ESTIMATION OF NUTRITIONAL STATUS OF POTATO (*Solanum Tuberosum* L.) PLANT BY SOIL AND LEAF ANALYSES GROWN IN PASINLER TOWN PLAIN OF ERZURUM

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ABSTRACT
This study was conducted to determine the fertility potential of potato grown soils in Pasinler Town region of Erzurum cityto achive this a total of 42 soil (was performed to determine soil texture, lime content, soil pH, total salt, soil organic matter content ,cation exchange capacity (CEC) and macro and micronutrient concentrations) and leaf samples were collected (macro and micronutrient content) and analyzed.
The results showed that 21,43%clay loamy, 16,67% sandy clay loam, 61,90% clay textureof the study area, respectively. Most of the soil pH measurements in the area fell between6,47-8,50 notral and slightly alkaline reactions. Soil organic matter content was deficient in all the region's soils and approximately half of the soils were classed as saline soils. Deficiency of nitrogen, phosphorous, potassium, iron, zinc, and cupper was determined in 55.65, 35.86, 39.63, 29.24, 43.4, and 2.8 % of the soils, respectively.
The analysis also showed a total soil Nitrogen (N) content and plant available nutrients (Calcium Ca. Magnesium Mg and Potassium. K) concentrations of soil samples in adequate proportions. Plant available nutrients such as Iron (Fe) and Cupper (Cu) were at suffecient levels. Also Lead (Pb). Nicel (Ni) and Cadmium (Cd) were not at toxic levels in plant and soil samples. Plant available nutrient such as Manganes (Mn), Zinc (Zn), Boron (B) was low in soils sampled from Pasinler town agriculture soils. Plant available P content is insufficient in plant leaf samples.
As a result of this. potato plant leaves grown on PasinlerPlain soils recorded insufficient levels of Phosphorus ,boron, manganese and Zinc .The results indicates that growers should make an attempt to conserve and improve the current fertility status of the soils.

Keywords: potato. critical nutrient levels. leaf analysis. soil analysis. fertility potential

1. INTRODUCTİON
Chemical soil analysis shows the potential availability of nutrients that roots may take up under conditions favorable for root growth and activity. Plant analyses in the strict sense reflects only the actual nutritional status of plants. Therefore. in prenciple. a combination of both methods provides a beter basis for recommending fertilizer applications than one method alone (Marschner. 1997)[1].

Potato is one of the important products that are cultivated in the world and in Turkey. Recently. there has been important developments and variations in the usage of potato in human nutrition. It is certain that the suitable fertilizer and fertilization will be used to raise the yield per unit of area of potato and reveal the features of the required quality (Tugay et al 1999).

2. MATERİAL AND METHOD
Soils from 42 representative were sampled (Jackson 1962)[2]. from potato grown fields in early April. 2010 with the aim of defining the nutrient potential in potato plants cultivated in Pasinler plain soils. 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 48hours 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 takenJune 2010 .The Kjeldahl method and Vapodest 10 Rapid Kjeldahl Distillation Unit (Gerhardt. Konigswinter. Germany) were used to determine total N (Bremner. 1982)[3].. Macro elements (C.K.Mg. Na and P) , micro elements (B.Cu.Fe.Mn and Zn) and some heavy metals (Cd. Ni. Pb) were determined using an inductively coupled plasma spectrophotometer (Optima 2100 DV. ICP/OES; Perkin-Elmer. Shelton. CT) (Mertens. 2005). All the data was subjected to analysis of variance using SPSS. a statistical program for data analysis. Means were separated by Duncan's multiple range tests (DM RT) (Düzgüneş et al 1987)[4]..

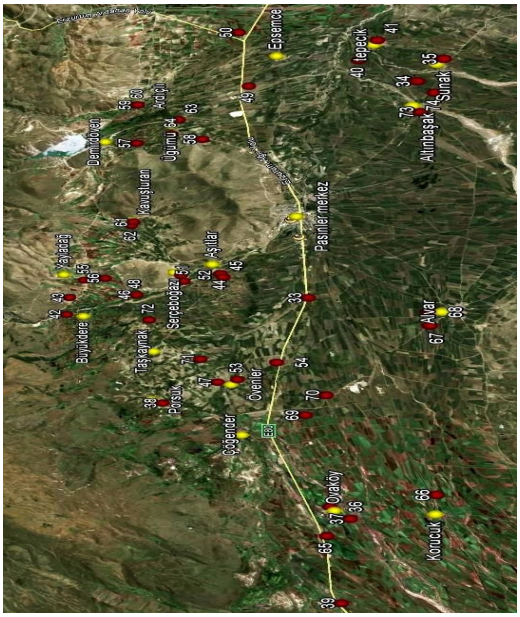

Figure 1: Soil and potato leaf sampled points of Pasinler Town plain

3. RESULTS AND DİSCUSSION

3.1 Evaluation of The Soil Analyses results

Chemical and physical proferties of sampled soils; texture classes ranged from 21,43% clay loamy, 16,67% sandy clay loamy, 61,90%clayof soils sampled from Pasinler plain. Statistical analysis showed close relation between the plant nutrient availability and the soil texture (Kacar and Katkat 2007)[5]..

Soil reaction (pH) of the soil samples ranged from 6,47-8,50 and averaging 7.71. This findings suggests that 28,57% of the soils are neutral and 71,43% of the soil samples are light alkaline in reaction (FAO 1990[1].; tovep 1991[1].; Günes vd 1998[1].). The pH of the soil is an important factor that affects the chemical. biological and physical processes in soils (Yıldız 2012)[ ].

The organic matter content of the soil samples ranged from 0,2-3,83% with an average of 1.69%. This finding suggested that 19,04% of the soil samples are very low. 42.10% are low and 50% are low, 21,42% medium and 9, 52% avarage respectively. The organic matter content of the soil had a negative weight dramatically because of the organic colloids that it contains. The weight of the organic colloids contents are far more than the clay minerals (Bakırcıoğlu 2009)[8].

The $CaCO_3$ content of the soil samples ranged from 0-20,99 % averaging 3,64 %. This finding suggests that all the soil samples are low in lime. The fact that the lime contents of the soils are made unavailable of micro elements especially phosphorous and zinc (Udo vd 1970[9].; Mengel and Kirkby 1982[10].; Kacar vd 1998[11].).

The EC of the soil samples ranged from 0,23-1,19 dS/cm and averaging 0,45 dS/cm. This finding suggests that 16,66% of the soil samples are light salty ,76,20% are medium salty and 7,14% high salty. The saltness stress is an environmental stress factor in terms of the cultivated plants and is the group of the chemical stress. The fact that the growth medium has a problem in terms of the salt brings about many negative effects (Yakıt and Tuna 2006)[12]..

Also the CEC of the soil samples ranged from 17,68-36,45 cmol kg-1 with an average of 22,23 cmol kg-1 (FAO 1990[1].; Tovep 1991[1].; Güneş vd 1998[1]).

The total amount of nitrogen in the soil ranged from 0,06-0,23 % with an average of 0,14%. These findings suggest that 47,38% of the samples are sufficient whereas 10,52% were low and 42,10% very high . Plant available NH_4^+-N level of the soil samples ranged from 28-98 mg kg-1 and averaging 54.01 mg kg-1. Plant available NO_3- N level of the soil samples ranged from 42-98 mg kg-1 averaging 58,67 mg kg-1.

Plant available P level of the soil samples ranged from 2-76 mg kg-1 and avaraging 20.69 mg kg-1. This finding suggests that 2.38 % of the samples are very low. 7.14 % are low, 61.90 % are sufficient and 28.57 % excess.

The exchangeable K level ranged from 1,91-3,93 cmolkg-1 with an average of 2,47 cmol kg^1.

Ca excahangeable level also ranged from 11,49-23,69 cmol kg-1 with 14,30 cmol kg-1 avearage. These findings suggest that 88,09% of the samples are sufficient and 11,91 % are high level.

For Mg. the exchangeable level ranged from 3,18-6,56cmol kg-1. averaging 4,02 cmol kg-1. This finding indicates a 61,90% sufficience whereas 38,10% were in excess.

Na showed an exchangeable range of 0,41-0,84 cmol kg-1and avaraging 0,53 cmol kg-1.

The concentration of Fe. Cu. Zn. Pb. Mn. B. Cd and Ni were compared with the critical values (Lindsay ve Norwell 1969[1].; FAO 1990; Tovep 1991[1].; Güneş vd 1998[1].. in Yıldız 2012[1]). Results indicated that the amounts of plant available Fe level of the soil samples ranged from 0,26-8,28 mg kg-1 with an average of 1,13 mg kg-1. This finding suggests that 95,23% are sufficient whereas 4,77 % of the samples were high. Plant available Cu level of the soil samples ranged from 1,19-3,81 averaging2,27 mgkg-1. This suggests that all the samples are sufficient. The research further revealed that Zn levels of soil samples ranged from 0,34-7,53. averaging 1,38 mg kg-1. This finding suggests that 23,80% of the samples were low and 66,68% are sufficient whereas9,52% of the samples were excess. B levels of soil samples also ranged from 0,07-0,37 mgkg-1 averaging 0,20 mgkg-1.This suggests that all the samples are very low. The up take of B is limited by a pH of <5.5 or >6.8. sandy soil with low organic matter (Yıldız 2012)[1]..

Plant available level of Mn ranged from 1,10-5,03 mgkg-1 and averaging 3,12 mgkg-1. This suggests that 47,61% of these samples are very low and 52,39% were low. These results are in line with previous results found by Taban et al. 1997[1].; Parlak et al. 2008[1].; Turan et al. 2010[1].; works conducted from different soils sampled from different regions and plants. A sample range of 0,09-0,41 mg kg-1 and averaging 0,24 mgkg-1 of Pb concentration was observed. Ni concentration ranging from 0,31-3,99 at an average of 1.06mg kg-1 was further observed. Finally. a Cd concentration ranging from 0,01-0,04 mgkg-1 at an average of 0.02 mgkg-1 was also observed.

3.2 Evaluation of Mineral Content in Potato Leaf samples

The content level of macro and micro elements in leaf samples of potato plant were compared with the limit values for potato (Yıldız 2012)[1].. As a result of the evaluation. N content of the leaf samples ranged from 3,88-5,38 % with an average of 4,59%. Nitrogen content were high in all leaf samples.

P content of the leaf samples ranged from 0,10-0,35 % with an average of 0,21%. 50% of the leaf samples were low whereas 38.19% were sufficient. Because of the availability of P. several side-effects on the internal and external factors of the soil

resulted in drought. excessive moisture or low temperature and clayey in type. The availability of the soil plant nutrients is related to the climatic factors. Due to this. more fertilizer should be applied in high temperature areas especially in the morning and as light intensity increases. It is adviced that texture classification of the soil is very important irrigation for irrigation purposes. Although the P level of the soils were low. its content level in the leaf samples ranged from 0.02% -0.15%.

K content of leaf samples ranged from 2,40-6,62 % with an average 4,55%. 8,10% of leaf samples were sufficient and suggests that 91,90% of the samples were in excess.

Ca content of the leaf also ranged from %0-2,89 % with an average of and it is averagingThis finding suggests that 4,76% of the leaf samples are low. 69,05% of the leaf samples are sufficient and 26,19% are excess.

Mg content of the leaf samples ranged from 0,29-1,45 % averaging 0,64%. This finding suggests that 14,28% of the leaf samples are sufficient. 85,72% of the leaf samples are high.

Na content of the leaf samples ranged from 0,02-0,07 % and it is averaging 0,04%.

S content of the leaf samples ranged from 0,23-0,48 % averaging 0,33%. This finding suggests that all of the leaf samples are sufficient.

Fe content of the leaf samples ranged from 139,86-958,50 mg kg-1 averaging 310,30 mg kg-1. This finding suggests that 14,28% of the leaf samples are sufficient 85,72% of the leaf samples are excess.

Cu content the leaf samples ranged from 10,00-27,59 mg kg-1 averaging 16,59 mg kg-1. This finding suggests that all of the leaf samples are sufficent.

Zn of the leaf samples ranged from 0,61-29,30 kg-1. averaging 17,25 mg kg-1. This finding suggests that 73,80% of the leaf samples are low. 26,20% of the leaf samples are sufficient.

Mn content of the leaf samples ranged from 22,14-302,32 mgkg-1. averaging 75,00 mgkg-1. This finding suggests that 78, 37% of the leaf samples are sufficient and 21,63% of the leaf samples are excess.

B content of leaf samples ranged from 0,61-29,30 mgkg-1. averaging 17,25 mg kg-1. This finding suggests that 73,80% of the leaf samples are low and 26,20% of the leaf samples are sufficient. When the temperature decrease boron availability decrease. The soil humidity also affects the mass flow and availability of the diffusion boron. Factors that affected transpiration also. negative affects availability of boron. The tubers are small. deformed and high-coloured when the B is not sufficient in the potato (Mahler 2010)[1]. The amount of available boron in the top soils is very changeable and is under the effect of some factors. The amount of available boron changes depending on the texture of the soils. the amount of hydrated iron oxide and aluminium oxide. electrical conductivity. the content of organic substance. the amount and types of changeable cations. the content of lime and the quality of irrigation water (Yıldız 2012)[1]..

The research further obtained results on Pb contents from leaf samples ranging from 0,01-0,65 with an average of 0,16 mgkg-1. Also, Ni leaf content ranged from 0,02-21,95 mgkg-1 averaging 4,39 mgkg-1. Obtained Cd content from leaf samples also ranged from 0,00-1,82 mgkg-1 averaging 0,27mgkg-1. Correlation analyses was then applied to the data to determine the reletionship between soil characteristics and leaf mineral content of soils from Pasinler town plain . This is showned in Table 1.

4. CONCLUSION AND SUGGESTIONS

Significiant negative relationships were found for plant available P, NO_3, Pb, Znconcentrations, soil pH, pH , clay content of soil sampled from Pasinler plain with N, K, Mg, Ca, S content of plant leaf samples.

On the other hand Significiant posstive relationships were found for plant availableK, Ca, Mg, Fe, B, Mn, Zn,NO_3, Cu, Pand $CaCO_3$, pH, sand , EC, clay content of soil sampled from Pasinler plain, with N,Ca, Mg, S, Fe, Cu, Zn content of plant leaf samples.

Results from the study indicates that the soils and plants are deficient in N, P, Zn, Fe, Cu and B. Total soil N content and plant available nutrient concentrations (P. Ca. Mg and K) of soil samples is sufficient for potato plant growth. Plant available B, Fe, Zn and Cu were in unsuffecient level and Pb and Cd is not at toxic levels in plant and soils. Plant availableN,P Fe, Zn,Cu and B is generally also low in soils from Pasinler plain. Plant available P content is insufficient value in plant leaves.

Finally, due to Nitrogen (N), Phosphorus (P), boron (B), iron (Fe) ,copper (Cu) and zinc (Zn) insufficient levels in potato plant leaves grown in Erzurum centergrowers should make an attempt to conserve and improve current fertility status of the soils. It is suggested that N,P, Zn, Fe, Cu and B sourced from soil and foliar fertilizers should be added towards increasing its productivity by considering field or greenhouse experiments in future.

As a result, Nitrogen (N) ,Phosphorus (P), boron (B), iron (Fe), copper (Cu) and zinc (Zn) were insufficient level of potato plant leaves which was grown in Erzurum center. The results indicated that growers should be in an attempt of conservation and improvement of current fertility status of the soils. It was suggested that the P, Zn, Fe,Cu and B (except N) sourced soil and foliar fertilizers should be added to increase its productivity by considering with field/greenhouse experiments later on.

ACKNOWLEDGEMENTS

We would like to thank the Ataturk University for funding the project (BAP. 2011/194)

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APPENDIX

Table 1: The correlation coefficiencies of soil and leaf properties studied (Pasinler Town Plain)

Parametres	**Locations(Villages)**								ÖD
	Altınbaşak	Alvar	Dereboğaz	Kümbet	Özbek	Sakalı kesik	Taşlıgüney	Tepeköy	
pH	8,238±0,216	8,083±0,216	0,213±0,008	0,235±0,012	0,190±0,012 AC	0,163±0,010 CD	0,200±0,012 AB	0,150±0,012 D	**
Org. Mat	2,668±0,604	2,190±0,604	5,180±0,286	3,720±0,405	3,540±0,405 AD	4,970±0,331 AB	4,020±0,405 AC	2,585±0,405 D	**
$CaCO_3$	8,151±2,866	4,269±2,866	0,675±0,057 CD	0,660±0,081 D	0,840±0,081 BD	1,243±0,066 A	0,870±0,081 BD	0,930±0,081 BC	**
EC	0,389±0,089	0,447±0,089	0,355±0,032 C	0,470±0,045	0,450±0,045 BC	0,590±0,037 AB	0,515±0,045 B	0,520±0,045 B	**
Clay	40,283±6,733	45,021±6,733	0,042±0,010	0,035±0,014	0,035±0,014	0,023±0,011	0,040±0,014	0,035±0,014	Ns
Silt	26,456±2,502	27,063±2,502	0,308±0,038	0,340±0,053	0,340±0,053	0,293±0,044	0,395±0,053	0,380±0,053	Ns
Sand	32,819±6,806	27,917±6,806	163,840±27,037	142,390±38,236	151,180±38,236	178,133±31,220	135,450±38,236	130,350±38,236	Ns
CEC	21,815±3,049	20,615±3,049	14,670±1,429	14,840±2,020	10,505±2,020	17,680±1,650	15,675±2,020	11,975±2,020	Ns
N	0,145±0,022	0,110±,022	37,765±3,123	39,155±4,416	33,670±4,416	28,107±3,606	31,685±4,416	29,640±4,416	Ns
NH_4^+	52,500±11,664	49,000±11,664	0,385±0,205	0,100±0,290	1,050±0,290	0,467±0,237	0,085±0,290	0,240±0,290	Ns
NO_3^-	59,500±6,973 bc	42,000±6,973 c	49,968±8,467	53,710±11,974	67,110±11,974	60,397±9,777	94,535±11,974	81,065±11,974	Ns
P	26,500±10,924	13,500±10,924	1,985±0,728	0,855±1,029	1,445±1,029	1,938±0,840	3,284±1,029	2,043±1,029	Ns
P_2O_5	60,685±25,017	30,915±25,017	17,010±0,594	14,555±0,841	11,855±0,841	11,467±0,686	10,175±0,841	11,460±0,841	**
K	2,490±0,324	2,350±0,324	0,102±0,043	0,088±0,061	0,123±0,061 AC	0,193±0,050C	0,240±0,061 C	0,154±0,061 C	Ns

Değişkenler	Köyler							ÖD
	Altınbaşak	**Alvar**	**Ardıçlı**	**Aşıtlar**	**Büyükdere**	**Çöğender**	**Demirdöven**	
pH	8,238±0,216	8,083±0,216	7,358±0,216	6,843±0,216 AC	7,363±0,216 BE	8,060±0,216 AB	7,923±0,216 AC	**
Org. Madde	2,668±0,604	2,190±0,604	0,585±0,604	0,708±,604	1,430±0,604	1,308±0,604	0,813±0,604	**
Kireç	8,151±2,866	4,269±2,866	,881±2,866	,220±2,866	2,124±2,866	1,465±2,866	1,068±2,866	ns
EC	0,389±0,089	0,447±0,089	0,482±0,089	0,529±0,089	0,469±0,089	0,320±0,089 bd	0,451±0,089	*
Kil	40,283±6,733	45,021±6,733	23,216±6,733	29,321±6,733	49,367±6,733	46,152±6,733	50,263±6,733	ns
Silt	26,456±2,502	27,063±2,502	26,048±2,502	23,992±2,502	19,287±2,502	24,407±2,502	24,570±2,502	ns
Kum	32,819±6,806	27,917±6,806	50,736±6,806	46,687±6,806	31,346±6,806	29,441±6,806	25,167±6,806	ns
KDK	21,815±3,049	20,615±3,049	24,930±3,049	19,155±3,049	24,430±3,049	21,375±3,049	20,780±3,049	ns
N	0,145±0,022	0,110±,022	0,125±0,022	0,120±0,022	0,150±0,022	0,125±0,022	0,165±0,022	ns
NH_4^+	52,500±11,664	49,000±11,664	63,000±11,664	56,000±11,664	56,000±11,664	42,000±11,664	63,000±11,664	ns
NO_3^-	59,500±6,973 bc	42,000±6,973 c	63,000±6,973	63,000±6,973	49,000±6,973	42,000±6,973 bc	52,500±6,973 bc	*
P	26,500±10,924	13,500±10,924	18,000±10,924	11,000±10,924	23,000±10,924	11,500±10,924	7,000±10,924	ns
P_2O_5	60,685±25,017	30,915±25,017	41,220±25,017	25,190±25,017	52,670±25,017	26,335±25,017	16,030±25,017	ns
K	2,490±0,324	2,350±0,324	2,845±0,324	2,065±0,324	2,635±0,324	2,440±0,324	2,370±0,324	ns
K_2O	3,013±0,392	2,843±0,392	3,442±0,392	2,499±0,392	3,188±0,392	2,952±0,392	2,868±0,392	ns
Ca	14,180±1,677	13,400±1,677	16,205±1,677	12,450±1,677	15,880±1,677	13,895±1,677	13,510±1,677	ns
Mg	3,930±0,543	3,715±0,543	4,490±0,543	3,450±0,543	4,400±0,543	3,850±0,543	3,740±0,543	ns
Na	0,550±0,072	0,520±0,072	0,605±0,072	0,440±0,072	0,560±0,072	0,540±0,072	0,480±0,072	ns
Fe	0,395±1,020	0,365±1,020	4,386±1,020	2,421±1,020	0,883±1,020	0,769±1,020	0,637±1,020	ns
Cu	2,065±0,418	1,782±0,418	2,083±0,418	3,057±0,418	2,964±0,418	2,306±0,418	1,347±0,418	ns
Zn	0,741±0,908	0,673±0,908	1,396±0,908	1,447±0,908	1,315±0,908	0,540±0,908	1,096±0,908	ns
Pb	0,119±0,034	0,245±0,034	0,372±0,034	0,114±0,034 af	0,365±0,034	0,225±0,034 cf	0,230±0,034	**
Mn	2,396±1,926	3,556±1,926	2,551±1,926	11,526±1,926	7,406±1,926	5,098±1,926	4,627±1,926	ns
B	0,160±0,049	0,177±0,049	0,168±0,049	0,120±0,049	0,079±0,049	0,229±0,049	0,173±0,049	ns
Ni	0,702±0,473	0,794±0,473	1,435±0,473	0,832±0,473	1,143±0,473	1,365±0,473	0,472±0,473	ns
Cd	0,014±0,005 BE	0,011±0,005 DE	0,032±0,005	0,019±0,005	0,028±0,005	0,012±0,005 AE	0,025±0,005	*

Parameters	Locations (villages)							ÖD
	Epsemce	Ezirmik	Kavuşturan	Korucuk	Kurbançayır	Övenler	Porsuk	
pH	6,918±0,216 E	7,885±0,216 AC	7,878±0,216 AC	7,848±0,216 AC	7,890±0,216 AC	7,972±0,177 AC	7,320±0,216 CE	**
Org. Mat	2,125±0,604	2,250±0,604	2,063±0,604	1,588±0,604	1,658±0,604	1,453±0,493	2,420±0,604	**
$CaCO_3$	0,224±2,866	0,207±2,866	4,170±2,866	0,202±2,866	1,757±2,866	4,030±2,340	0,074±2,866	ns
EC	0,315±0,089 d	0,673±0,089	0,631±0,089	0,324±0,089 d	0,370±0,089 bd	0,385±0,073	0,351±0,089 cd	*
Clay	34,870±6,733	37,833±6,733	43,901±6,733	41,078±6,733	47,491±6,733	34,077±5,498	51,009±6,733	ns
Silt	20,791±2,502	26,456±2,502	27,085±2,502	26,055±2,502	22,598±2,502	24,211±2,043	23,333±2,502	ns
Sand	44,340±6,806	35,710±6,806	29,014±6,806	32,867±6,806	29,911±6,806	41,712±5,557	25,659±6,806	ns
CEC	23,210±3,049	19,780±3,049	26,240±3,049	20,240±3,049	20,020±3,049	20,347±2,490	27,925±3,049	ns
N	0,105±0,022	0,135±0,022	0,150±0,022	0,125±0,022	0,190±0,022	0,180±0,018	0,150±0,022	ns
NH_4^+	52,500±11,664	56,000±11,664	63,000±11,664	63,000±11,664	63,000±11,664	60,667±9,524	77,000±11,664	ns
NO_3^-	66,500±6,973 b	56,000±6,973 bc	91,000±6,973 a	63,000±6,973 bc	59,500±6,973 bc	65,333±5,694 bc	59,500±6,973 bc	*
P	18,000±10,924	18,500±10,924	32,000±10,924	21,500±10,924	15,500±10,924	17,667±8,920	27,000±10,924	ns
P_2O_5	41,220±25,017	42,365±25,017	73,280±25,017	49,235±25,017	35,495±25,017	40,457±20,426	61,830±25,017	ns
K	2,500±0,324	2,255±0,324	2,995±0,324	2,310±0,324	2,160±0,324	2,197±0,264	3,070±0,324	ns
K_2O	3,025±0,392	2,729±0,392	3,624±0,392	2,795±0,392	2,614±0,392	2,658±0,320	3,715±0,392	ns
Ca	15,090±1,677	12,855±1,677	17,055±1,677	13,155±1,677	13,015±1,677	13,227±1,369	15,045±1,677	ns
Mg	4,180±0,543	3,670±0,543	4,720±0,543	3,640±0,543	3,605±0,543	3,660±0,443	5,080±0,543	ns
Na	0,535±0,072	0,455±0,072	0,660±0,072	0,510±0,072	0,460±0,072	0,467±0,059	0,645±0,072	ns
Fe	2,444±1,020	0,733±1,020	0,723±1,020	0,490±1,020	0,603±1,020	0,770±0,832	0,950±1,020	ns
Cu	2,467±0,418	2,680±0,418	1,810±0,418	1,557±0,418	2,483±0,418	2,076±0,341	3,139±0,418	ns
Zn	0,943±0,908	1,256±0,908	3,329±0,908	0,494±0,908	1,985±0,908	0,850±0,742	0,981±0,908	ns
Pb	0,248±0,034	0,239±0,034	0,347±0,034	0,165±0,034	0,391±0,034	0,152±0,028 af	0,238±0,034	**

Mn	7,729±1,926	5,348±1,926	2,462±1,926	5,169±1,926	4,284±1,926	5,151±1,572	3,797±1,926	ns
B	0,174±0,049	0,193±0,049	0,259±0,049	0,157±0,049	0,145±0,049	0,300±0,040	0,197±0,049	ns
Ni	0,832±0,473	2,920±0,473	0,549±0,473	2,002±0,473	0,568±0,473	1,309±0,386	1,049±0,473	ns
Cd	0,026±0,005	0,014±0,005	0,022±0,005	0,014±0,005	0,026±0,005	0,012±0,004 AC	0,019±0,005 AC	*

Parametres	**Locations (Villages)**							**ÖD**
	Serçeboğaz	**Sunak**	**Tar.araş.ens.**	**Taşkaynak**	**Tepecik**	**Ügümü**	**Yayladağ**	
pH	7,800±0,216	8,115±0,216	7,815±0,216	7,738±0,216	8,073±0,216	7,668±0,216 AD	7,057±0,216 DE	**
Org. Mat	2,125±0,604	2,023±0,604	1,140±0,604	1,573±0,604	1,308±0,604	1,608±0,604	2,362±0,604	**
$CaCO_3$	6,875±2,866	15,561±2,866	4,343±2,866	6,540±2,866	10,236±2,866	4,028±2,866	,229±2,866	ns
EC	0,843±0,089	0,380±0,089 bd	0,414±0,089	0,408±0,089	0,389±0,089	0,435±0,089	0,504±0,089	*
Clay	31,440±6,733	50,300±6,733	36,175±6,733	60,808±6,733	43,100±6,733	34,958±6,733	44,848±6,733	ns
Silt	26,981±2,502	23,179±2,502	23,678±2,502	19,472±2,502	21,984±2,502	24,171±2,502	26,464±2,502	ns
Sand	41,579±6,806	26,521±6,806	40,147±6,806	19,720±6,806	34,916±6,806	40,872±6,806	28,688±6,806	ns
CEC	27,835±3,049	24,715±3,049	23,090±3,049	21,275±3,049	21,790±3,049	19,645±3,049	18,900±3,049	ns
N	0,140±0,022	0,135±0,022	0,120±0,022	0,135±0,022	0,150±0,022	0,165±0,022	0,140±0,022	ns
NH_4^+	56,000±11,664	59,500±11,664	70,000±11,664	63,000±11,664	70,000±11,664	49,000±11,664	56,000±11,664	ns
NO_3^-	59,500±6,973 bc	49,000±6,973 bc	56,000±6,973	49,000±6,973 bc	63,000±6,973	56,000±6,973 bc	63,000±6,973 bc	*
P	41,500±10,924	9,000±10,924	35,000±10,924	28,500±10,924	25,500±10,924	29,000±10,924	14,000±10,924	ns
P_2O_5	95,035±25,017	20,610±25,017	80,150±25,017	65,265±25,017	58,395±25,017	66,410±25,017	32,060±25,017	ns
K	3,000±0,324	2,820±0,324	2,630±0,324	2,425±0,324	2,350±0,324	2,240±0,324	2,035±0,324	ns
K_2O	3,630±0,392	3,412±0,392	3,182±0,392	2,934±0,392	2,843±0,392	2,710±0,392	2,462±0,392	ns
Ca	18,090±1,677	16,065±1,677	15,010±1,677	13,830±1,677	14,160±1,677	12,770±1,677	12,285±1,677	ns
Mg	5,010±0,543	4,580±0,543	4,280±0,543	3,830±0,543	3,920±0,543	3,535±0,543	3,400±0,543	ns

Na	0,640±0,072	0,570±0,072	0,530±0,072	0,535±0,072	0,500±0,072	0,495±0,072	0,430±0,072	ns
Fe	0,561±1,020	0,816±1,020	0,378±1,020	0,339±1,020	0,605±1,020	3,068±1,020	1,229±1,020	ns
Cu	2,088±0,418	3,071±0,418	2,528±0,418	1,659±0,418	2,754±0,418	1,951±0,418	2,103±0,418	ns
Zn	2,701±0,908	1,133±0,908	0,623±0,908	0,784±0,908	1,127±0,908	4,361±,908	1,192±,908	ns
Pb	0,117±0,034 ef	0,257±0,034 bd	0,238±0,034	0,208±0,034 bf	0,213±0,034 cf	0,328±0,034 ac	0,252±0,034 bd	**
Mn	3,434±1,926	5,958±1,926	1,119±1,926	4,121±1,926	1,801±1,926	4,659±1,926	5,417±1,926	ns
B	0,311±0,049	0,184±0,049	0,214±0,049	0,170±0,049	0,192±0,049	0,286±0,049	0,171±0,049	ns
Ni	0,484±0,473	1,440±0,473	0,954±0,473	0,588±0,473	1,084±0,473	0,680±0,473	0,899±0,473	ns
Cd	0,022±0,005 AC	0,025±0,005 AE	0,010±0,005 E	0,015±0,005 BE	0,015±0,005 BE	0,029±0,005 AB	0,023±0,005 AE	*