Estımatıon Of Nutrıtıonal Status Of Potato (*Solanum Tuberosum* L.) Plant By Soıl And Leaf Analyses Grown In Erzurum Center

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ABSTRACT
This study was conducted to determine the fertility potential of potato grown soils in Erzurum region To achive this a total of 19 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 loamy, sandy clay loamy and clay loamy soils covered 65.11, 27.35, and 7.54 % of the study area, respectively. Most of the soil pH measurements in the area fell between slightly alkaline and 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.
Texture classes of in City center Erzurum region agriculture soils, were sandy caly loamy. Soil reaction (pH) of Erzurum soil samples were slightly alkaline reaction. Organic matter (OM) content of City center soil samples is usually very low. Salt content City center soil samples were found have medium.
Texture classification of agricultural soils within Erzurum city consisted of sandy-clayey loamy. Soil samples of Erzurum showed a between slightly alkaline and alkaline reaction. Organic matter (SOM) and total salt content of soils sampled from the City center were usually low
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 Erzurum. Plant available P content is insufficient in plant leaf samples.
As a result of this. potato plant leaves grown on Erzurum Plain (City center) 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 19 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 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 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]..

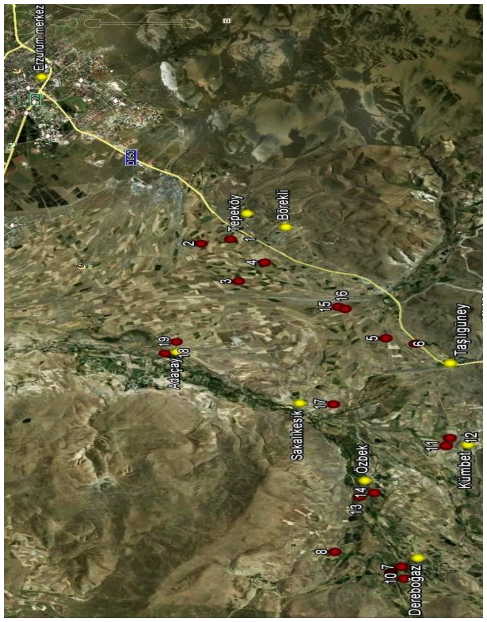

Figure 1: Soil and potato leaf sampled points of Erzurum plain

3. RESULTS AND DİSCUSSION

3.1 Evaluation of The Soil Analyses results

Chemical and physical proferties of sampled soils; texture classes ranged from 5.26% loamy. 47.37% sandy-clayey loamy. 15.79% was 1.58 clayey-loamy of soils sampled from central Erzurum. 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 6.47-7.99 and averaging 7.10. This findings suggests that 84.22 % of the soils are neutral and 15.78 % 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 0.02-2.10% with an average of 0.93%. This finding suggested that 52.63% of the soil samples are very low. 42.10% are low and 5.60% are 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 0.05-0.53. 99 % averaging 0.13%. 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 0.23-0.53 dS/cm and averaging 0.36 dS/cm. This finding suggests that 42.10% of the soil samples are light salty and 57.89% are medium 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 17.07-49.70 cmol kg-1 with an average of 23.81 cmol kg-1 (FAO 1990[1].; Tovep 1991[1].; Güneş vd 1998[1]).

The total amount of nitrogen in the soil ranged from 0.11-0.29% with an average of 0.19%. These findings suggest that 42.10% of of the samples are sufficient whereas 57.90% were rich. Plant available NH4+-N level of the soil samples ranged from 28-98 mg kg-1 and averaging 54.01 mg kg-1. Plant available NO3- N level of the soil samples ranged from 14-70 mg kg-1 averaging 35.37 mg kg-1.

Plant available P level of the soil samples ranged from 6-65 mg kg-1 and avaraging 26.05 mg kg-1. This finding suggests that 5.26 % of the samples are low. 52.63% are sufficient and 42.10 % excess.

The exchangeable K level ranged from 1.95-5.67 cmolkg-1 with an average of 2.71 cmol kg^1.

Ca excahangeable level also ranged from 10.62-30.90 cmol kg-1 with 14.32 cmol kg-1 avearage. These findings suggest that 73.69% of the samples are sufficient.

For Mg. the exchangeable level ranged from 3.07-8.93 cmol kg-1. averaging 4.15 cmol kg-1. This finding indicates a 73.68% sufficience whereas 26.32% were in excess.

Na showed an exchangeable range of 0.39-1.14 cmol kg-1and avaraging 0.55 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 0.61-5.09 mg kg-1 with an average of 1.74 mg kg-1. This finding suggests that 94% and 74 % of the samples were sufficient. This finding suggests that 5% and 26 % were in excess.

Plant available Cu level of the soil samples ranged from 1.07-3.80 averaging 1.85 mgkg-1. This suggests that all the samples are sufficient. The research further revealed that Zn levels of soil samples ranged from 0.67-7.91. averaging 2.26 mg kg-1. This finding suggests that 68.42% of the samples were sufficient and 31.58% of the samples were excess. B levels of soil samples also ranged from 0.12-1.01 mgkg-1 averaging 0.34 mgkg-1. This indicates that 94.73% of the samples were so low and 5.27% of the samples were sufficient. 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 1.11-14.87 mgkg-1 and averaging 6.75 mgkg-1. This suggests that 26.31 % of these samples are too low. 68.42% were low and 5.26% were sufficient respectively. 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 0.05-0.26 mg kg-1 and averaging 0.16 mgkg-1 of Pb concentration was observed. Ni concentration ranging from 0.25-1.50 at an average of 0.70 mg kg-1 was further observed. Finally. a Cd concentration ranging from 0.01-0.03 mgkg-1 at an average of 0.02 mgkg-1 was also observed.

4. 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 4.49%-6.42 % with an average of 5.50%. Nitrogen content were high in all leaf samples.

P content of the leaf samples ranged from 0.10-0.35% with an average of 0.19%. 60.81% of the leaf samples were insufficient while 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 2.40-5.69% with an average 4.24%. 15.78% of leaf samples were sufficient and suggests that 84.21% of the samples were in excess.

Ca content of the leaf also ranged from 0.60-1.33% with an average of and it is averaging 0.92%. All the leaf samples are sufficient.

Mg content of the leaf samples ranged from 0.29-1.45 % averaging 0.64%. This finding suggests that 63.15% of the leaf samples are sufficient. 36. 85% of the leaf samples are high.

Na content of the leaf samples ranged from 0.02-0.09 % 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 106.50-416.40 mg kg-1 averaging 175.36 mg kg-1. This finding suggests that 31.57% of the leaf samples are sufficient 68.43% of the leaf samples are excess.

Cu content the leaf samples ranged from 10.29-19.25 mg kg-1 averaging 14.44 mg kg-1. This finding suggests that all of the leaf samples are sufficent.

Zn of the leaf samples ranged from 23.32-49.12 kg-1. averaging 32.48 mg kg-1. This finding suggests that 42.85% of the leaf samples are low. 28.57% of the leaf samples are sufficient.

Mn content of the leaf samples ranged from 36.27-100.20mgkg-1. averaging 68.32 mgkg-1. This finding suggests that 94.73% of the leaf samples are sufficient and 5.27% of the leaf samples are excess.

B content of leaf samples ranged from 10.08-17.75 mgkg-1. averaging 12.90mg kg-1. This finding suggests that all of the leaf samples are low. 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 0.01-2.63 with an average of 1.98 mgkg-1. Also, Ni leaf content ranged from 0.35-5.74 mgkg-1 averaging 3.05mgkg-1. Obtained Cd content from leaf samples also ranged from 0.03-0.31 mgkg-1 averaging 0.14 mgkg-1. Correlation analyses was then applied to the data to determine the reletionship between soil characteristics and leaf mineral content of soils from Central Erzurum. This is showned in Table 1.

5.CONCLUSION AND SUGGESTIONS

Significiant negative relationships were found for plant available NO_3 concentrations, soil pH, sand content of soil sampled from Erzurum plain with K, Ca, Na, S, Zn and B content of plant leaf samples.

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

Results from the study indicates that the soils and plants are deficient in P, Zn, Mn 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 Fe and Cu were in suffecient level and Pb and Cd is not at toxic levels in plant and soils. Plant available Zn, B and Mn is also low in soils from Erzurum. Plant available P content is insufficient value in plant leaves.

Finally, due to Phosphorus (P), boron (B), manganese (Mn) 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 P, Zn, Mn 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, Phosphorus (P), boron (B), manganese (Mn) 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, Mn, and B sourced soil and foliar fertilizers should be added to increase its productivity by considering with field/greenhouse experiments later on.

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Table 1. The correlation coefficiencies of soil and leaf properties studied

Parametres	Locations (Villages)								ÖD
	Adaçay	Börekli	Dereboğaz	Kümbet	Özbek	Sakalıkesik	Taşlıgüney	Tepeköy	
N	5,205±0,212 CD	4,793±0,212 D	5,816±0,150 AC	5,978±0,212 AB	6,318±0,212 A	5,142±0,173 CD	5,408±0,212 BD	5,160±0,212 CD	**
P	0,155±0,012 CD	0,160±0,012 CD	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	**
K	4,855±0,405	3,740±0,405	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	**
Ca	1,285±0,081 A	,980±0,081 B	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	**
Mg	0,700±0,045 A	0,515±0,045 B	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	**
Na	0,030±0,014	0,070±0,014	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
S	0,345±0,053	0,310±0,053	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
Fe	321,450±38,236	190,250±38,236	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
Cu	17,050±2,020	11,270±2,020	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
Zn	29,190±4,416	27,515±4,416	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
Pb	0,160±0,290	0,335±0,290	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
Mn	67,200±11,974	94,895±11,974	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
Ni	1,156±1,029	3,165±1,029	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
B	11,000±0,841	12,255±0,841	17,010±0,594	14,555±0,841	11,855±0,841	11,467±0,686	10,175±0,841	11,460±0,841	**
Cd	0,088±0,061 C	0,112±0,061	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