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Suitability of Sequential & DTPA-TEA Extraction Methods In Determining of The Available Micro Nutrient and Some Heavy Metal Contentof Erzurum Plain Agricultural Soils

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ABSTRACT
The purpose of this investigation, micronutrients and some heavy metals status of Erzurum plain (centre) soils was to determine and also to find out suitability of different extraction methods (DTPA-TEA and sequential extraction method) in determining of the plant available micronutrient and some heavy metal 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, sequential extraction methods and DTPA-TEA method were not interrelated with biological indexes for the plant available micro nutrients and some heavy metals except sequential method step.6 residual Mn investigated in Erzurum plain soils.

Keywords:
Availability,Soil-available micronutrients tests , heavy metals SequentialyExtraction Methods,Correlation, Biological indexes

1. INTRODUCTION
For mineral elements that are constituents of organic compounds which act in plants as enzymes, co-enzymes, membrane constituents etc. at least some of their function has been well defined (Barker and Pilbeam,2007) .
Micronutrients are the essential elements required by plants in relatively low concentrations. Micronutrients form a coherent group, including eight core elements: iron (Fe), sodium (Na),chlorine (Cl), boron (B), manganese (Mn), zinc (Zn), copper (Cu),and molybdenum (Mo).Plants need micronutrients in low enough concentrations that the relative likelihood of deficiency is far less than for the macronutrients.Iron is found in the soil as various oxides and also in association with various organic molecules. Even in the field, micronutrient deficiency may be unlikely or known only in a few instances. However, for some micronutrients in certain parts of the world, the repetitive long-term crop harvest from a plot of land has stripped away these nutrients, resulting in soil conditions likely to cause deficiency. Symptoms associated with deficiency were gleaned from controlled laboratory studies in which micronutrient deficiencies were maintained by careful purification of all media involved in growing the plants.For certain plant species, a given site may have insufficient quantities of a micronutrient and thus it shows a deficiency. If the same location were planted with a different crop with distinct nutritional demands, however, the amount and availability of the micronutrient could be sufficient for the new species. This differential need for mineral nutrients is a hallmark of plant nutrition research. Further, all micronutrients enter the soil solution by the weathering of parent soil materials. The rates of weathering and the availability of micronutrients are often a function of the pH (acidity or alkalinity) of the soil, and so soil chemistry and chemical changes caused by roots affect the overall availability of a micronutrient (Wiedenhoeft, 2006)
Heavy metals are natural elements that are found at various high background levels.at different places throughout the world, due to various concentrations in the bedrock. Thus, for example, Ni, Cr and Co are abundant in serpentine soils, whereas Zn, Pb and Cd are high in calamine soils. Heavy metals are persistent and cannot be deleted from the environment. Thus, a problem arises when their availability is high due to high background levels or to human activity. (Temmerman et al. 1984) Metals have to be in an available form for plants to take up or plants must have mechanisms to make the metals available. Soil and sediment colloids roughly consist of inorganic clay minerals and organic substances. Due to the hydroxyl groups and electron pairs of oxygen in the structure of clay minerals, and to the carboxyl and phenolic groups of organic substances, the soil and sediment colloids are negatively charged (Mengel and Kirkby 1982;Greger.2004).
Soil test is a chemical or physical measurement of soil its properties based on the sample of soil (Melsted and Peck.1973). Commonly, however, the soil test is considered as a rapid chemical analysis or quick test to assess the readily extractable chemical elements of a soil. Interpretations of soil tests provide assessments of the amount of available nutrients, which plants may absorb from the soil. Recommendations for fertilization may be based on the results of soil tests. Chemical soil tests may also measure salinity, pH, and presence of elements that may have inhibitory effects on plant growth. A basic principle of soil testing is that an area can be sampled so that chemical analysis of the samples will assess the nutrient status of the entire sampled area(Peck and Melsted.1973)
Results of soil tests must be calibrated with crop responses in the soil. Crop responses, such as growth and yields, are obtained through experimentation. In the calibrations, the results of soil tests are treatedas independent variables

affecting crop growth and yields; otherwise, all other variables such as weather, season, diseases, soil types, weeds, and other environmental factors must be known and interpreted. The consideration of results of soil test as independent variables may impart difficulties in interpreting the results, especially if the environmental factors have marked effects on crop yields.Results of soil analysis, sometimes called total analysis, in which soil mineral and organic matter are destroyed with strong mineral acids, heat, or other agents do not correlate well with crop responses (Morgan,1941). Generally, soil tests involve determination of a form of a plant nutrient with which a variation in amount is correlated with crop growth and yield. These forms of nutrients are commonly called available plant nutrients. The different forms of nutrients are extracted from the soil with some solvent. Many different methods of extraction of soil samples are being used for measurement of available nutrients in soils. Extractants are various combinations of water, acids, bases, salts, and chelating agents at different strengths. The extractants are designed to extract specific nutrients or are universal extractants (Morgan 1941;Watanabe and Olsen.1962).

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. The development of a soil test requires selection of an extractant, development of studies that correlate the amount of nutrient extracted with element accumulation by crops, and calibration studies that determine a relationship between soil test results and amount of fertilizer required foroptimal production (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; Yıldız and et.al 2008); Yildiz and Güler 2010a; Yildiz and Güler.2010b; Yildiz and at al. 2010; Dizikisa and Yildiz 2016a; Dizikisa and Yildiz 2016b; Yıldız and Dizikısa.2017).

2. MATERIAL 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, 2016b).

Sequential Extraction Procedure for the Speciation ofParticulate Trace Metals (Tessier et all.1979 ; Cheng, 2005)In defining the desired partitioning of trace metals, care was taken to choose fractions likely to be affected by various environmental conditions; the following six fractions were selected.

Fraction 1. Water soluble forms . 05 g soil and 10ml pure water, vortex 3 hour. And filtrated. After centrifuged.

Fraction 2. Exchangeable. Numerous studies (Possek et all 1968; Weijden et all 1977) performed on sediments or on their major constituents (clays, hydrated oxides of iron and manganese, humic acids)

Fraction 3. Bound to Carbonates. Several workers (Gupta and Chen 1974; Stover et all 1976 ;Chester.et all 1967; Perkc.1974) have shown that significant trace metal concentrations can be associated with sediment carbonates; this fraction would be susceptible to changes of pH.

Fraction 4. Bound to Iron and Manganese Oxides (Metal oxides). It is well established (Jenne,1968) that iron and manganese oxides exist as nodules, concretions, cement between particles, or simply as a coating on particles

Fraction 5. Bound to Organic Matter. living organisms, detritus, coatings on mineral particles, etc. The complexation and peptization properties of natural organic matter (notably humic and fulvic acids) are well recognized.

Fraction 6. Residual. These metals are not expectedto be released in solution over a reasonable time span underthe conditions normally encountered in nature.

3. RESULTS AND DISCUSSION

Determining of available micro nutrients (Fe,Cu,Zn and Mn) and some heavy metals (Pb,Cd) contents of Erzurum plain soils 2 different chemical methods (sequential extraction method and DTPA+TEA, Lindsay and Norvell.1978) were used results shown in table1 and 2

Micro nutrients (Fe,Cu,Zn and Mn) and some heavy metals (Pb,Cd) contents of potato leaf were determined (Table2) as a results of Biological indexes (Yildiz and Dizikisa,2016b).

Results showed that the step 6available Mnmight be used for plant available (residualfraction form) at least in this conditions growing potato in this location.

The results of this study showed that plant available Mn obtained with sequentaly extraction step (residual chemical exraction methods) were interrelated ($p<0.05$) with were interelated with Mn content of potato leaf (biological index) in Erzurum Plain soils (Table 3).

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REFERENCES

[1] Baker, A. V. and Pilbeam, D. J., 2007. Handbook of Plant Nutrition. CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487‑2742.

[2] Beckett P.H.T., 1964. Studies on soil potassium. II. The ‘immediate’ Q/I relations of labile potassium in the soil. J. Soil Sci. 15:9–23

[3] Benton.Jr., 2012. Plant Nutrition and Soil Fertility Manual, Second Edition. CRC Press. Taylor & Francis Group.6000 Broken Sound Parkway NW, Suite 300. Boca Raton, FL 33487-2742 by Taylor & Francis Group, LLC. CRC. Press is an imprint of Taylor & Francis Group, an Informa business

[4] Chen, Y. 1975. Environ. Len., IO, 129-158 k.~C. Stover, L. E. Sommers, and D. J. Silviera, J.1976. Water Pollut. Control Fed., 48, 2165-2175

[5] Chester R. ,and M. J. Hughes, 1967.Chem. Geol., 2, 249-262

[6] Carrie, L., 2008. Soil testing and Plant analysis. Dept. Of Soil Science. U.V-Madison.

[7] Cheng,Yuan, C.,Hung-Lung, C.,Zhao-Ji, S. and Chu-Fang, W., 2005. A sequential extraction method mesaures the toxic metal content in fly ash form a municipal solid waste incineratör. Journal of the Chinese Chemical Society, 52, 921-926

[8] Dizikısa, T., Yıldız N., 2016a. Estımatıon Of Nutrıtıonal Status Of Potato Solanum Tuberosum L Plant By Soıl And Leaf Analyses Grown In Pasınler Town Plaın of Erzurum. EI: Engineering Index International Journal of Innovative Research in Engineering& Management (IJIREM) 6, 2349-2058 234 -238

[9] Dizikısa, T., Yıldız, N., 2016b. Estımatıon of Nutrıtıonal Status of Potato Solanum Tuberosum L Plant by Soıl and Leaf Analyses Grown in Oltu Town of Erzurum EI: Engineering Index International Journal of Innovative Research in Engineering& Management (IJIREM) 6, 2349-2058, 234- 238

[10] Forsee Jr. W.T. 1942. Development and evaluation of methods for the determination of phosphorus in Everglades peat under various conditions of treatment. Soil Sci. Soc. Fla. Proc. 4:50–54, 1942.

[11] Heckendorn, S., 2007. Soil Testing and Plant Analysis. Virginia Cooperative Extension.

[12] Jackson, M. L., 1962. Soil Chemical Analysis. Prentice-Hall. Inc. Cliffs, USA

[13] Jenne. E. A. 1968. "Trace Inorganics in Water", A&. Chem. Ser. 73, 337-387

[14] Lindsay, W.L.; Norvell, W.A. 1978. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Science Society of America Journal 42: 421-428.Malavolta, E.; Vitti, G.C.; Oliveira,

[15] Melsted S.W., T.R. Peck. 1973. The principles of soil testing. In: L.M. Walsh, J.D. Beaton, eds. Soil Testing and Plant Analysis. Revised edition, Madison, Wis.: Soil Science Society of America, Inc.,1973, pp. 13–21.

[16] Mengel K, Kirkby EA (1982) Principles of plant nutrition. International Potash Institute Bern, Switzerland

[17] Morgan.M.F.1941 Chemical Soil Diagnosis by the Universal Soil Testing System. New Haven: Connecticut Agric. Exp. Sta. Bull. 450, 1941, pp. 579–628.

[18]F.S. Watanabe, S.R. Olsen.1962. Colorimetric determination of phosphorus in water extracts of soils. Soil Sci. 93:183–188, 1962.

[19] Greger. M. 2004 Metal Availability, Uptake, Transport and Accumulation in Plants Department of Botany, Stockholm University, 106 91 Stockholm, Sweden In.Heavy Metal Stress in Plants. ISBN 978-3-642-07268-0

[20] Possek,H. S. F. J. Anderson, and W. J. Weber, Jr.,1968 Environ. Sci. Technol.,12, 1087-1093 .

[21]Van Der WeijdenC. H.,H. L. Arnoldus, and C. J. Meurs. Neth. J.1977.Sea Res., 11, 130-145 S. K. Gupta and K.

[22]Perkc.R. M.1974. Research Report No. 32, Water Resources Research Center,The University of Tennessee, Knoxville, Tenn.

[23] Peck .T.R., S.W. Melsted.1973. Field sampling for soil testing. In: L.M. Walsh, J.D. Beaton, eds. Soil Testing and Plant Analysis. Revised edition, Madison, Wis.: Soil Science Society of America, Inc., 1973, pp. 67–75.

[24] Peck .T.R., S.W. Melsted.1973. Field sampling for soil testing. In: L.M. Walsh, J.D. Beaton, eds. Soil Testing and Plant Analysis. Revised edition, Madison, Wis.: Soil Science Society of America, Inc., 1973, pp. 67–75.

[25] Temmerman LO, Hoenig M, Scokart PO (1984) Determination of "normal" levels and upper limit values of trace elements in soils. Z Pflanzen Bodenkd 147:687-694

[26] Tessier, A., Campbell, P. and Bisson, M., 1979.Sequential extraction procedure fort he speciation of particulate trace metals. Analytical Chemistry, 51: 844-851.

[27]Wiedenhoeft, Alex C.2006. Plant nutrition.(The green world)ISBN 0-7910-8564-3Chelsea House An imprint of Infobase Publishing132 West 31st Street New York NY 10001

[28] Yıldız, N., Canbolat M. Y. ve Aydemir O., 1999. Erzurum Daphan Ovası Topraklarının Bitkiye yarayışlı Azot Durumunun Değerlendirilmesi. GAP. I. Tarım Kongresi. 1043-1049, Şanlıurfa.

[29] Yıldız, N., Güler, E., Bilgin, N., Kahraman, F., Akkuş, F., Er, G. ve Diyarbakırlı, S., 2010. Erzurum Ovası Topraklarının Kalsiyum, Magnezyum ve Molibden Durumunun Neubauer Fide Yöntemi ile Belirlenmesi. 5. Bitki Besleme ve Gübre Kongresi. 15-17 Eylül. Ege Üniversitesi. Ziraat Fakültesi Dergisi. Özel Sayı. ISSN: 1018-8851., 447-452, İzmir.

[30] Yıldız, N ve Güler E., 2010a. Erzurum Ovası Tarım Topraklarının Bitkiye Yarayışlı Bor Durumunun Uygun Ekstraksiyon Yöntemleri Seçilerek Değerlendirilmesi. 5. Bitki Besleme ve Gübre Kongresi. 15-17 Eylül. Ege Üniversitesi. Ziraat Fakültesi Dergisi. Özel Sayı. ISSN: 1018-8851., 458-464. İzmir.

[31] Yıldız, N ve Güler E., 2010b. Erzurum Ovası Tarım Topraklarının Bitkiye Yarayışlı Bor Durumunun Uygun Ekstraksiyon Yöntemleri Seçilerek Değerlendirilmesi. 5. Bitki Besleme ve Gübre Kongresi. 15-17 Eylül. Ege Üniversitesi. Ziraat Fakültesi Dergisi. Özel Sayı. ISSN: 1018-8851., 458-464. İzmir.

[32] Yıldız, N., Bilgin N. ve Aksu E., 2003. Erzurum-Daphan Ovası topraklarının fosfor durumunun değerlendirilmesi. GAP.III. Tarım Kongresi. 2-3 Ekim, 583-587, Şanlıurfa.

[33] Yıldız, N., and Dizikısa, T., 2016. Estımatıon Of Nutrıtıonal Status Of Potato Solanum Tuberosum L Plant By Soıl And Leaf Analyses Grown In Erzurum Center EI: Engineering Index International Journal of Innovative Research in Engineering & Management (IJIREM) , 3/2350-0557 241- 245.

[34] Yıldız, N., Bilgin, N. ve Barik, K., 2008. Determination of plant available nitrogen of Erzurum plain soils SCI-Expanded Asıan Journal of Chemıstry 4, 3049 -3056.

[34] Yıldız.N and T.Dizikısa. 2017.A Comparison of Different Soil Phosphorus ExtractionMethods for Used to Determine Plant Available Soil Phosphorus of Erzurum Plain Agricultural Soils.International Journal of Innovative Research in Engineering & Management (IJIREM)ISSN: 2350-0557, Volume-4, Issue-3, May-2017

APPENDIX

Table 1: Results of Sequential (step1-6) of microelement and some heavy metal analyses for Erzurum plain soils (ppm)

	Sequential Extraction step1						Sequential Extraction step2						Sequential Extraction step3						Sequential Extraction step4						Sequential Extraction step5						Sequential Extraction step6					
No	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Pb	Cd	Mn	Zn	Cu	Cd	Pb NG	Fe	Mn	Fe	Cu	Pb	Cd	Zn	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd	Pb
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1220087.00	0.00	0.00	0.00	0.00	0.00	0.00	337.27	45.04	0.00	0.00	0.00	0.00	1601.44	16440.18	60.01	134.05	183.10	19.89	85.61	7731.98	5.64	18.49	95.24	3.43
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	714.64	221.51	0.00	0.00	0.00	0.00	1045.82	10086.92	40.07	343.77	60.15	9.58	21.26	2428.44	1.55	4.81	10.84	0.00
3	0.94	0.00	0.17	0.72	20.50	18.05	0.34	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	411.24	100.69	0.00	0.00	0.00	0.00	861.45	6478.58	23.36	67.42	30.41	7.13	56.17	6160.54	3.83	11.41	70.64	2.13
4	7.49	763.32	1.37	3.91	10.22	318.85	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	338.70	39.05	0.00	0.00	0.00	0.00	1298.13	14126.27	64.14	118.34	204.25	17.01	50.62	5235.68	3.64	11.75	83.14	2.53
5	1.15	215.11	0.67	0.77	1.61	52.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	334.75	27.43	0.00	0.00	0.00	0.00	888.56	10350.94	32.56	97.39	78.66	36.94	41.06	4386.67	3.12	12.58	77.61	2.37
6	1.03	176.98	0.90	1.59	1.74	132.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	393.90	31.51	0.00	0.00	0.00	0.00	1842.75	4825.90	39.43	126.59	141.46	14.87	43.58	3400.29	3.17	15.01	43.13	1.79
7	5.65	1024.60	1.07	3.75	4.18	198.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	261.34	21.42	0.00	0.00	0.00	0.00	1798.39	17999.22	58.19	142.61	327.21	30.64	76.62	7938.22	5.19	21.02	63.17	3.46
8	0.74	101.24	0.78	0.93	0.49	31.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	159.57	16.52	0.00	0.00	0.00	0.00	2553.01	13928.68	97.86	316.26	618.10	17.08	82.51	5133.32	4.91	18.61	70.77	2.56
9	2.06	347.28	0.82	1.02	2.04	69.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	344.37	16.16	0.00	0.00	0.00	0.00	1307.18	5586.57	23.41	85.16	174.51	13.26	68.35	7106.53	5.20	19.31	61.72	2.23
10	0.04	0.00	0.38	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	362.21	11.25	0.00	0.00	0.00	0.00	1494.70	7754.16	28.63	111.59	154.68	12.61	37.47	3452.05	2.42	11.32	67.54	2.03
11	1.28	305.60	0.74	1.30	0.45	43.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1821.55	174.55	0.00	0.00	0.00	0.00	1108.38	12059.55	56.30	106.31	118.98	12.23	62.28	7191.88	5.01	17.58	40.37	1.76
12	2.93	447.25	2.15	4.65	58.14	109.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	446.41	116.86	0.00	0.00	0.00	0.00	2365.51	28493.43	91.01	194.10	181.12	20.65	45.45	4234.50	2.89	9.38	57.36	1.79
13	4.51	466.62	0.90	1.65	1.07	116.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	432.91	73.03	0.00	0.00	0.00	0.00	2357.81	27015.27	107.69	220.35	446.20	35.88	88.95	7416.91	4.61	17.82	92.66	3.36
14	7.81	872.99	1.18	2.97	2.50	165.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	276.35	35.39	0.00	0.00	0.00	0.00	2291.92	22585.46	101.57	355.58	233.34	31.79	19.98	2202.53	1.67	10.44	35.17	1.00
15	1.57	157.43	0.59	1.14	1.34	30.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	306.20	56.74	0.00	0.00	0.00	0.00	1139.69	9933.28	41.10	133.16	81.96	15.76	39.52	4544.53	3.42	11.49	71.96	2.45
16	0.01	0.46	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	218.77	73.74	0.00	0.00	0.00	0.00	1438.88	17541.28	48.27	144.80	146.08	21.40	32.78	3777.36	2.69	7.27	45.11	1.24
17	0.09	0.00	0.33	0.14	1.19	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	171.76	8.49	0.00	0.00	0.00	0.00	1378.20	11368.44	36.49	105.55	166.58	24.50	31.98	3104.22	2.73	7.39	44.07	1.43
18	0.27	29.84	0.57	0.30	12.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	249.81	13.61	0.00	0.00	0.00	0.00	1886.80	15967.20	103.67	326.79	384.72	33.01	58.79	4616.77	4.06	12.56	79.21	2.73
19	4.54	423.81	1.94	8.32	97.83	415.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	140.05	14.69	0.00	0.00	0.00	0.00	721.57	11762.36	46.71	130.98	25.12	14.83	29.15	2705.43	2.17	38.88	38.21	1.22

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Table 2: Results of DTPA+TEA and microelement and some heavy metal content of Potato plant leaf (Biological Index)

Soil Extraction DTPA – TEA ppm						BIOLOGICAL INDEX(potato leaf analyses) ppm					
Fe	Cu	Mn	Zn	Pb	Cd	Fe	Cu	Zn	Mn	Pb	Cd
1.01	1.07	4.74	1.85	0.10	0.01	145.60	12.98	30.26	81.55	0.40	0.03
3.84	1.60	14.87	0.97	0.09	0.02	115.10	10.97	29.02	80.58	0.08	0.28
1.24	1.47	7.16	0.67	0.08	0.02	191.90	12.25	30.38	89.59	0.49	0.10
1.68	1.88	9.41	2.42	0.20	0.03	188.60	10.29	24.65	100.20	0.18	0.12
1.01	1.33	10.84	1.57	0.22	0.02	106.50	12.49	27.07	93.28	0.01	0.31
2.54	2.41	6.97	5.27	0.26	0.02	164.40	18.86	36.30	95.79	0.16	0.17
3.01	1.86	12.72	1.66	0.22	0.02	159.33	10.87	36.12	44.70	0.16	0.13
5.09	3.80	9.84	7.91	0.15	0.03	111.30	19.25	39.20	44.31	0.87	0.04
0.89	2.09	6.29	2.65	0.18	0.02	192.93	14.35	37.94	60.39	0.26	0.12
0.61	2.10	5.66	2.64	0.17	0.02	191.80	14.21	37.80	50.47	0.25	0.12
0.76	1.53	2.31	2.03	0.12	0.01	170.18	18.59	29.19	71.15	0.02	0.15
2.39	2.28	11.09	1.65	0.09	0.02	114.60	11.09	49.12	36.27	0.18	0.03
1.58	1.78	1.11	1.56	0.05	0.02	124.40	10.64	40.63	38.30	1.87	0.05
1.54	2.23	4.95	1.00	0.20	0.02	177.96	10.37	26.71	95.92	0.23	0.20
2.29	1.27	2.36	1.04	0.17	0.02	150.30	17.34	28.18	41.53	0.54	0.24
0.90	1.41	3.63	1.11	0.13	0.02	150.60	17.43	28.29	68.55	0.59	0.24
0.71	1.15	2.38	1.72	0.19	0.01	233.50	18.27	27.85	71.11	0.27	0.10
1.08	1.99	4.40	3.35	0.22	0.02	416.40	17.81	35.06	74.95	0.12	0.05
0.86	1.87	7.54	1.82	0.24	0.02	226.50	16.29	23.32	59.45	0.20	0.13

Table 3: Results of the correlation analyses among Sequential analyses , DTPA+TEA and Bıological Index for Erzurum plain soils

	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd	Pb	Mn	Fe	Cu	Zn	Cd
Mn	1																																		
Fe	.937**	1																																	
Cu	.671**	.662**	1																																
Zn	.696**	.650**	.892**	1																															
Cd	.255	.165	.706**	.830**	1																														
Pb	.794**	.710**	.778**	.921**	.635**	1																													
Mn	.053	-.081	-.160	-.028	.081	.019	1																												
Fe	-.237	-.284	-.273	-.216	-.060	-.233	.293	1																											
Cu	-.210	-.214	-.323	-.197	-.110	-.187	-.072	-.074	1																										
Zn	-.126	-.023	-.092	-.135	-.167	-.174	-.012	-.145	-.046	1																									
Cd	-.179	-.153	-.171	-.141	-.041	-.244	.144	-.124	-.053	.706**	1																								
Pb	.225	.270	.262	-.015	-.172	-.076	-.324	-.184	.024	-.209	-.193	1																							
Mn	.451	.451	.433	.295	.173	.160	-.256	-.191	.092	-.070	.098	.662**	1																						
Fe	.394	.354	.372	.195	.059	.132	-.263	-.284	.018	-.062	-.040	.805**	.809**	1																					
Cu	.131	.084	.026	-.048	-.081	-.092	-.305	-.264	-.097	-.100	.184	.571*	.441	.715**	1																				
Zn	.147	.192	.083	-.103	-.269	-.073	-.254	-.150	-.023	-.218	-.318	.809**	.453	.749**	.526*	1																			
Cd	.316	.369	.153	.026	-.148	.053	-.371	-.035	-.016	-.298	-.379	.428	.591**	.546*	.292	.444	1																		
Pb	-.011	.094	-.071	-.139	-.231	-.107	.052	-.183	.388	.083	-.149	.378	.204	.324	-.087	.627**	.161	1																	
Mn	.054	.196	-.113	-.126	-.256	-.090	.174	-.154	.368	.278	.011	.088	.122	.077	-.336	.309	.079	.896**	1																
Fe	-.065	.081	-.125	-.181	-.285	-.143	.052	-.136	.400	.195	-.151	.192	.030	.145	-.247	.463*	.069	.940**	.936**	1															
Cu	.286	.290	.462*	.656**	.590**	.640**	-.130	-.261	.127	-.065	-.338	-.126	-.052	.033	-.196	.072	-.034	.319	.260	.310	1														
Zn	.042	.006	-.059	-.151	-.172	-.077	.194	-.128	.385	-.273	-.446	.211	.183	.234	-.236	.404	.337	.695**	.613**	.626**	.104	1													
Cd	.118	.200	.003	-.063	-.207	-.001	.055	-.163	.370	-.171	-.453	.295	.202	.258	-.242	.507*	.383	.844**	.784**	.807**	.268	.902**	1												
Pb	.035	.106	.072	.022	-.118	-.012	-.101	-.235	-.147	-.104	.211	.431	.096	.300	.537*	.474*	-.116	.168	-.053	.051	-.079	-.154	-.027	1											
Mn	.162	.177	.384	.191	.081	.165	-.139	-.317	-.307	-.176	-.231	.635**	.096	.456*	.464*	.653**	-.066	.211	-.112	.079	.186	-.030	.029	.626**	1										
Fe	.132	.234	.217	.262	.198	.231	.081	-.249	-.126	-.126	.208	-.051	-.059	-.105	.196	-.044	-.122	-.116	-.137	-.171	-.013	-.233	-.179	.586**	.300	1									

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Cu	-.190	-.152	.079	-.084	-.124	-.030	-.206	-.157	-.057	-.134	-.354	.464*	-.195	.258	.234	.627**	-.102	.362	.010	.304	.201	.135	.205	.521*	.819**	.119	1								
Zn	.229	.272	.285	.312	.125	.434	-.263	-.021	-.248	-.336	-.652**	-.139	-.370	-.168	-.103	-.065	.200	-.308	-.342	-.180	.300	-.133	-.025	-.093	.166	.110	.288	1							
Cd	.376	.280	.337	.255	.087	.361	.188	-.404	-.438	-.413	-.207	.251	.033	.249	.294	.386	-.024	.022	-.157	-.106	.021	.168	.066	.532*	.651**	.455	.430	.178	1						
Pb	-.065	-.123	-.033	.001	.156	.025	.071	.214	-.104	-.143	-.355	-.089	-.145	.120	.108	.065	.129	-.078	-.112	-.001	.097	.072	.056	-.417	-.072	-.320	.037	.411	-.113	1					
Mn	-.564*	-.533*	-.190	-.229	-.046	-.268	-.254	.201	-.106	.096	-.206	-.073	-.422	-.135	-.107	.081	-.232	-.028	-.160	.104	.142	-.161	-.100	-.021	.169	-.429	.524*	.308	-.186	.321	1				
Fe	-.125	.015	.243	-.064	-.003	-.237	-.172	-.191	-.082	-.035	.000	.680**	.363	.359	.154	.497*	.082	**.457***	.281	.308	-.081	.242	.325	.320	.510*	.126	.364	-.305	.145	-.142	-.077	1			
Cu	.058	-.049	-.258	-.159	-.200	.061	.353	.122	.150	.078	.046	-.351	-.357	-.236	-.041	-.384	-.042	-.339	-.247	-.240	-.243	-.162	-.285	-.249	-.251	.089	-.103	.286	-.054	.173	-.104	-.604**	1		
Zn	.073	-.036	-.079	-.124	-.154	-.085	.035	-.022	.022	-.188	-.056	.440	.408	.415	.148	.534*	.237	.498*	.320	.276	.081	.432	.389	.151	.148	-.405	.102	-.522*	.180	-.260	-.074	.307	-.454	1	
Cd	-.049	-.029	-.235	-.142	-.226	-.051	-.106	-.135	-.310	.112	.259	-.527*	-.356	-.486*	-.057	-.554*	-.014	-.636**	-.428	-.520*	-.281	-.480*	-.519*	-.016	-.351	.201	-.366	.240	.021	-.290	-.042	-.548*	.362	-.332	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results of the statistical analyses indicated that, sequential extraction methods step.6 residual Mn method were interrelated ($p<0.05$) with biological indexes investigated in Erzurum plain soils

