Status of Phosphorous in Soil and Plants of Apple Orchads in Quetta Valley

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ABSTRACT

The study was planned to assess the phosphorous status of apple orchards around Quetta valley through soil and plant analysis. Two hundred soil samples were acquired from 40 different locations of 05 orchards at 0-15, 15-30, 30-45, 45-60, 60- 75 and 75-90 cm depths. The soil samples were analyzed for available phosphorous by AB-DTPA method. At the same time forty apple trees were selected for leaves samples and analyzed for plant phosphorous content by Rhoades, 1982 .AB-DTPA phosphorous in soil showed a sizeable variation ranging from 0.24 to 14.46 mg kg^{-1}. Whereby plant analysis registered minimum phosphorous content 0.06% and the maximum phosphorous content 0.47% in apple plant leaves which confirms phosphorous concentration found deficient in apple orchards of Quetta valley.

Introduction

Apple is widely grown fruit around the world. People like apple due to its delightful flavor and richness in potassium, phosphorus, sodium, iron, vitamins content (Boyer, 2004). Pakistan harvests 366000 tons apple fruit from estimated area of 112000 hectares annually and out of this Baluchistan's share in apple production is 251000 tons from an area of 102000 hectares (GoP, 2013). Soil macronutrients had vital role and should be present in soil in adequate quantity for the healthy apple trees. Phosphorus is required for the normal cell division, growth and establishment of sugar-phosphate molecules (Salisbury and Ross, 1992). For high yield and quality phosphorous is supplied through commercial fertilizers. Phosphorous is one of the major plant nutrients. It has been established that phosphorous is an immobile element and usually remain at the place where it is originally present in soil and only small portion of applied phosphorous (10-20%) become available to plants. It is generally believed that the availability of P mostly depends upon soil conditions i.e., soil pH, activity of ions like Ca, Fe, Al and Mn along with clay minerals present in soils.(Nachtigall, and Dechen.2006). For all the orchards, soil sampling and laboratory testing is vital to know the N, P and K status in soil for deciding the use of fertilizers (Stile, 2004)

The apple orchards are mostly found in Quetta, Ziarat, Pishin, Mustung and Kalat districts. These orchards produce quality fruits which are consumed not only in local market but also exported to several foreign countries. The apple growers of Baluchistan earn a major portion of their total earnings through this fruit. Nearly, all the varieties of apple like Red delicious, Golden delicious, Mashadi, Amri etc. are sown in Quetta valley but yield and quality are decreasing year after year, may be due to some nutritional upsets in the soils (Saleem *et.al*., 2018). Hence, analysis of soil and plants from apple orchard was carried out to investigate the status of Phosphorous in apple orchard to address decreasing yield and quality of apple in Quetta valley.

Materials And Methods

Phosphorous status of different apple orchards of Dr. Farm, Deciduous fruit Development Centre (DFDC), Agriculture Research Institute (ARI), Balochistan Agriculture College (BAC) and Haji Sangeen Khan Garden (HSK) from Quetta, Balochistan was assessed by AB-DTPA method (Soltanpour et al 1979). The soil samples were collected from 40 different locations of 05 orchards in Quetta valley. At each location samples were taken from 06 depths i.e. 0-15, 15-30, 30-45, 45-60, 60-75, and 75-90 cm. The samples were air dried in the laboratory ground with wooden mortar and passed through 2mm nylon sieve, finally packed in the polythene bags and labeled for conducting analysis. Separate sampling was done from two varieties of apple, i.e. red delicious (T.K) and golden delicious (S.K). Phosphorous (mg/kg) in soil is determined by AB-DTPA method

Soltanpour, et al 1979. The 18-20 mid shoot leaves were taken randomly from each orchard at both sites, washed with distilled water, initially air dried and then dried in the oven at 72°Cfor 48 hours, the dried samples were ground sieved through 2mm mesh and stored in bottles. To record the nutrients, 0.5mg of plant samples were taken in100ml flask, Ground plant samples were digested in per chloric-nitric acid (2:1 1N) mixture (Rhoades, 1982) . These samples were digested using a hot plate, the samples were filtered in100ml volumetric flask and the volume was made up to the mark with distilled water. Total Phosphorous (%) in plant is determined by AB-DTPA method proposed by (Soltanpour *et.al*., 2001)

Results And Dicussion

The data regarding total Phosphorous content in soil is shown in (table-1and fig 1-2). The lowest and highest values for Phosphorous content were 1.81 to 14.46, 0.31 to 5.92, 0.31 to 7.84, 0.24 to 4.13, 0.31 to 2.82 and 0.24 to 3.44mg/kg at 0-15, 15-30, 30-45, 45-60, 60-75 and 75-90 cm depths respectively. The average value of all the depths was 5.56, 2.49, 2.06, 1.47, 1.23, and 1.53 mg/kg respectively. These data have been grouped into four categories based on the categorization suggested by (Soltanpour, et al 1979). He grouped the soils as low when P was (0-3) mg/kg, medium (4-7) mg/kg, high (8-11) mg/kg and very high >11mg/kg on the basis of AB-DTPA extractable P. The data revealed that in 0-15cm depth 30% samples were low 40% were medium and 20% samples were very high. At 15-30cm depth 60% were low, 40% were medium. At 30-45 cm depth 80% were low, 10% were medium and 10% were high, where as at 45-60cm depth 80% low and 20% were medium at 60-75 cm 100% were low but in 75-90 cm layer 90% were low and 10% were high in AB-DTPA Phosphorous in soil. This means the P content decreased with increase in soil depth as reported (Saleem *et.al*, 2018). The results for chemical analysis of apple leaves for Phosphorous content in red delicious ranged from 0.20 to 0.47, 0.19 to 0.25, 0.15 to 0.24, 0.15 to 0.24 and 0.19 to 0.39 percent at 5 different orchards respectively. Similarly the variety for Golden Delicious it ranged from 0.18 to 0.22, 0.16 to 0.21, 0.15 to 0.36, 0.19 to 0.29 and 0.19 to 0.36 percent from five different orchards respectively. The results were compared with the previous reports by Rueter and Robinson (1986) for the deficiency and adequacy of P in the leaves of apple plants (table-2 and fig-3).It was found that 40% of Red delicious samples were adequate, 45% were high and 15% samples were excessive, similarly 55% samples of Golden delicious plant samples were adequate, 40% were high and 5% were excessive in Phosphorous content. As a whole it was found that 47.5% were adequate, 42.5% were high and 10% leave samples shown in (table-2 and fig-3) were excessive in phosphorous.

Conclusion

Based on the findings it is concluded that soil and leaves of apple orchards of Baluchistan are deficient in available P and Plant P. Further studies are also required to improve nutritional status of apple orchards in the study area and consequently optimizing sustainable orchards productivity along with fruit quality.

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TABLE-1 Status of Phosphorous mg kg^{-1}

Depths in cm	Dr.Farm	DFDC	BAC	HSK	ARI	values
0-15	5.30(TK) 3.9(SK)	1.18 5.53	3.9 1.90	5.25 11.31	2.33 14.46	Min.1.81 Max.14.46
15-30	5.92(TK) 0.31(SK)	3.68 1.88	3.9 4.71	1.36 2.13	0.32 0.77	Min 0.31 Max 5.92
30-45	1.88(TK) 1.97(SK)	1.25 0.65	0.47 0.31	3.67 1.61	1.52 7.34	Min 0.31 Max 7.34
45-60	2.33(TK) 2.33(SK)	0.92 3.44	0.51 0.24	2.53 1.61	1.66 4.13	Min 0.24 Max 4.13
60-75	1.88(TK) 2.82(SK)	0.79 1.16	0.70 0.31	0.70 1.15	1.61 1.16	Min 0.31 Max 2.81
75-90	1.88(TK) 1.97(SK)	1.06 3.44	0.70 0.47	0.24 1.84	1.16 2.53	Min 0.24 Max 3.44

TK = Tor Kulu

SK = Shen Kulu

DFDC = Deciduous Fruit Development Center

BAC = Balochistan Agriculture College

HSK = Haji Sangeen Khan Garden

ARI = Agriculture Research Institute

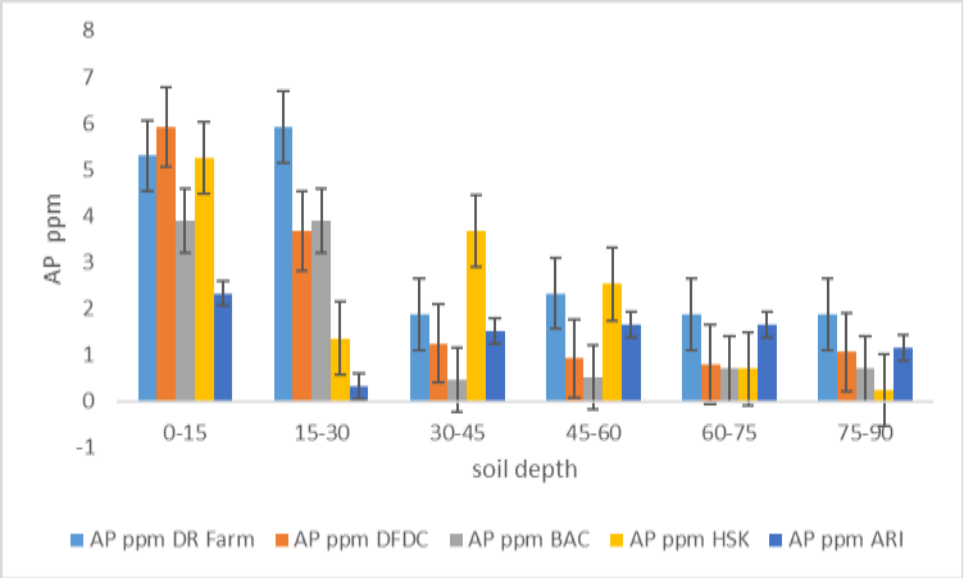

Fig-1: Soil` Phosphorous mg/kg in TK apple orchards of Quetta Valley

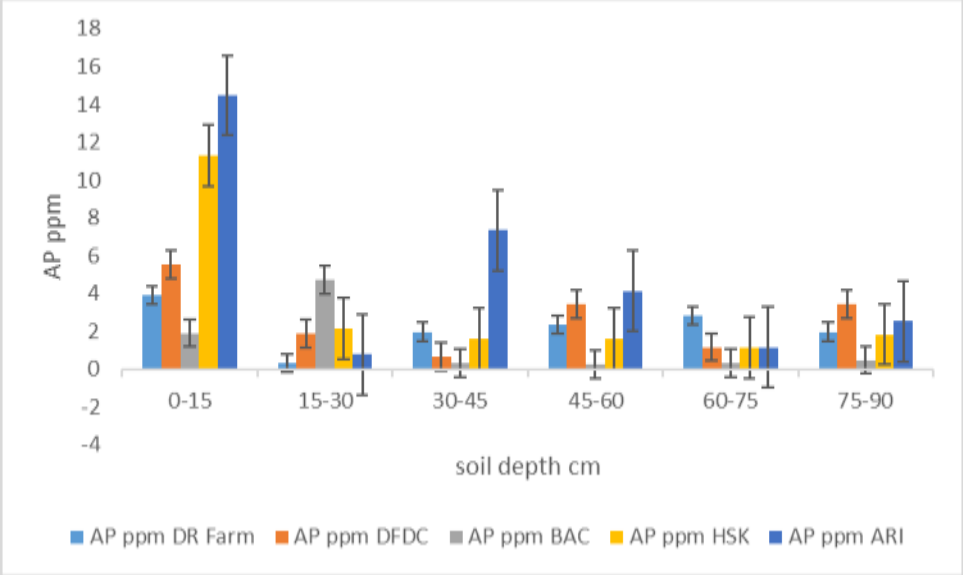

Fig-2: Soil` Phosphorous mg/kg in SK apple orchards of Quetta Valle

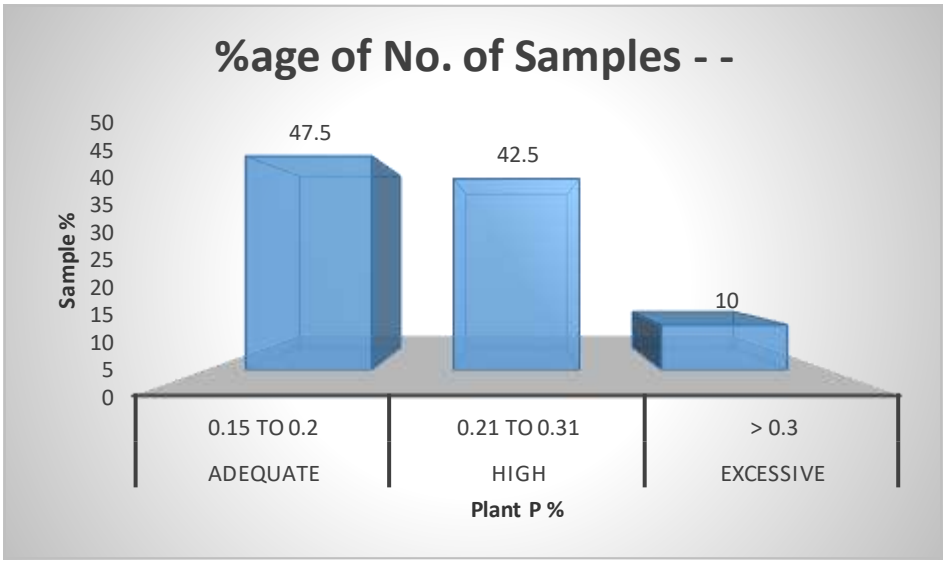

Fig-3:` phosphorous % in apple leaves of Quetta Valley orchards

Table-2: Categorization of apple leaves samples for P content in Quetta Valley

N status	Interpretation of Values range (%)	No. Of Samples	%age of No. of Samples
Deficient	<1.1	-	-
Marginal	0.6 to 0.14	-	-
Adequate	0.15 to 0.2	9.5	47.5
High	0.21 to 0.31	8.5	42.5
Excessive	> 0.3	2	10
Total		20	100

SOURCE: Rueter and Robinson (1986)