphate molecules synthesis (Salisbury and Ross, 1992). Potassium is needed to make a tree more resistant to illnesses and insect pests, as well as to regulate water uptake and improve fruit quality (Marschner, 1995). For high-quality apple production, the correct amount of macro nutrients in the soil is critical (Stiles and Reid, 1991).

Macronutrients and micronutrients are both necessary for plant development and production of fruits because they influence a variety of metabolic processes and enzymatic responses. Zinc (Zn), for example, is a major structural component of a wide range of enzymes in numerous metabolic pathways, as well as protein, axon, and glucose. Peptidase, posphohydrolase, dehydrogenase, and proteins are examples of enzymes that contain these. Respiration, photosynthesis, and the metabolism of carbohydrates all depend heavily on zinc (Zn). Equally copper (Cu) is an element of laccase and cytochrome oxidase, ascorbic acid oxidase and plays a vital role in respiration, photosynthesis, and carbohydrate metabolism. The enzymes laccase, cytochrome oxidase, and ascorbic acid oxidase all require it to function. Iron is required for photosynthesis, nitrogen fixation, and energy conversion in addition to homo- and non-homo proteins, ferrodoxins, and oxidation-reduction in respiration (Fe). An ingredient in the enzymes phosphotransferase and anginase, manganese (Mn) aids in the formation of cell walls and tissues. (Kumar *et al*., 2021).

Lack of micronutrients causes uneven plant growth, which causes some plants to fail. Production of grain and flowers is severely constrained. However, little is known about this for apple orchards in Ziarat. To boost output, it is vital to comprehend the status of micronutrients in soils and to establish plans to remedy micronutrient deficiencies. Determining the nutritional value of apple orchard soils was the aim of this research study with precise objectives were to assess the Nutrient status of apple orchards' soil of District Ziarat Balochistan.

Materials and Methods

Site description

Ziarat is the smallest district in Balochistan, having a total size of 1487 km2 and is situated at an altitude of 2453 metre at 30°22′51 North and 67°43′37 East (Figure1).District Ziarat is known for having the secondworld's largest forest of Juniper. The district is 70 kilometres east of Quetta and consists of two tehsils with seven union councils (GoB, 2012). The main valleys, which have an elevation between 1,800 and 3,488 metres, include Kach, Kawas, Ziarat (the district's administrative Center), Zandra, Mangi, Mana, and GogiAhmadoon.Flood land, plain land, and stony ground make up the district's land area. Shallow lime, which is also included in coal, marble, calcite, and laterite, is the area's main parent substance. Only 1-2 % of the laterite deposits, which span 65 kilometres from Ziarat to Sanjavi, are composed of titanium oxide. Iron and aluminum are far more abundant. Apples, as well as cherries, plums, apricots, almonds, and grapes, are the most important fruit crops in the region

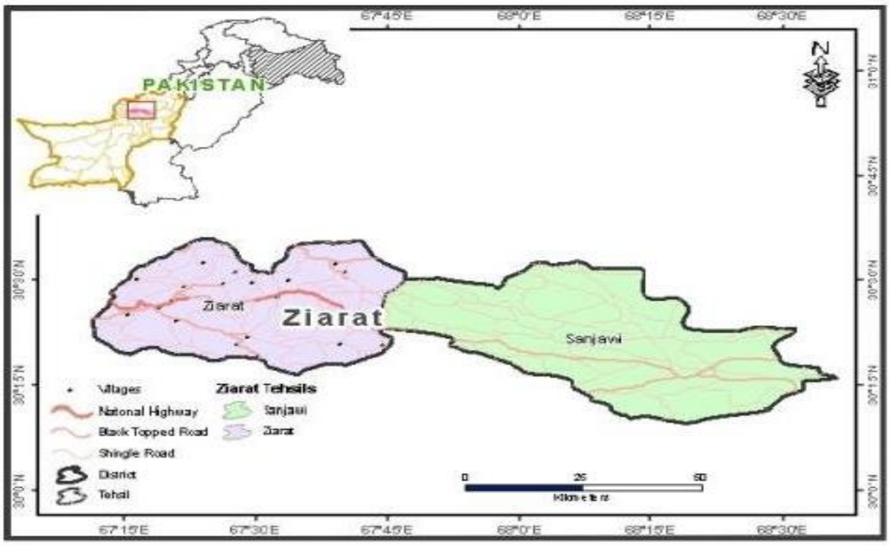

Fig. 1 Map of Balochistan showing Ziarat district

Soil sampling and processing

Fifty apple orchards in the research area at Ziarat had soil samples collected using a stainless steel screw type soil auger, which includes two tehsils and seven union councils. Tehsil Ziarat provided 34 orchards, whereas Tehsil Sanjavi provided 16 orchards. In the month of August, sixteen hundred soil samples from fifty apple orchards were taken in the area of Ziarat at a depth of 0-30 cm. Each location's GPS coordinates were recorded. In each apple orchard, eight trees were chosen at random to meet the sampling criterion. Each of the eight apple trees had four soil cores dug beneath its canopy, which were pooled into a single sample. The soil samples were kept in clear plastic containers, let to dry by air, and then ground in a pestle and mortar with a wooden pestle. The materials were then sieved using a 2 mm strainer. The divided samples were then put in airtight malleable jars and brought to the soil science lab at Sindh Agriculture University Tandojam for analysis.

Soil analysis

In soil samples taken from 50 apple orchards, the physical properties i.e. texture, organic matter, pH, electrical conductivity (Ec),N, P, K ,Cu, Fe Mn, and Zn were determined. The Bouyoucos hydrometer method was used to determine the soil texture (Bouyoucos, 1922). Hydrometer readings were utilized to quantify the percentages of sand, silt, and clay, and the USDA textural triangle was used to identify the textural class (Foth, 1984). The oxidizing method was used to determine how much organic matter was present in the soil. Black (1973; Walkley, 1947). An EC metre (Model HI8033) and a pH metre (Model WTWpH720) were used to measure the EC and pH deionized water to soil ratio is 1:2. (McLean, 1982).

Bremner's description of the most popular method, Kjeldahl's method, was used to determine total N. (1965). Using the AB-DTPA extraction method described by Soltanpour and Schwab (1977) and in more detail in the handbook by Estefan *et al.,* (2013). The available nutrients in the soil i.e. P, K, Cu, Fe, Mn, and Zn were determined. The soil Phosphorus was determined using spectrophotometry, as described in Murphy and Riley’s (1962) approach for blue color creation with a spectrophotometer Model no ANA 75.Soil K was measured using a Flame photometer and emission spectroscopy (JENWAY PFP 7). Micronutrients extracted using the AB-DTPA technique were measured by using an atomic absorption spectrophotometer (Graphite Furnace Atomizer Model Shimadzu AA-6300).

Descriptive statistic

Descriptive statistics of chemical properties were determined. These analytical results were computed by using Microsoft Excel.

Results & Discussion

The physical and chemical properties of soil are influenced by a variety of factors, including the parent material of the soil, its location, the climate, and other physical and chemical processing aspects. The Ziarat district's apple orchard soils were analyzed for their soil texture, organic matter, pH, EC, N, and AB-DTPA extractable macronutrients (P and K) and micronutrients (Cu, Fe, Mn, and Zn).

Particle size distribution (%)

In the particle soil study of apple orchards, the percentages of sand, silt, and clay ranged from 8.30 to 73.70 percent, 9.20 to 79.60 percent, and 7.10 to 26.70 percent, respectively, with average values of 27.97 percent, 57.66 percent, and 14.39 percent. (Table 1) Following sand and silt particles, the majority of the samples showed silt percentages that were close to the upper border of the range. The data from the textural class showed that there were three different types of soil texture in 50 orchards, as shown in Figure 2. This result suggested that the soil was light in texture.

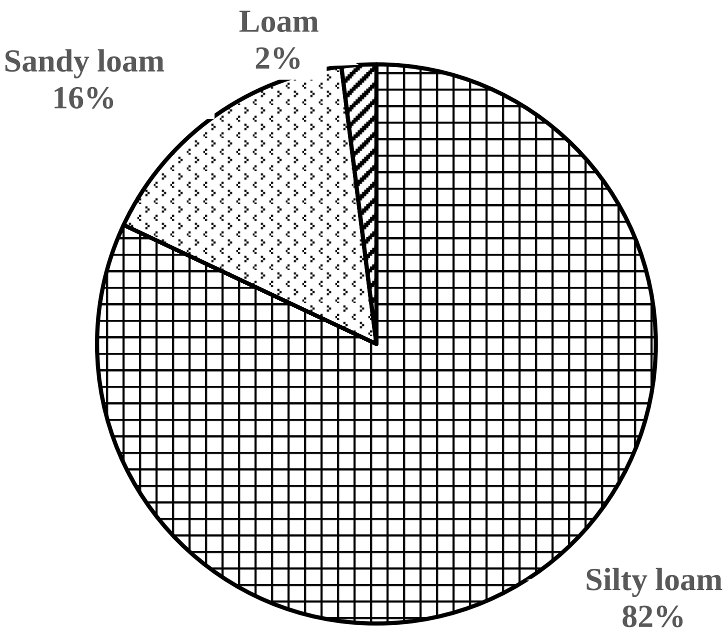

Fig 2. Ziarat's apple orchard soils' texture class

Electrical conductivity (dSm^{-1})

The results showed that apple orchard soils ranged in electrical conductivity from 0.20 - 1.85 dS m^{-1}, with mean of 0.40 dS m^{-1}. The maximum readings were close to normal levels with a mean of 0.36. (Table 1). The coefficient of variation revealed a small data spread. Figure 3 depicted the non-saline nature of all orchard soils. Only one orchard out of fifty had an EC value of 1.85 dS m^{-1}; the electrical conductivities of the other orchard soils varied between 0.20 - 0.65 dS m^{-1}.When the soil parameters of apple orchards in various apple-growing districts of Balochistan were examined, it was discovered that EC values below 4 dSm^{-1} indicate the absence of saline in the study area (Hussain *et al*., 2021 and Zia-ul-Haq *et al*., 2018).

pH

The pH values of 50 apple orchards were found to be within a range of 7.71 and8.45, with an average of 8.05.The coefficient of variability indicated that the maximum number of the results were close to mean values, as indicated by the mode value of 7.93 (Table 1).Figure 4 shows that 92 percent of soils were classed as moderately alkaline based on their pH readings (7.9-8.4). According to USDA categorization, 6% are somewhat alkaline (7.4-7.8) and 2% are severely alkaline. These findings indicated that apple orchard soils were generally alkaline in response (Bangroo.2020). The presence of carbonates, particularly calcium carbonates, causes the soil to be alkaline, and its strong buffering capacity prevents it from changing rapidly after amendments are added (Khalid *et al.,* 2012).

Organic matter (%)

The results showed that the organic matter concentration in our soils ranged from 0.31 - 2.91 %, with a mean value of 1.39 %.The maximum number of result were near to mean values despite the lack of a range for mode values (Table 1). The data's spread is described by the coefficient of variability values, on the other hand. This is further supported by the minimum and maximum dispersion of the data. Figure 5 shows that 27 apple orchard soils (54 percent) had an organic matter concentration of greater than 1.29 percent, which is considered sufficient. While 15(30%) were in the range of 0.86-1.29 percent, which is considered medium. The 8 orchard soils that remained 16% of total sample were classified as having an organic matter concentration of less than 0.86 percent. As evaluating the organic matter levels in the majority of apple orchards in the district

KillaSaifullah, Balochistan, Saleem *et al.*, (2018) discovered low organic matter when compared to critical ranges (Jones *et al.*, 1991).He suggested that the presence of small amount of organic matter content in the soil of various apple-growing areas of Balochistan is due to the lack of farm yard manure application, and if it is accessible, it is expensive, and farmers are unable to pay the costs.

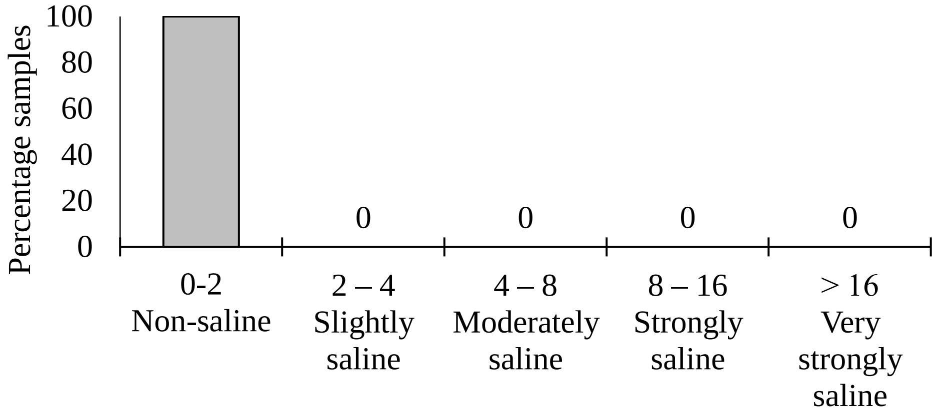

Fig 3. Electrical conductivity categorization of apple orchard soils in Ziarat

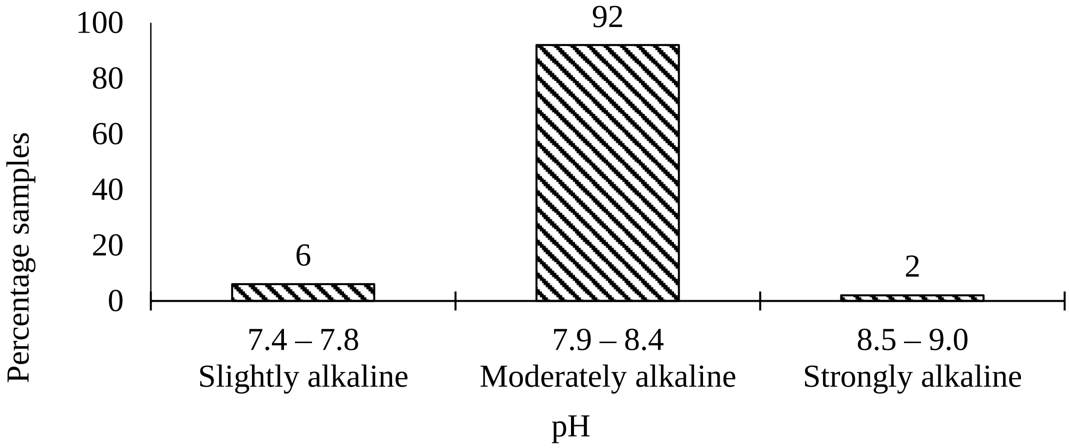

Fig 4. pH categorization of apple orchard soils in Ziarat

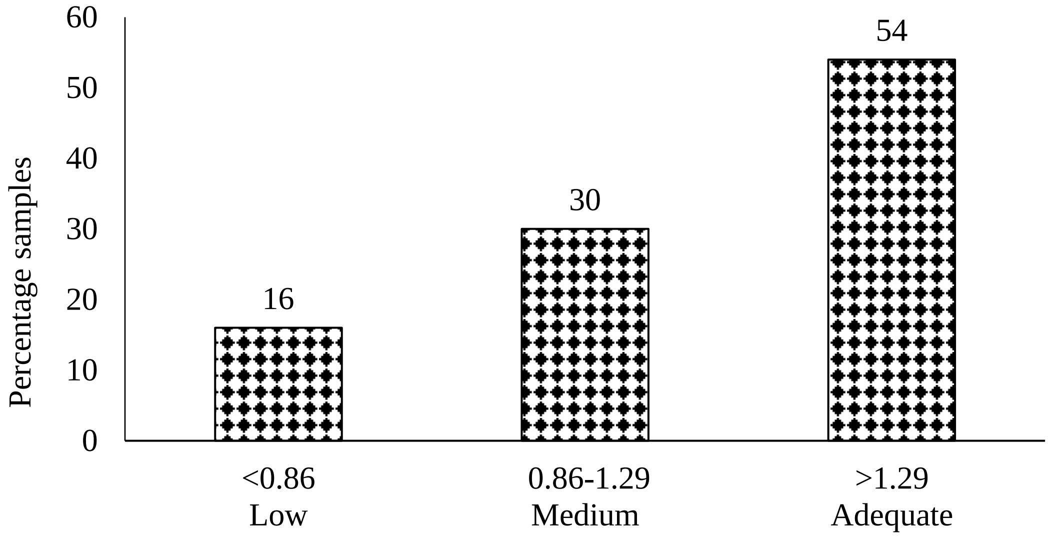

Fig 5. Organic matter categorization of apple orchard soils in Ziarat

Table: 1 Summary characteristics of soils sampled from district Ziarat, Balochistan.

Soil property	Range	Mean± SD	categorization		
pH	7.71-8.32	8.07± 0.18	7.4-7.8 (6%) Slightly alkaline	7.9-8.4 (92%) Moderately alkaline	8.5-9.0 (2%) Strongly alkaline
EC (dS m-1)	0.22-0.65	0.36±0.10	0-2 (100%) Non saline	2-4 (0%) slightly saline	4-8 (0%) Moderately saline
OM (%)	0.31-2.54	1.39±0.59	< 0.86 (16%) Low	0.86-1.29 (30%) Medium	> 1.29 (54%) Adequate
$CaCO_3$ %	13.43-28.51	19.48±5.08	5-10 (0%) Slightly calcareous	10-15 (26%) Moderately calcareous	>15 (74%) Strongly calcareous
Sand (%)	8.7-73.70	29.0±18.48	Silt loam (82%)	Medium Texture	
Silt (%)	9.2-74.60	56.39±17.96	Loam (02%)	Medium Texture	
Clay (%)	9.2-26.7	14.65±4.73	Sandy loam (16%)	Coarse Texture	

Nitrogen

Table 2 shows the overall nitrogen content of fruit yielding apple orchards in Ziarat districts. The nitrogen concentration ranged from 0.02 - 0.15 percent, with mean values of 0.07 percent. As shown in Figure 6, the observed N content was compared to recognized key nutritional limits for TN. Because the apple orchard soils had a wide range of values, they were divided into three groups. Only 16 percent of apple orchards had values larger than 0.1 percent of TN, classed as adequate in N, according to the breakdown by percentage of orchards falling into different groups. While 46 percent of orchards were in the 0.05-0.1 percent range, which is considered medium, and approximately the same amount (38 percent) were below the critical limit of 0.05 percent, which is considered low. This revealed that 84 percent(42 samples) of apple orchards had insufficient nitrogen levels. Zia ul Haq *et al*., (2018) reported similar findings, who investigated the nitrogen content of apple orchards in Baluchistan's KillaSaifullah are a total nitrogen was suitable in the district. According to Hou *et al*., (2007), the increase in nitrogen concentration (total nitrogen) in apple orchard soil was caused by both a high rate of N fertilizer application and a continuous application. On the other hand, in regions where farmers don't utilize manure or compost, low TN with a critical limit could be caused by a deficiency in soil organic matter.

Table 2. Macro and Micro nutrient in apple orchards soil of Ziarat

Nutrient	Range	Mean SD	Low	Marginal	Adequate	CV%
N %	0.02-0.15	0.07±0.03	<0.05 38%	0.05-0.1 46%	>0.1 16%	41.54
P*	0.26-9.41	3.10±2.07	<4 72%	4-7 24%	>7 4%	66.54
K	21.0-203.60	67.04±31.69	<60 59%	60-120 44%	>120 6%	47.27
Cu	0.21-1.35	0.68±0.27	<0.2 0%	0.2-0.5 26%	>0.5 74%	39.61
Fe	0.25-6.29	1.54±1.24	<2.0 74%	2.1-4.0 20%	>4.0 6%	80.10
Mn	0.41-65.97	8.86±11.80	<1.8 10%	-	>1.8 90%	133.12
Zn	1.80-27.01	5.11±3.71	<1.0 0%	1.0-1.5 0%	>1.5 100%	72.63

(*unit in mgkg^{-1})

Phosphorus

Table 2 demonstrates that the soils in the apple orchards in the Ziarat district lacked sufficient AB-DTPA extractable P with a minimum concentration of 0.26 mg kg^{-1} at the lowest level and a maximum concentration of 9.41 mg kg^{-1} at the highest level throughout the entire orchard nutrition-related P scenario.When observed available P concentrations were compared to critical limitations on a percentage basis, only 4% of samples had a concentration of 7.0 mg kg^{-1} soil that was deemed adequate (Figure 7). While the vast majority of orchard soils (72%) were below the 4 mg kg^{-1} threshold level. With values ranging from 4-7 mg kg^{-1}, the remaining 24% of orchard soils were marginal. As a result, 96 %(48 samples) of apple orchards lacked adequate P.This could be related to a lack of organic matter in apple orchards, which reduces fertility (Bozkurt *et al.,* 2010).

Potassium

The results for K nutrition in soil were nearly identical to those for N and P. With a range of 0.21- 203.6 mgkg^{-1}, the average amount of extractable K was 67.04 mgkg^{-1} (Table 2). The data exhibited a high degree of variability, as indicated by the coefficient of variability numbers. One of the basic reason of low K levels in Apple orchards soil could be owing to parent materials, or it could be because of the high expense of potassium fertilizer. When a thorough analysis of the relationship between land use and soil quality indicators was done in the Pakistani Karakoram region, it was found that there was no fluctuation in the K concentration of farm soil. According to Zia ul Haque *et al*., (2018) just 3% of the orchards in the KillaSaifullah district had low soil K levels, which varied depending on the depth of the soil and among various orchards. Based on AB-DTPA extractable K categorization, the orchard soils were classified as low (50 percent) or marginal (60-120 mg kg^{-1}). Figure 8 shows that only three orchard soils (or 6%) were sufficient when compared to the critical K availability criteria (44 percent).

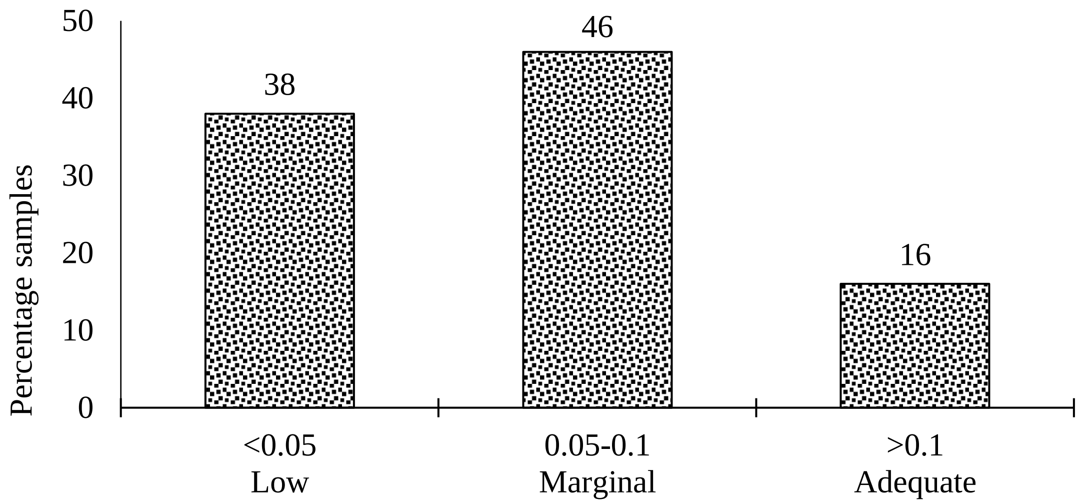

Fig 6. Kjeldahl's N categorization of apple orchard soils in Ziarat

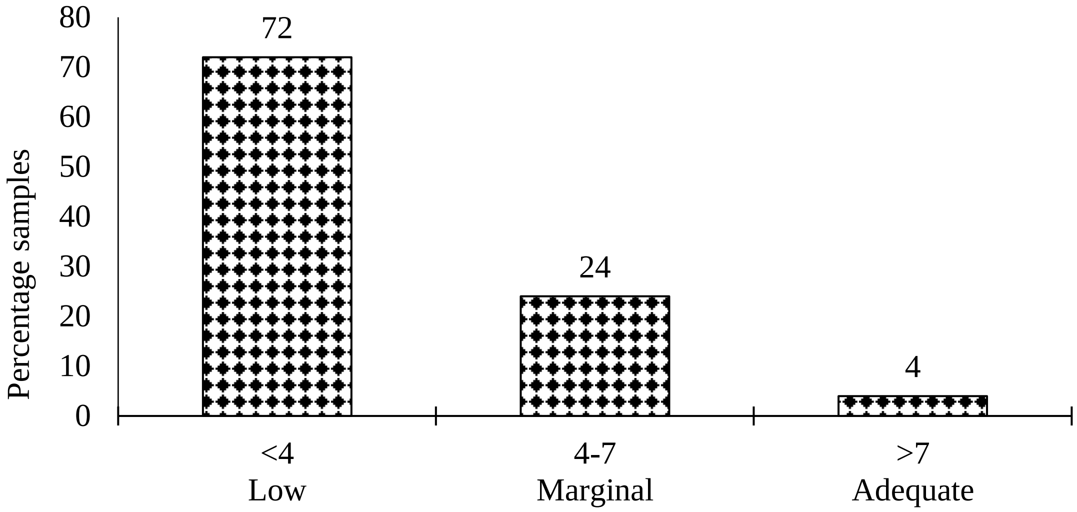

Fig 7. AB-DTPA extractable P categorization of apple orchard soils in Ziarat

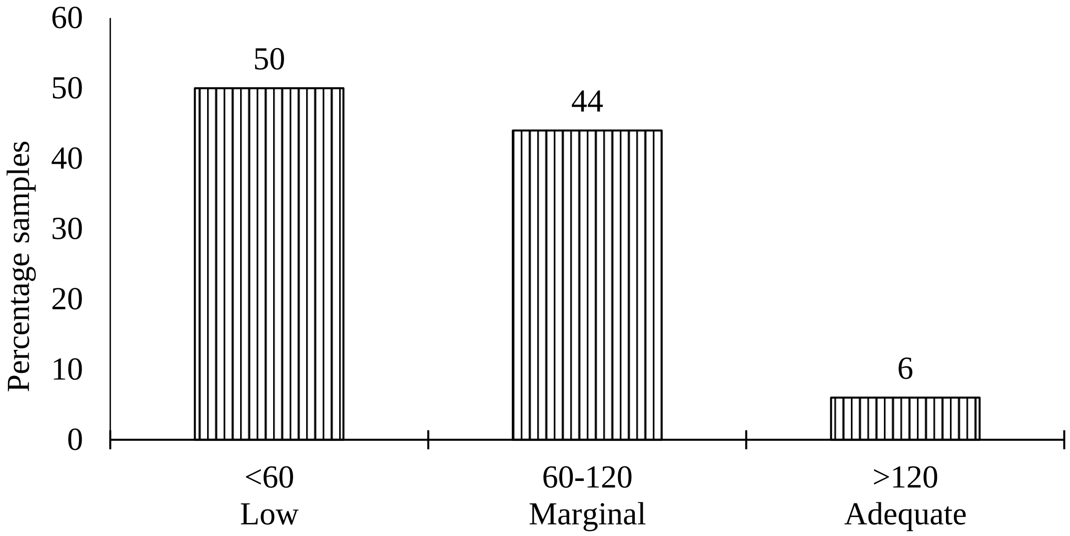

Fig 8. AB-DTPA extractable K categorization of apple orchard soils in Ziarat

Micronutrient status of apple orchards

The micronutrient analysis results revealed that copper, manganese, and zinc concentration levels were adequate in all orchard soils, with the exception of iron, which was found to be inadequate in 74% of orchards (Table 2).With an average concentration of 0.68 mg kg^{-1} and a coefficient of variation of 36.91 mg kg^{-1}, the range of copper concentrations in soil was 0.21 to 1.35 mg kg^{-1}.As can be seen by the mode value of 0.53 mg kg^{-1}, the majority of the data were in the range between the lowest and highest values, which is close to the average value. Figure 9 shows that the soils' Cu nutrition has greatly improved, with adequate soils being classed as having adequate Cu levels of greater than 0.5 mg kg^{-1} in 74% of orchard soils. In 26% of cases, orchard soils with a Cu level of 0.20 to 0.5 mg kg^{-1} were classified as marginal. Cu deficiency was discovered in 26%(13) of apple orchards as a result.

In the apple orchards in district Ziarat, the Fe concentration of the soils fluctuated a much. Fe concentrations in the samples varied between 0.25 - 6.29 mg kg^{-1}.According to the coefficient of variability, Fe nutrition was present low in 94 percent of apple orchard soils, with considerable dispersion (Table 2). The majority of the values, however, were found outside of the established range of apple orchard. The bulk of orchard soils(74%) had Fe concentrations < 2.0 mg kg^{-1}, which is considered low. While 20% of orchard soils had Fe concentrations of 2.1-4.0 mg kg^{-1}, which were considered poor. Only 6% of the remaining orchard soils had an iron content more than 4.0 mg kg^{-1}, which is considered sufficient. As a result, 94 %(47) of apple orchard soils were deficient in Fe nutrition (Figure 10).

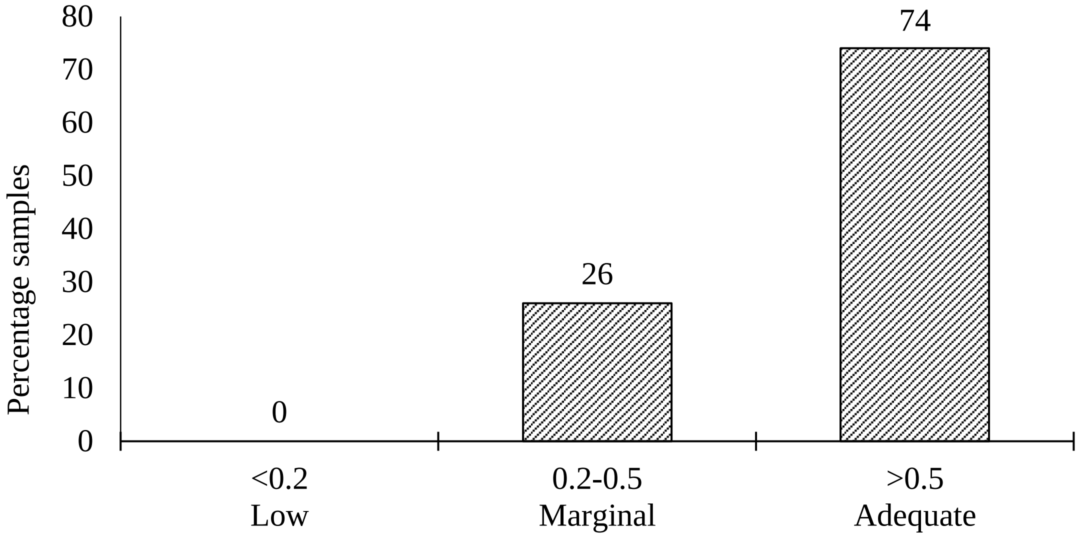

Fig 9. Categorization of AB-DTPA extractable Cu in Ziarat orchards

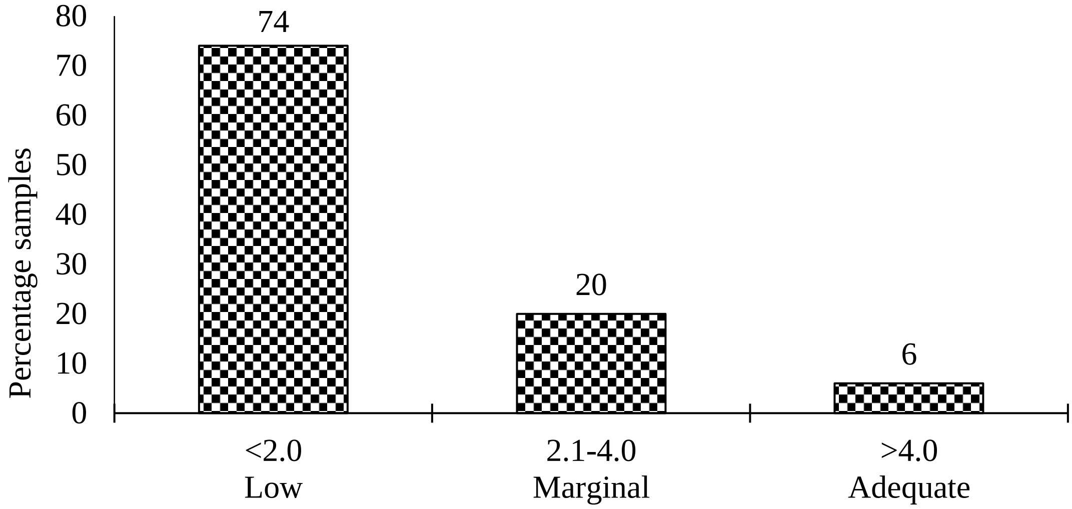

Fig 10. Categorization of AB-DTPA extractable Fe in Ziarat orchards

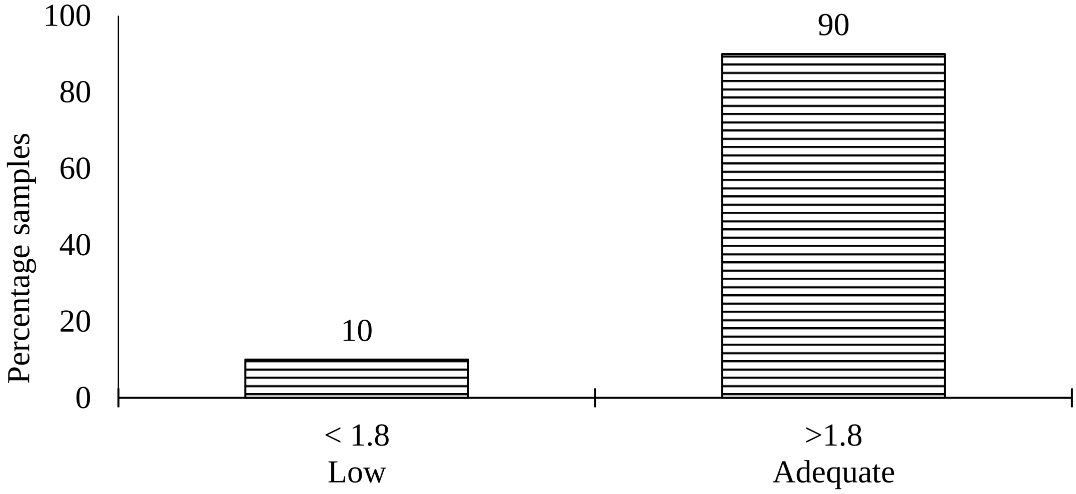

Fig 11. Categorization of AB-DTPA extractable Mn in Ziarat orchards

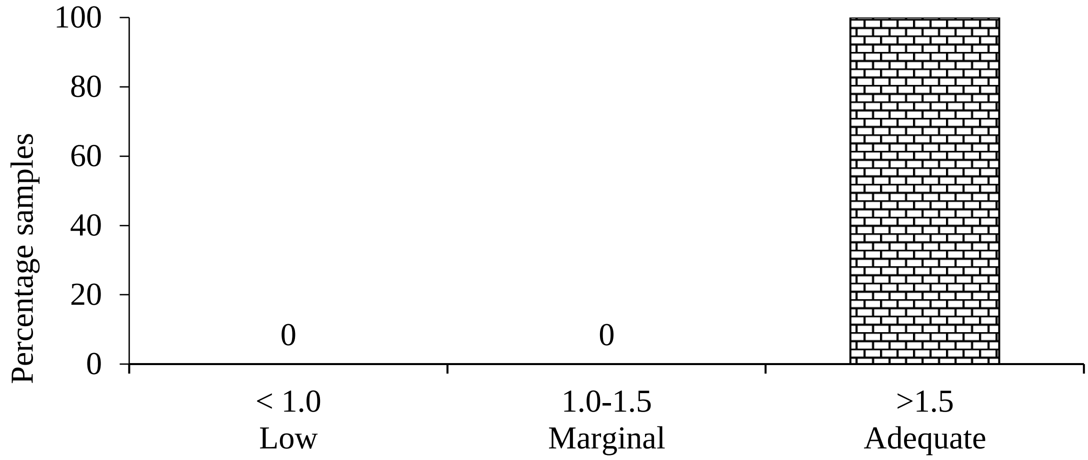

Fig 12. Categorization of AB-DTPA extractable Zn in Ziarat orchards

The Mn concentration in the soil varied from 0.41 - 65.97 mg kg^{-1}, with 8.86 mg kg^{-1}mean, which wasn't adequately represent Ziarat's apple orchards. In addition, the value of mode which is presented in (Table 2) was undetected. Similarly, the coefficient of variability revealed high smatterings in the data. Figure 11 shows that the Mn concentration was low in just 10% of apple orchards (1.8 mg kg^{-1}) even back then. The majority of the samples(90%) were much above the threshold limit (>1.8 mg kg^{-1}), indicating that they were adequate.Mn was not a problem in Ziarat's apple orchard soils, according to soil classification. Only ten percent of orchard soils(5 orchards) were deficient in Mn.

The Zn concentrations in Ziarat's apple orchards were higher than 1.5 mg kg^{-1} (Table 2). Results varied from 1.80 to 27.01 mg kg^{-1} with an average of 5.11 mg kg^{-1} (Figure 12). Apple orchard soil contained an adequate level of zinc. The average results of 5.11 mg kg^{-1} do not reflect the original state of the orchards. The mode readings of 4.83, which were similarly near to average levels, revealed the real situation. Because of a few measurements that were noticeably higher than normal, such 27.01 mg kg^{-1} soil, the coefficient of variability displayed a wide range of values.

According to the findings of soil texture, the majority of apple orchard soils (82%) were silt loam, 16% were sandy loam, and only 2% were loam. Sanjavi Tahsil had 12% of the texture is silt loam. The Ziarat Tahsil boundary was where the remaining 4% of sandy loam soils were located. Some of the soil develops a sandy loam texture as a result of the rocky material. According to the aforementioned discussion and soil particle size, silt made up the majority of the soils, followed by sand and a relatively small amount of clay. Zia ul Haq *et al*., (2018) reported a similar texture for the neighboring district (Qilla Saifullah). In actuality, light-textured soil is excellent for growing apples (Wojcik, 2007). This was consistent with the findings for apple orchard texture in the Swat of the Khyber Pakhtunkhwa province (Shah and Shazad, 2008).

All apple orchard soils were non-saline, according to electrical conductivity measurements, with values between 0.21 and 1.85 dS m^{-1} that were lower than 2 dS m^{-1} (Richards, 1954; Shirokova *et al.*, 2000). All results were less than 1.0 dS m^{-1} with the exception of one apple orchard in Sanjavi Tahsil, where the Ec value was 1.85 dS m^{-1}. The first Ec values did not approach the mean value more closely (0.40 dS m^{-1}).This apple orchard in Zandra has a relatively higher value because it was previously managed differently. For instance, the orchard's soil was brought there from another city and treated to farmyard waste. Rajput's study from 2017 also showed that applying farm yard manure increased the soil Ec. Electrical conductivities in the majority of the soils were clearly below 1.0 dS m^{-1}. The salt content was reduced by abundant rain and light-textured soils (Gelaye *et al.*, 2019). Hidayatullah *et al.*, (2019) discovered equivalent electrical conductivity values for the same region. Akram *et al.*, (2014)also provided information for the Muzaffargarh district.

According to the results of pH, which ranged from 7.71 to 8.45, the soils' reaction was alkaline, which was directly related to their calcareous character and lack of vegetation (Ahmad *et al.*, 2018). The soils in the research area had a $CaCO_3$ concentration ranging from 13.43% to 31.20%. The findings showed that only 26% of apple orchard soils were moderately calcareous and ranged between 10-15% calcium carbonate content, whereas 74% of them were very calcareous (>15%). The Ziarat district's soils, in general, were formed from mountainous material and as a result, they include a lot of alumino silicate and carbonate minerals.These soils also absorb carbonates from bicarbonate-rich water that contains dissolved cations. Irrigation-induced cations also raise the soil's overall alkalinity (Bloom and Skyllberg, 2012). The soils in apple orchards had a higher pH as their $CaCO_3$ level rose. Wasiullah and Bhatii (2007) noted the same for Chitral's steep regions. The extent of the alkaline pH may rely on the degree of calcium carbonate dissolution, which may be induced by the increasing number of cations in these soils. The findings of these soils' pH values were consistent with Hidayatullah's reported pH values (2019). Similar pH values for fruit trees grown in comparable settings were also observed by Ozkan *et al*., (2009).

The organic matter concentration of the soils ranged substantially, from 0.31% to 2.91%. Apple orchards in the 52% range had an appropriate level of 1.29% organic matter. According to the classification of Jones *et al.,* (1991) the remaining 30% (15 orchards) and 16% (8 orchards) as having medium and low organic matter concentrations, respectively. The changes brought about by soil management practices, such as the turnover of organic matter, depend more on the quantity of organic matter present. The expanse of a chilly or rainy climate, or a dry and warm climate, has also been linked to varying organic matter (Glaser *et al*., 2000). The latter is irrelevant to this discussion and contains little organic substance. The mountain soils have seen significantly cooler, wetter weather, with an extended rainy season as a result. However, in other regions with fewer active bacteria and slower decomposition rates, the amount of organic matter may be lower. But it was comparatively more than in plain places (Sarwar *et al*., 2008). Because of the valleys' colder temperatures and heavier rainfall, they contained more than 1% organic matter (Hood, 2001; Siddique , 2009).

In addition to micronutrient inadequacies, almost all Pakistani soils have been shown to be deficient in N, P, and K. as reported by Khalid *et al.,* 2012; Memon, 2005; and Bajwa, 1990. The availability and supply of nutrients has a significant impact on any crop's production. Kjeldahl's N, one of the key nutrients, ranged from 0.02-0.15%, with average values of 0.07%. All of Ziarat's orchards have poor soil N levels based on average values. A total of 46 and 38% of orchard soils fell into the low (0.05%) or medium (0.05-0.1%) categories, respectively. Only 16% of orchard soils possessed acceptable levels of nitrogen, defined as greater than 0.1%. (Melherb, 1963). The readings of 8 orchards, however, hardly exceeded the 0.1% upper limit. In addition, only one of the 0.13% and 0.15% N levels were found in each of the other seven orchard soils. As a result, the entire apple-growing orchard soils lacked N. The organic matter content and nitrogen concentration of orchard soils were correlated. Except for a little amount of animal manure applied to a few orchards, no nitrogenous fertilizer has been applied to the orchards through the soil or in the form of foliar spray. Therefore, mineralization may be the only mechanism that may provide N. Through this process, soils with sufficient organic matter can supply a large concentration of N. (Stiles and Reid, 1991).The Kjeldahl's N results from this investigation were in agreement with the concentrations discovered in apple orchards in the Quetta valley as reported by Rehman *et al*., (2015). According to Kai *et al*., (2015), total N concentration in apple orchards in Iizuna Town, Nagano Prefecture, Japan, was 0.45% in uphill areas and 0.85% in low-hill areas. The lowest level of N concentration exceeded the level they saw in their investigation. N-rich products that can increase N levels include manure, compost, and N-fixing cover crops (such peas and alfalfa). Chicken excrement frequently contains sizable concentrations of soluble nitrogen that is available to plants, while it has apparently been discovered that alfalfa hay contains higher levels of N (Sideman, 2007).

With an average value of 3.10 mg kg^{-1} and a range of 0.26 to 9.41 mg kg^{-1}, the P content was incredibly low. The investigation found a P shortage throughout Ziarat's whole apple-growing region. Deposits of greenish grey and black shale may be responsible for the prevalence of P in these areas (Malkani, 2011). According to Soltanpour and Schwab's classification of P from 1977, two orchard soils (4%) had P concentrations that were over the essential limit of 7.0 mg kg^{-1}, which is insufficient for tree growth. The amount of phosphatic fertiliser that should be applied often during the growing season is far greater than what apple trees actually need (Schmitt *et al.,* 2017). All other orchards (72% + 12%) exhibited readings that were between 4 and 7 mg kg^{-1} or less than 4 mg kg^{-1}, respectively. These P results agreed with those published by Mujtaba *et al*., (2015) in apple orchards in Ziarat (2.8-6.1 mg kg^{-1}). The type of parent material, texture, general environment, but most significantly, the rate and type of applied fertiliser depending on the history of cultivation, all affect the quantity of phosphorus in soils (Sharpley, 2011).The results of the investigation demonstrated that organic (Tiecher *et al.,* 2012a) or inorganic (Tiecher *et al*., 2012b) P fractions are present in both fruit crops (Brunetto *et al*., 2013; Schmitt *et al.,* 2013; Schmitt *et al.,* 2014) and annual crops (Ciampitti *et al.,* 2011; Linquist *et al.,* 2011). However, this kind of accumulation occurs more frequently in the inorganic form of P. After application, P fertilizer can be absorbed and then bound (Rheinheimer and Anghinoni, 2001). Although no P fertiliser was used in the current study, some areas did get animal dung without any rate or schedule estimates. The leaching of nutrients may be facilitated by the land slope of apple orchard areas from higher elevation to lower elevation (Kai *et al.,* 2015).

The results showed that potassium values in apple orchard soils ranged from 21.03 to 203.6 mg $kg^{-1}$with an average value of 67.04 mg kg^{-1}, K behaved in a manner substantially resembling that of the other two important nutrients, N and P. The majority (50 + 44%) of the orchard soils in Mana and Warchm areas were K deficient, with only 3 (6%) of the orchard soils exceeding the necessary level of 120 mg kg^{-1} and being categorized as sufficient (Soltanpour and Schwab, 1977). Some locations may have higher K concentrations due to weathering of the natural mineral sources in the soil. The quality of the ground water may also be affected by springs, tube and dug wells, and karezes that are located throughout the Ziarat valley. These valley water sources have a low reported K content (i.e. 0.3 to 8.3 mg L^{-1}). It might, however, have accumulated over time (Akram *et al*., 2010).

The inside of the rock contains potassium silicate, among other things, which can change tonalite porphyry (Malkani, 2011).

The soil's available Cu was in significantly better condition. With an average value of 0.68 mg kg^{-1}, the values ranged from 0.21 to 1.35 mg kg^{-1}. The findings showed that 74% of orchard soils had adequate Cu concentrations (>0.5 mg kg^{-1}). The remaining 26% of orchard soils had near-borderline Cu levels (0.20–0.5 mg kg^{-1}) (Soltanpour and Schwab, 1977).

The levels of Fe were low (2.0 mg kg^{-1}) in 74% of orchard soils and marginal in 20%, in contrast to the concentration of Cu. Fe levels in the remaining 6% of apple orchard soils were adequate (>4.0 mg kg^{-1}).Overall, Fe values were 0.25 to 6.29 mg kg^{-1}. Fe was thus one of the micronutrients that was deficient in the study area. Soil with high pH (i.e., 7.5-8.5) in calcareous environments include excessive amounts of bicarbonate, which causes Fe shortage in soils used for various fruit production (Korcak, 1987; Lucena, 2000). Fruit crops are quite concerned about it. Even after its administration, Fe insufficiency has been noted in several investigations. In a calcareous environment, the applied Fe may precipitate and reduce the available Fe. However, the chelated Fe might be useful for this (Ojeda *et al.*, 2004).

Only 10% of apple orchards had low Mn contents (1.8 mg kg^{-1}). 90% of the remaining orchard soils had adequate Mn concentrations (>1.8 mg kg^{-1}). The range of concentrations in all orchards was 0.41 to 65.97 mg kg^{-1}.This adds up to a substantial Fe deficiency of 94% (47), followed by a Cu deficiency of 26% (13), and just 10% (5) of Mn orchards. Low clay content and sufficient organic matter in the soils may be the cause of significant concentrations of Mn that are readily available (Nagy *et al.*, 2006). Another possible explanation for the lack of Fe is the fact that the apple orchard soils in district Ziarat were generally adequate in Mn. Low Fe concentrations can result from high Mn in the soil interfering. Adequacy of 70% apple orchards was also found by Zia ul Haq *et al.*, (2018) in the Balochistan province district Qilla Saifullah. They also stated that the Cu and Mn levels in every orchard were adequate. However, this study found a 26% and a 10% Mn shortage, respectively.

All of the orchards exhibited appropriate amounts of zinc (>1.5 mg kg^{-1}), ranging from 1.80 to 27.01 mg kg^{-1}.The average values of 5.11 mg kg^{-1} do not reflect the original picture of the orchards. Mode values of 4.83 depicted the real picture and were also close to average values. The wide spread of values illustrated from coefficient of variability was mainly due to very few values which were much higher i.e. 27.01 mg kg^{-1}soil. There was no deficiency of Zn in apple orchard soils.

Conclusion

From this study, it was inferred that texturally most apple orchards' soils were silty loam and alkaline in nature with no salinity problem. The soil organic matter in the majority of orchards prevailed adequacy along with total nitrogen, copper, manganese, and zinc concentration. But the other plant essential nutrients such as phosphorus, potassium, and iron concentration were found in low ranges. Through questionnaire-based surveillance investigation during sampling, it was noted that the majority of the apple growers apply manure, urea, and zinc only but do not apply other chemical fertilizers which was evidenced by their laboratory analysis. Consequently, it is suggested that recommended rate of phosphorus, potassium and iron fertilizer must be used in fruit-bearing apple orchards in the spirit of 4R nutrient stewardship.

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