Determination of Phosphorus and Potassium Status of Erzurum Plain Soils with Neubauer Seedling Technique

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ABSTRACT

The purpose of this investigation was to determine phosphorus and potassium status of Erzurum plain soils .Representative 22 soils samples were collected from Erzurum plain. A greenhouse experiment was conducted using randomized block design each treatment replicated three times Rye (S.cerale tetraploid) was used as the test plant according to Neubauer seedling method

Rye plants have been grown for 17 day duration. In a short time P and K in soil has been exploited by multiple branched roots, obtained from plants grown on 100 g soil. The plants harvested after 17 days growing period. P and K concentration in plants were determined quantitatively by using chemical analysis methods.

As a result, soils, except 2 ,6 and 15 numbered samples were found adequate for P_2O_5 and except 6 and 10 numbered soils, all samples were found adequate in terms of K_2O for Erzurum plain soils

Key Words: Soil, available, phosphorus, potassium, Neubauer method, rye.

INTRODUCTION

The determination of plant available nutrient fraction can be carried out by various techniques . This differ basically in principle and three different approaches are provided by the methods of soil analysis , plant analysis , and plant experiments such as pot and field trials.

An important aspect which must be considered in relation to nutrient availability is the difference in nutrient requirement between crops . High yielding crops and intensive cropping systems place a greater demand on available nutrients in the soil and particularly on phosphate (P) and potassium (K) (Mengel and Kirkby ,2001).

The Primary meusurements to obtain availability ratios or availability indexes must be made using plants because the concept of availability is defined in terms of plants. Several different biological methods are used to provide primary indexes. Biological methods are three classes: internal standart, direct and slope ratio.

Internal standart methods , the nutrient availability index is derived from the comparative responses produced by the supply of the nutrient in the soil and by knovn additions of the nutrient in the form of fertilizer (Mitscherlich b value, Dean a value, Isotope dilution etc.).

In direct methods , no fertilizer is added, and the availability index is inferred directly from the magnitude of some plant response measurement (Neubauer method etc.).

Slope ratio methods are an adaptation of direct methods .

The purpose of this investigation was to determine phosphorus and potassium status of Erzurum plain soils used in The Neubauer Method. The Neubauer Method , proposed by Neubauer and Schneider (1923), and its numerous modifications probably have been used more than any other method. In the original method: 100 grams soil are mixed with 50 grams of sand the mixture is covered with 250 grams sand , and 100 rye seeds are planted in the surface layer of sand. The rye seedlings are harvested on the 17 th day after planting. The tops and roots are analyzed together to determinete the quantities of phosphorus and potassiumthey contain. The quantities contained in the plants grown in parallel cultures without soil are subtracted to obtain the quantities The resulting figures are taken as indexes of the availabilities of P and K in the soil. In this method , nutrients other than P and K are not added Because of the short period of growth , the seeds supply most of the nutrients needed. The affect of factors other than supply of P and K in the soil is limited by dilution of the soil with sand and by the short period of growth. The plants on different soils produce about the same yield of dry matter . Atechnical difficulty en countered with same soils is that the roots cannet readily be separeted from the soil for analysis (Black ,1992).

To determine P and K situation of soils found in different agro-climatic areas a lot of studies has been carried out and these studies has been continuing as well (Aksoy.1967 ; Kacar, 1964 ; Kacar, et al. 1973; Kacar, et al. 1974 ; Özdemir 1986 ; Zabunoğlu, 1967; Yildiz et al 2003).

MATERIAL and METHODS

Representative 22 surface soil samples were collected from Erzurum plain. A greenhouse experiment was conducted using randomized block design each treatment replicated three times Rye (S.cerale tetraploid) was used as the test plant according to Neubauer seedling method

Rye plants have been grown for 17 day duration. In a short time P and K in soil has been exploited by multiple branched roots, obtained from plants grown on 100 g soil. The plants harvested after 17 days growing period

P and K concentration in plants were determined quantitatively by using chemical analysis methods (Kacar, 1972).

RESULTS and DISCUSSION

For his study , freshly collected soil samples were air- dried , sieved to pass 2 mm mesh immediately after they were borught to the laboratory and the soil of the sampling site were **Loam, Clay Loam, and Sand texture** (Baykan et al. 1965) with the following properties: **pH 6.86-8.26** (1;2.5 soil-water , Peech, 1965) , **organic matter 0.46% - 4.49%** (Hocaoğlu, 1966) **, CEC 20.42-55.55 cmol.kg^{-1}** (Knudsen vd 1982)**, $CaCO_3$ content 0.46%-13.6%** (Hızalan ve Ünal. 1966) **, Available P 17.01-73.05**

ppm (Olsen ve Sommers, 1982)**, Exchangable K 0.84- 3.76 cmol.kg^{-1}** (Knudsen et al. 1982) respectively

(Table.1).

Table 1. Characteristics of selected experiment soils

Soil No	**pH**	**$CaCO_3$ (%)**	**OM (%)**	**CEC cmol kg^{-1}**	**Exc.K cmol kg^{-1}**	**P mg kg^{-1}**	**Clay %**	**Silt %**	**Sand %**	**Texture clases**
1	**6.86**	1.29	2.57	49.6	2.45	17.01	19.31	**27.54**	52.55	L
2	6.93	**1.01**	**4.49**	52.1	2.25	**13.95**	19.96	27.60	52.44	L
3	7.82	4.33	**0.46**	**55.55**	2.71	18.36	23.98	31.15	44.89	C
4	7.44	5.31	3.79	47.58	2.33	21.92	13.50	33.75	52.75	SL
5	**8.82**	7.16	3.55	49.19	3.69	22.47	19.92	38.14	37.71	C
6	8.26	8.23	2.04	45.8	1.36	19.87	15.60	35.83	48.57	L
7	8.10	6.74	1.98	48.27	1.99	17.62	13.50	46.41	40.09	L
8	7.92	4.36	2.79	51.34	1.71	17.50	13.50	39.97	46.53	L
9	7.92	3.16	0.79	38.84	1.53	16.86	13.52	42.28	42.40	L
10	7.89	2.96	1.56	36.01	**0.84**	23.25	9.65	**51.87**	38.48	SL
11	7.39	1.07	1.2	29.98	2.72	46.91	17.32	37.11	45.57	L
12	7.44	1.36	2.63	29.75	**3.76**	**73.05**	21.69	33.06	45.25	L
13	7.88	4.92	3.43	44.57	1.2	23.72	**30.29**	33.20	**36.51**	CL
14	8.02	5.51	2.53	32.64	1.11	18.11	17.41	35.25	47.36	L
15	7.96	7.94	2.39	44.19	2.15	27.59	23.74	33.31	42.95	L
16	7.85	10.16	3.6	49.93	3.72	26.74	19.67	36.66	43.67	L
17	8.10	**13.97**	2.24	40.74	1.68	24.19	17.61	29.34	33.05	SL
18	8.34	5.57	3.31	37.92	3.01	32.68	15.33	47.66	37.01	L
19	7.31	1.04	1.63	22.85	1.26	26.38	**4.91**	30.67	**64.42**	SL
20	7.33	2.59	1.74	**20.42**	1.65	16.19	4.92	34.84	60.24	SL
21	7.67	2.88	1.21	30.83	1.54	21.04	13.22	33.66	53.72	SL
22	7.66	3.1	1.55	35.77	1.89	20.09	9.11	43.48	47.41	L

22 surface soils representing in Erzurum soils were chosen for the glasshouse experiments. The calculation of P and K values of soils according to Neubauer assay showed in Table. 2 and 3 (Özbek, 1969 and Aydemir,1992):

Each mg nutrients in per 100 g at equal 6 kg per hectar when we consider 1 hektar soil is 3 billion kg , this value is equal 30 kg. But plants in nature takes 1/5 of P and K in soils , thus this value can be accepted as 6 kg.

Table.2. Dry weight and P_2O_5 values of rye plants grown according to Neubauer method (For Kontrol pot= pure sand, P_2O_5 =19.3 mg / 100 gr in 100 rye grain)

Soil Samp No	Dry weight g pot^{-1}	P (%)	P uptake mg pot^{-1}	P_2O_5 (mg)	Control plant (pure sand) mg P_2O_5. 100 g^{-1}	P_2O_5 kg ha^{-1}	Deficient P_2O_5 Kg ha^{-1}
1	3.22	0.38	12.24	28.03	8.68	52.08	2.08
2	2.64	0.41	10.82	24.78	5.43	32.58	**-17.42**
3	4.48	0.38	17.02	38.98	19.63	117.78	67.78
4	2.62	0.48	12.58	28.81	9.46	56.76	6.76
5	2.88	0.47	13.54	31.01	11.66	69.96	19.96
6	2.12	0.43	9.116	20.88	1.53	9.18	**-40.82**
7	4.10	0.42	17.22	39.43	20.08	120.48	70.48
8	3.86	0.41	15.83	36.25	16.9	101.4	51.4
9	3.04	0.44	13.38	30.64	11.29	67.74	17.74
10	2.60	0.47	12.22	27.98	8.63	51.78	1.78
11	3.44	0.46	15.82	36.23	16.88	101.28	51.28
12	2.56	0.51	13.06	29.91	10.56	63.36	13.36
13	4.16	0.37	15.39	35.24	15.89	95.34	45.34
14	3.28	0.42	13.78	31.56	12.21	73.26	23.26
15	2.52	0.45	11.34	25.97	6.62	39.72	**-10.28**
16	3.54	0.42	14.87	34.05	14.7	88.2	38.2
17	3.38	0.4	13.52	30.96	11.61	69.66	19.66
18	3.24	0.49	15.88	36.37	17.02	102.12	52.12
19	3.4	0.41	13.94	31.92	12.57	75.42	25.42
20	4.66	0.4	18.64	42.69	23.34	140.04	90.04
21	3.02	0.45	13.59	31.12	11.77	70.62	20.62
22	3.54	0.47	16.64	38.11	18.76	112.56	62.56

Rye plants with high yield takes up 50 kg and 100 kg available P_2O_5 and K_2O respectively (Özbek,1969) . For better rye yield at least 8.33 mg P_2O_5 and 16.6 mg K_2O should be found in 100 g soil for each element.

For Erzurum Plain soils:

When consider at least 8.33 mg P_2O_5 / 100 g soil and 16.6 mg K_2O / 100 g soil should be found in soil , the sample except Number 2, 6, and 15, all samples P_2O_5 is relevant and for K_2O all samples except Number.6 and 10 were found sufficient.

For Application P_2O_5 (kg ha^{-1}) :

For Nr. 2, 6 ve 15 soil samples :

17.4 P_2O_5 kg ha^{-1} x 100/20= 87kg ha^{-1}

40.8 P_2O_5 kg ha^{-1} x100/20= 200 kg ha^{-1}

10.2 P_2O_5 kg ha^{-1} x100/20= 51 P_2O_5 kg ha^{-1} needed.

According to Neubauer Method , the plant can take up only 1/5 of total soil Phosphorus in natural conditions.

Table.3. Dry weight and P_2O_5 values of rye plants grown according to Neubauer method (For Kontrol pot= pure sand, K_2O mg=14,37 / 100 gr in 100 rye grain)

Soil sample No	**Dry weight g pot^{-1}**	**K (%)**	**K Uptake mg pot^{-1}**	**K_2O (mg)**	**Control plant (pure sand) mg K_2O 100 gr^{-1}**	**K_2O Kg ha^{-1}**	**Deficient K_2O Kg ha^{-1}**
1	3.22	1.13	36.39	44.03	29.66	177.96	77.96
2	2.64	1.18	31.15	37.69	23.32	139.92	39.92
3	4.48	1.48	66.3	80.23	65.86	395.16	295.16
4	2.62	1.50	39.3	47.55	33.18	199.08	99.08
5	2.88	1.25	36	43.56	29.19	175.14	75.14
6	2.12	0.78	16.54	20.01	5.64	33.84	**-66.16**
7	4.1	0.90	36.9	44.65	30.28	181.68	81.68
8	3.86	0.88	33.97	41.1	26.73	160.38	60.38
9	3.04	1.00	30.4	36.78	22.41	134.46	34.46
10	2.6	0.93	24.18	29.26	14.89	89.34	**-10.66**
11	3.44	1.15	39.56	47.87	33.5	201	101
12	2.56	1.38	35.33	42.75	28.38	170.28	70.28
13	4.16	0.70	29.12	35.24	20.87	125.22	25.22
14	3.28	0.95	31.16	37.7	23.33	139.98	39.98
15	2.52	1.20	30.24	36.59	22.22	133.32	33.32
16	3.54	1.35	47.79	57.83	43.46	260.76	160.76
17	3.38	1.40	47.32	57.26	42.89	257.34	157.34
18	3.24	1.25	40.5	49.01	34.64	207.84	107.84
19	3.4	0.93	31.62	38.26	23.89	143.34	43.34
20	4.66	0.85	39.61	47.93	33.56	201.36	101.36
21	3.02	1.30	39.26	47.5	33.13	198.78	98.78
22	3.54	1.53	54.16	65.54	51.17	307.02	207.02

For Application K_2O (kg ha^{-1}):

For Nr. 6 ve 10 soil samples.:

66.1 K_2O kg ha^{-1}x 100/60= 110 K_2O kg ha^{-1}

10.6 K_2O kg ha^{-1}x 100/60= 17.6 K_2O kg ha^{-1} needed.

(According to Neubauer Method ,the plant can take up only 1/3 of total soil Potassium in natural conditions (Aydemir,1992).

With this study , adequate fertilizer dose was defined by considering soil and plant analyses and the importance of Economical and Ekological were emphasized

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