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ISOTOPIC EXCHANGE STUDIES OF ZINC IN ALKALINE SOILS OF THRACE REGION

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ABSTRACT

The labile pool of zinc in representative soils of Thrace region was determined by the application of isotopic dilution principle under laboratory condition. The effect of pH of the extraction mixture on the labile pool was also included in this study and the following results were found:

1. The percent radioactivity of ^{65}Zn in the equilibrium solution generally increased by the effect of pH of the solution. The difference at pH 5 and 7 in most of the soils was significant, while the difference at pH 7 and 8 with one exception was remarkably similar in all soils.

2. Zinc labile pool values of the soils were not affected mostly by the pH of the extraction solution. However the differences at pH 5 and 7 and also at pH 7 and 8 were remarkably similar in most of the soils.

3. These findings were in agreement with the results of some investigators.

ÖZET

Trakya bölgesinden alınan temsili toprak örneklerine laboratuvar koşullarında isotopik seyreltme prensibi uygulanarak bu toprakların çinko bakımından labile pool (LP) değerleri ve ekstraksiyon çözeltisinin pH'sının LP üzerine olan etkisi araştırılmıştır. Elde edilen sonuçlar şöyledir:

1. Ekstraksiyon çözeltisinin pH'sının arttırılması çözeltideki yüzde ^{65}Zn radyoaktivitesinin de genellikle artmasına neden olmuştur. Bu fark pH 5 ile 7 arasında toprakların çoğu için önemli bulunmuş, pH 7 ile 8 arasındaki fark ise bir toprak dışında, diğer bütün topraklarda birbirine çok büyük yakınlık göstermiştir.

2. Ekstraksiyon çözeltisinin pH'sı toprakların LP değerlerini çoğunlukla etkilememiş ve gerek pH 5 ve 7, gerekse pH 7 ve 8 arasında toprakların çoğu için birbirine çok yakın LP değerleri bulunmuştur.

3. Araştırma sonuçlarıyla bazı araştırıcıların aynı konu ile ilgili olarak elde ettikleri sonuçlar arasında iyi bir uyum saptanmıştır.

INTRODUCTION

Soil labile pool of micronutrients including zinc is the amount of an element in the soil solution and solid phase as measured either by chemical equilibrium or plant uptake, utilizing isotopic exchange /1/.

The use of complexing agents as extractants for the determination of available Zn in soils has been advocated by several investigators, since they believed that the isotopic dilution of radioactive Zn in complexing agents or in growing plants can provide a reliable reference method for the measurement of total labile pool of Zn in alkaline soils.

Many investigators have also studied the effect of pH of the extraction solution on labile pool of Zn, but there were some disagreements of their findings related with this subject. However some of them found that labile pool values of Zn were not affected by pH of the extraction solution, while some others concluded that the labile pool of Zn changed depending to the pH of the extraction solution and especially the difference was remarkably significant at pH 5 and 7.

Lopez and Graham /2/ measured the labile pool of Mn, Fe, Cu and Zn utilizing isotopic exchange technique and they concluded that Zn labile pool values were about the same of the various pH's of the extraction solution, while Mn, Fe and Cu were pH dependent.

Sinha et al /3/ indicated that the difference in the values of labile pools of Zn at 5 and 7 was remarkably significant, while this difference at pH 7 and 8 was not so significant.

Rule and Graham /4/ reported that Zn labile pools were remarkably similar for all of the air-dried samples and were not affected by pH and for most of the field-moist samples also no effect of pH was evident.

The primary objectives of this investigation were to determine labile pool of zinc in alkaline soils by

isotopic exchange in 0.005 M DTPA buffered to different pH values, and to find out the effect of pH of the extracting mixture on the labile pool of zinc.

MATERIALS AND METHODS

Ten representative soil samples were collected from Thrace region and 0-20 cm depth. First they were air dried grounded and sieved. Some important physical and chemistry properties of the soils were determined with the methods outlined by Jackson /5/. The results of these analysis were given in Table-1.

Determination of labile pool

Extraction solutions containing 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M Naacetate were prepared and these solutions were buffered to pH 5, 7 and 8. The extractants contained 0.01 µCi ^{65}Zn per ml. Isotopic exchange was carried out in triplicate 10 g. of soil with 20 ml of extractant. The soil suspension was shaken on an end-over end shaker for 48 hours at room temperature. After equilibration the samples were centrifuged and the supernatant filtered. From each sample 5 ml aliquot was counted using well type scintillation head on a gamma-ray spectrometer. The calculation of the labile pool was based upon the isotopic dilution of the radioactive tracer with the stable isotope of the solid and solution phases /6,7/.

The amounts of stable Zn in the soil extracts were determined by atomic absorption spectrophotometer. Labile pool (LP) of Zn was calculated from the values of Zn concentration and isotopic measurements as follows:

$$LP_{Zn} = \frac{\text{Concentration of Zn in soil solution (ppm)}}{\text{Radioactivity of } ^{65}Zn \text{ in soil solution (\%)}}$$

TABLE-1. Some physical and chemical properties of the soils.

Soil no	Textural class	pH 1 : 2 Soil-water ratio	$CaCO_3$ %	Organic matter %	C.E.C me/100 g.	DTPA extractable*			
						Zn	Cu (ppm)	Fe	Mn
2	CL	8.55	1.76	2.55	59.43	1.93	1.21	2.71	7.89
3	CL	8.55	5.94	2.14	63.51	0.60	1.08	2.89	7.94
4	CL	8.50	3.49	2.41	73.04	0.81	1.29	2.59	5.27
9	CL	8.30	0.91	2.28	43.10	0.30	0.87	1.71	3.31
12	L	8.30	1.37	1.61	28.14	0.34	1.24	3.11	8.41
13	SL	5.90	0.66	1.34	8.57	0.51	0.87	10.45	37.10
16	CL	7.50	0.76	2.28	37.65	0.40	0.81	2.29	11.00
17	C	8.10	1.04	2.14	43.10	0.73	1.15	1.75	6.82
18	CL	8.65	4.05	1.88	37.65	0.44	0.79	1.42	2.05
20	C	8.60	2.15	2.88	49.90	0.33	0.90	2.12	3.67

* All micronutrients tested were found in critical level /8/.

RESULTS AND DISCUSSION

The results obtained related with the percent radioactivity of ^{65}Zn in solution and the values of labile pool of Zn in soils determined in DTPA-$CaCl_2$-Na Ac mixture buffered to different pH values were given in Table-2.

According to the data in Table-2, the percent radioactivity of ^{65}Zn in the solution generally increased by the effect of pH of the equilibrium solution. The difference at pH 5 and 7 with few exceptions (soil 12, 18 and 20) was significant, while this difference at pH 7 and 8 with one exception (soil 12) was remarkably similar in all soils.

On the other hand the data in Table-2, shows clearly that the calculated Zn labile pool affected mostly by the pH of the extraction solution. However the differences at pH 5 and 7 and also pH 7 and 8 were found remarkably similar with few exceptions (soil 2, 17 and 12, 17) respectively.

These results were in conformity with the findings of some investigators who reported that the increasing pH of the solution resulted in increased percent of the radioactivity of ^{65}Zn in most of the soils and Zn labile pool values of the soils were mostly not affected by the pH of the extraction solution and were found remarkably similar /2,6/.

TABLE-2. Labile pool of Zn from DTPA extraction of the soil samples

Sample no	pH of equilibration suspension			Radioactivity of zinc in solution %			Labile pool (LP) of zinc (ppm)		
	5	7	8	5	7	8	5	7	8
2	6.8	8.3	8.6	93.4 a*	99.6 b	99.6 b	3.0 a	2.8 b	2.8 b
3	6.9	8.4	8.5	91.0 a	97.2 b	96.7 b	1.0 a	1.0 a	1.0 a
4	6.8	8.5	8.5	93.4 a	97.3 b	98.2 b	1.7 a	1.7 a	1.6 a
9	6.7	7.9	8.3	77.6 a	96.3 b	96.7 b	1.0 a	0.9 a	0.9 a
12	6.4	7.9	8.1	96.6 a	96.2 a	93.9 b	0.9 a	0.8 a	0.6 b
13	5.5	6.8	7.9	94.9 a	99.9 b	99.6 b	1.1 a	1.1 a	1.1 a
16	6.1	7.1	8.0	78.0 a	98.5 b	99.0 b	1.1 a	1.0 a	1.0 a
17	6.5	7.9	8.1	78.0 a	98.6 b	97.7 b	1.8 a	1.3 b	1.1 c
18	6.6	8.4	8.5	97.9 a	96.9 ab	95.1 b	1.0 a	0.9 ab	0.8 b
20	6.9	8.3	8.7	95.1 a	95.3 a	96.1 a	0.9 a	0.0 a	0.8 a

* Treatment means in each column not followed by the same letter significantly different at the 0,05 level according to Duncan's new multiple range test.

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