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A Comparison of Different Soil Phosphorus Extraction Methods for Used to Determine Plant Available Soil Phosphorus of Erzurum Plain Agricultural Soils

Nesrin YILDIZ
Atatürk University, Faculty of Agriculture,
Dept.Of Soil Science and Plant Nutrition,
Erzurum, Turkey.

Tülay DİZİKISA
Agrı Vocational Training School,
Ibrahim Çeçen University,
Agrı, Turkey.

ABSTRACT
Phosphorus (P) fertilization is commonly based on soil testing, for which a variety of different soil P extraction methods are in use.
The purpose of this investigation, Phosphorus status of Erzurum plain (centre) soils was to determine and also to find out suitability of different extraction methods (distilled water, NaHCO3, and sequential extraction method Step 1. and 6.) in determining of the plant available Phosphorus in Erzurum region soils. Representative 19 soils samples were collected from different soil locations. In order to select the most suitable chemical method as related to Phosphorus content of test plant (potato) was taken as the standart (biological) index.
The results of the statistical analyses indicated that, all chemical extraction methods were not interrelated with biological indexes for the plant available phosphorus investigated in Erzurum plain soils.

Keywords: Availability ,Soil-P tests ,Extraction Methods, Plant uptake ,Correlation, P-Availability indexes

1. INTRODUCTİON
A plant nutrient is a chemical element that is essential for plant growth and reproduction. Essential element is a term often used to identify a plant nutrient. The term nutrient implies essentiality, so it is redundant to call these elements essential nutrients. Seventeen elements are considered to have met the criteria for designation as plant nutrients. Carbon, hydrogen, and oxygen are derived from air or water. The other 14 are obtained from soil or nutrient solutions. For all the nutrients, their roles in agriculture were the subjects of careful investigations long before the elements were accepted as nutrients. One of them is Phosphorus (P). P is a central element to life on Earth. Living organisms are dependent on a persistent supply of P as it is crucially involved in most major metabolic processes, e.g. in energy transfer as adenosine triphosphate (ATP).Soil testing is a common approach to assessments of soil fertility and plant nutrition. With correlation to plant growth, development, and yield, soil testing indicates the capacity of soils to supplyplant nutrients and suggests appropriate corrective measures. Plant analysis, used in conjunction with plant symptoms and soil testing, is another common tool for assessment of the nutritional status of plants. As noted in a previous section, crop response to phosphorus is correlated poorly to the total amount of phosphorus in a soil. Therefore, a successful soil test should represent some index of phosphorus availability. The development of a soil test requires selection of an extractant, development of studies that correlate the amount of nutrient extracted with phosphorus accumulation by crops, and calibration studies that determine a relationship between soil test results and amount of fertilizer required for optimal production (Barker and Pilbeam,2007).
Phosphorus (P): Mineral soils low in organic matter content, long history of cropping without adequate P fertilization reducing the supply of P, P-rich soils lost by erosion, calcareous soils where P availability is reduced by alkaline pH, the rate at which this process occurs depends on a number of soil factors: pH, soil moisture content, physiochemical characteristics of the colloidal substances, solubility characteristics of the solid-phase components, temperature biological activity (Jones,2012).
The development of a soil test requires selection of an extractant, development of studies that correlate the amount of nutrient extracted with phosphorus accumulation by crops, and calibration studies that determine a relationship between soil test results and amount of fertilizer required for optimal production. Generally, water or dilute salt solutions characterize phosphorus in the soil solution or the intensity factor, whereas acids, complexing solutions, or alkaline buffer solutions generally characterize the quantity factor. Tests based on water extraction often correlate well with phosphorus accumulation in shallowrooted, fast-growing vegetable crops. However, soil tests capable of better characterizing the labile fraction and capacity factor generally produce more reliable results for field and orchard crops. As noted in the previous section, the amounts of phosphorus applied to crops should be based ideally on a well-calibrated soil test. However, even at a given soil-test phosphorus level, the amount of phosphorus fertilizer required for economic-optimum yield often will vary with crop. Generally, fast-growing, short-season vegetable crops have higher

phosphorus requirements than field and orchard crops. Many deciduous fruit crops infrequently respond to phosphorus fertilization even if soil tests are low . It is presumed often that surface soil tests fail to characterize the full soil volume where trees take up nutrients or the fact that trees take up nutrients over a considerable time period (Barker and Pilbeam ,2007).

A chemical method for estimating the nutrient suppling capacity of a soil ; measures a portion of a nutrient from a 'pool' that is used by plants; an index of nutrient availability ; does not measure the total amount of nutrient in the soil ; needs to be calibrated in field /greenhouse rate studiesto then use in nutrient (fertilizer) recommendations. Can determine soil nutrient status before a crop (field, vegetable, ornamental) is planted (Carrie, 2008; Heckendron, 2007)

Research on the selection of chemical extraction method has been done for different climate and will be continued fort he future of all different soil and plant nutrient in Erzurum region (Yildiz and et al.1999; Yildiz and et al.2003; Yildiz and Güler 2010a; Yildiz and Güler.2010b; Yildiz and at al. 2010; Dizikisa and Yildiz 2016a; Dizikisa and Yildiz 2016a).

2. MATERİAL AND METHOD

Soils from 19 representative were sampled from potato grown fields in early April. 2010 with the aim of defining the nutrient potential in potato plants cultivated in central Erzurum. Soil samples from 0-40 cm depth in selected particular stations were taken and sieved with a 2mm mesh screen to analyse the different chemical properties and soil nutrient status. Leaf tissue was oven dried at 68 °C for 48 hours and ground to pass through a 1 mm mesh screen. The potato plant leaf sampled in start flowering from the 4th leaf plant leaf sample was taken June 2010 (Yildiz and Dizikisa, 2016).

3. RESULTS AND DISCUSSION

Plant phosphorus content of potato leaf were determined (Table1) (Yildiz and Dizikisa,2016).

Table.1 The results of Biological indexes and The concentrations of P Obtained distilled water, $NaHCO_3$, and sequential extraction methods (Step 1. and 6.)

Determining of available P contents of Erzurum plain soils 3 different chemical methods were used results shown in table1.

The results of this study showed taht plant available P obtained with distilled water, sodyumbikarbonat, and sequentaly extraction 1 and 6.step methods were interrelated with each other. But, the results of this study showed that plant available phosphorus obtained with distilled water, $NaHCO_3$, and sequential extraction step 1. and 6. methods (Table 1) were not interelated with phosphorus content of potato leaf (biological index) in Erzurum Plain soils (Table 2).

Results also showed that the 3 different chemical exraction methods might not be used for plant available P at least in this conditions growing potato in this location.

Before decising that the methods are completely unsuitable in evaluating plant available P under diffirent plants , climate and soil conditions the methods have been tried extensively in other experimental conditions, greenhouse and field etc.

Although application of fertilizer in irrigation water (fertigation) is a common practice with mobile nutrients such as nitrogen, it is less common with phosphorus because of concerns about efficiency of utilization. Owing to the soil reactions discussed in a previous section, it is often presumed that much of the phosphorus applied with water will be tied up at its point of contact with the soil.

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Table.1 The results of Biological indexes and The concentrations of P Obtained distilled water, NaHCO3, and sequential extraction methods (Step 1. and 6.)

P (ppm)					Plant P content (%)
Sequential extraction method			Water soluble P	Olsen ($NaHCO_3$)	
Samp. No	Step.1	Step.6			
1	<0.00	12851	10,91	27	0,15
2	<0.00	3129	4,98	14	0,15
3	<0.00	9160	4,40	15	0,14
4	2,53	9315	18,04	45	0,18
5	<0.00	6234	4,73	21	0,22
6	0,78	7262	5,68	16	0,18
7	1,88	12394	9,41	33	0,21
8	23,22	27319	31,60	65	0,23
9	6,46	12375	21,92	45	0,20
10	0,11	5144	12,88	35	0,21
11	1,04	16121	10,10	31	0,22
12	0,13	5136	1,21	06	0,25
13	2,73	18165	3,28	19	0,19
14	2,25	2879	5,40	21	0,19
15	<0.00	4497	3,42	09	0,17
16	<0.00	4207	3,80	20	0,16
17	0,07	3353	8,87	18	0,16
18	0,04	14393	6,76	24	0,14
19	1,08	4694	6,63	31	0,17

Table.2 The linear correlation cofficients between chemical extractable P concentrations (ppm) with plant P % (Biological index) for Erzurum Plain Soils

	S.E (step 1)	S.E(step 6)	Water	$NaHCO_3$	Plant P.cont (%)
S.E (step 1)	1				
S.E (step 6)	0,729**	1			
Water	0,825**	0,633**	1		
$NaHCO_3$	0,770**	0,651**	0,944**	1	
Plant P.cont (%)	0,395	0,270	0,290	0,307	1

****; Significant at the 0,01 probability**

Water soluble; distilled water; 5 g soil/ 50 ml dist. water (Forse,1942)

Plant leaf P content (%); P content of Potato leaf Biological index (Yildiz and Dizikisa, 2016)

$NaHCO_3$; 0,5 M $NaHCO_3$, pH;8,5 (Olsen, 1954)

S.E; Sequential Extraction (step1 and 6) Procedure; Water soluble P, step1; 0,5 g soil/10 ml distile water step 6; For silica bound P, residual soil / HNO_3+H_2O_2+ HF (3;5;2 ml) high -pressure bomb digestion at 190 ^{0}C (Tessiar 1979 ; Cheng et al 2005)).

