



Araştırma Makalesi (Research Article)

Evaluation of Nutritional Status In Term of Selenium and Micro Nutrients of Maize Cultivation Lands in Sanliurfa Province

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Abstract: This study was conducted to determine the nutritional status of maize cultivated lands and maize plant in Sanliurfa province in term of selenium and micro elements. For this purpose, samples of soil and plants were taken from Sanliurfa province and Akcakale, Ceylanpinar, Harran and Viransehir districts. Texture, soil reaction, electrical conductivity, CaCO₃, organic matter, available selenium, exchangeable iron, zinc, copper, manganese and boron analysis were done in the soil samples. Total iron, zinc, copper, manganese, selenium and boron content were determined in plants samples. According to results of soil and leaf analysis, nutritional problems in term of selenium have been determined in the lands of maize cultivation in all districts. Nutritional problem in term of zinc has been determined in only Ceylanpinar district, in term of copper has been determined in Ceylanpinar and Viransehir district. Considering the results of the work carried out in Sanliurfa; it is understood that effective fertilization programs, methods and fertilization time are extremely important. The quality and highly efficient production in the maize cultivation is related to balanced fertilization, addition of organic fertilizers and other technical applications.

Şanlıurfa İlinde Mısır Tarımı Yapılan Alanların Selenyum ve Mikro Besin Elementleri Bakımından Beslenme Durumunun Değerlendirilmesi

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Anahtar kelimeler

Mısır,
Mısır alanları,
Beslenme durumu,
Şanlıurfa,
Selenyum.

Öz: Bu çalışma, Şanlıurfa ilinde mısır yetiştiriciliği yapılan toprakların ve mısır bitkisinin selenyum ve mikro elementler açısından beslenme durumlarının belirlenmesi amacıyla yürütülmüştür. Bu amaçla Şanlıurfa ili Merkez, Akcakale, Ceylanpinar, Harran ve Viransehir ilçelerinden toprak ve yaprak örnekleri alınmıştır. Toprak örneklerinde; tekstür, pH, EC, CaCO₃, organik madde, alınabilir selenyum ve değişebilir demir, çinko, bakır, mangan, bor analizleri yapılmıştır. Yaprak örneklerinde toplam demir, çinko, bakır, mangan, selenyum ve bor içerikleri belirlenmiştir. Toprak ve yaprak analiz sonuçlarına göre; tüm ilçelerde mısır tarımı yapılan alanlarda selenyum açısından beslenme sorunlarının yaşandığı tespit edilmiştir. Çinko açısından beslenme sorununun sadece Ceylanpinar ilçesinde, bakır açısından beslenme sorununun da Ceylanpinar ve Viransehir ilçesinde yaşandığı tespit edilmiştir. Şanlıurfa ilinde gerçekleştirilen bu çalışmanın sonuçları dikkate alındığında, etkili gübreleme programı, yöntemi ve zamanının son derece önemli olduğu anlaşılmaktadır. Mısır tarımında kaliteli ve yüksek verimli üretim; dengeli gübreleme, organik gübre ilavesi ve diğer teknik uygulamalarla ilgilidir.

1. Introduction

In the nutrition circle among human, plant and animal, the use of plant nutrient sources is important in animal feed, the use of animal nutrient sources is important in human nutrition. Maize is one of the important nutrients used as human food and animals feed. In recent years, maize has become the most important grain product used in the food industry of the modern world. In the World, the maize production is in second place after sugar cane with production amount of 1 016 736 092 tons according to the year 2013 data. In Turkey maize production with the 5.9 million tons production is in fourth place after wheat, sugar beet and barley. In Sanliurfa province, maize production is 732 125 tons of grain, 205 635 tons of silage on the 1 003 482 da area (Anonymous, 2013). Light acidic, unsalted, good organic matter, low medium calcareous and tin structure soils are ideal for maize plants. For maize plants, it is desired soil that the groundwater level is not high, well drained but sufficiently waterholding, without stone gravel, dark and in term of macro-micronutrients sufficient and balanced (Zengin and Ozbahce, 2011). The soil selection of maize plant is not too high, outside of very sandy or heavy clay soils, the soils of rich organic matter and plant nutrient, well drained, high water retention capacity are the most suitable for high yield (Kun, 1985), and high grain yields are obtained due to the developments of good root in deep, loamy and clayey-loamy soils (Bayram and Elmaci, 2014). Kun (1985) found that maize cultivation can be carried out in a very wide range of soil due to the reaction, but that the most suitable soil is slightly acidic or neutral soils maize is included in the medium-sensitive plants class in term of soil salinity. In general, maize plants can start to germinate when the soil temperature is 10-11 °C, germination accelerates when the temperature of the soil reaches 15 °C at 5-10 cm depth. When the temperature reaches 32 °C, a sudden decrease in the stem, stem extension is observed, when the temperature reaches 40 °C, germination stops (Kirtok, 1998). In term of human nutrition, maize grain contains iron (Fe), magnesium (Mg), potassium (K), A, B1, B3, B9 and C, as well as high carbohydrate (starch), protein, different sugar derivatives, fiber and fat content. Due to high protein, vitamin A content, maize grains become indispensable in animal nutrition, participate in feed rations at a rate of 15-65% (Emeklier, 2002). Maize grain has become one of the most important silage plants in the world for ruminant animals in recent years with the development of silage techniques, together with being a good feed for single mussels and poultry in animal feeding. The intense consumption of cerealbased foods, which are poor in micronutrient, causes micronutrient deficiencies in humans and serious health problems associated with it (Welch and Graham, 2005; Cakmak, 2008; Cakmak et al., 2009). These important nutrients are Fe, zinc (Zn) and selenium (Se). Selenium is one of the most studied micronutrients in the world along with Fe and Zn (Cakmak et al., 2009). Selenium which has an important place in nutrient is also commonly consumed by feed (Shamberger, 1984). Selenium has a potent antioxidant role in animals with vitamin E as synergistic action (Lawrence et al., 2003). In animal, white muscle disease occurs in case of lack Se. It is desirable that concentration of Se in consumed foods should be between 100-1000 µg kg⁻¹ for adequate nutrition of humans and animals (Alloway, 1968; Adams et al., 2002; Broadley et al., 2007; Cakmak et al., 2009). The most important source of Se and other nutrients in plant-based foods is soil (Marchner, 1995). Excessive or inadequate fertilization reduces yields, negatively affects product quality, and increases the susceptibility of plants to disease and harm (Gunes et al., 2000). Soil and leaf analysis should be used in order to establish a correct fertilization program in plants crops. With the soil analyzes the available concentrations of the nutrients in the soil are determined for plants, and the insufficiencies can be eliminated by fertilization. However, in addition of soil analysis, plant analysis need to be done in order to determination of the nutritional levels of plants and apply of fertilization programs. Plant analysis is a very important technique in term of revealing the utilization rate of plants from the nutrients available in the soil. There are many ecological factors limiting nutrient uptake conditions, although the nutrient ions are available (Deliboran et al., 2014).

This study aimed to determination of the nutritional status of maize growing areas in the Center, Viransehir, Ceylanpinar, Harran and Akcakale districts of Sanliurfa province in terms of Se and micro nutrients by soil and leaf analysis; to compare the obtained results with the reference values and to determine the problems arising for various reasons.

2. Materials and Methods

Soil and leaf samples constituting the research material were collected from total 38 maize farms in 2012 as Sanliurfa province Center, Akcakale, Ceylanpinar, Harran and Viransehir (Figure 1). Soil samples were taken from 0-30 cm depth (Jackson, 1967); leaf samples were taken from the complete leaves that has not completed its development just below the point where the hilltop leaves before pre-tuft of maize plants. The samples were prepared for analysis according to Kacar (1972).

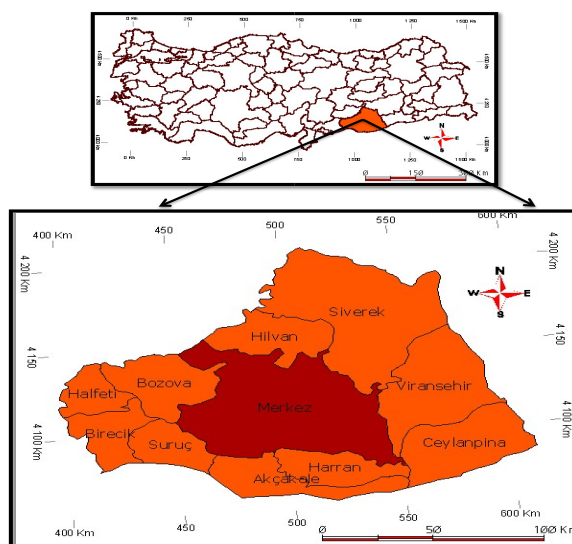


Figure 1. The research area.

In soil samples, texture (Bouyoucos, 1995); pH, electrical conductivity (EC), lime (CaCO_3) (Tuzuner, 1990); organic matter (OM) (Black, 1965); extractable Fe, Zn, manganese (Mn), copper (Cu) (Lindsay and Norvell, 1978); available boron (B) (Kacar, 1995) were determined. Available Se was determined by KH_2PO_4 extraction method by the Atomic Absorption Spectrophotometer (ASS) connected to ETC-60 (Electrothermal Temperature Controller) and VGA-77 (Vapor Generator Aparatus) apparatus (Cakmak et al., 2009).

Plant samples were burned with nitric acid (HNO_3)+perchloric acid (HClO_4) mixture and total B, Fe, Cu, Zn, Mn were determined by ICP (Kacar, 1995). Samples were dried to a constant weight at 40 °C in an air circulating dryer cabinet. The dried and ground samples were prepared for Se determination by wet digestion in microwave oven with 5 ml concentrated HNO_3 and 2 ml 30% hydrogen peroxide (H_2O_2) by using a digesting program, which have been developed. All Se measurements were checked against certificated Se values in different reference plant material (1547 Peach Leaves, NIST). After digestion, the total volume was completed up to 20 ml, and Se concentration of the samples were measured by ASS equipped with VGA 77 and ETC-60. Firstly, Se (+ VI) in the samples was reduced to Se (+ IV) form by treatment with hydrochloric acid. After, it was reacted with sodium tetraborate (NaBH_4) reductive in acidic medium and it was reduced to form volatile hydrogen selenide (SeH_2) and the absorption intensity was measured by atomizing SeH_2 at high temperature (850-950 °C) with ETC-60 instrument in the hydride forming unit of a hydride generator module (VGA-77) which mounted in front of the sample entry system of the Se (+ IV) AAS device. The accuracy and reproducibility of the analysis values were controlled using standard reference materials (NIST, Gaithersburg, USA) (Cakmak et al., 2009).

3. Results

3.1. Physical and chemical properties of soils

Some physical and chemical properties of Center, Viransehir, Ceylanpinar, Harran, Akcakale districts and General were given Table 1. In General the sand, clay and silt content of soils changed between 17-45%, 19-63%, 13-48%; the soil reaction, lime, OM and EC contents were between 7.10-8.00; 0.4-29.2%; 1.32-3.27%, 0.49-1.61 dS m⁻¹, respectively.

Table 1. Some physical and chemical properties of soil samples taken from maize cultivation area in the Sanliurfa province

Province		Texture (%)			pH	EC (ds m ⁻¹)	CaCO ₃ (%)	O.M. (%)
		Sand	Clay	Silt				
Center	Minumum	17	53	17	7.59	0.90	0.40	1.70
	Maximun	22	61	21	7.81	1.36	26.9	3.13
	Average	26	55	19	7.69	1.06	12.1	2.27
Viransehir	Minumum	22	51	13	7.61	0.92	7.6	1.59
	Maximun	28	63	22	7.81	1.44	14.0	2.39
	Average	25	59	17	7.68	1.35	10.8	1.98
Ceylanpinar	Minumum	22	33	19	7.59	0.49	16.3	1.89
	Maximun	43	59	26	7.75	0.88	28.8	3.27
	Average	35	42	23	7.64	0.67	25.1	2.50
	DK	21	19	12	1	19	18	20
Harran	Minumum	27	43	16	7.43	0.49	21.2	1.35
	Maximun	37	53	26	7.76	1.60	27.3	2.71
	Average	32	47	21	7.60	1.07	24.3	2.04
Akcakale	Minumum	21	19	16	7.10	0.65	15.1	1.32
	Maximun	45	53	48	8.00	1.61	29.2	3.11
	Average	31	44	25	7.72	1.11	23.0	2.03
General	Minumum	17	19	13	7.10	0.49	0.40	1.32
	Maximun	45	63	48	8.00	1.61	29.20	3.27
	Average	30	48	22	7.66	1.03	19.88	2.19
	Kurtosis	-0,44	0,73	12,58	4,47	0,04	-0,04	-0,13
	Skewness	0,58	-0,71	2,75	-1,02	0,52	-1,02	0,40
	Median	29,44	49,05	21,50	7,68	1,03	22,60	2,20
	StdS	6,74	9,85	5,64	0,15	0,34	8,46	0,50
	Variance	44,25	94,47	30,93	0,02	0,12	69,65	0,25
DK	22	21	26	2	33	43	23	

The soil reaction was determined between 7.59-7.81, 7.61-7.81, 7.59-7.75, 7.43-7.76, 7.10-8.00 and 7.10-8.00; the lime and OM contents changed between 0.4-26.9%, 7.6-14.0%, 16.3-28.8%, 21.2-27.3%, 15.1-29.2%, 0.4-29.2%; and between 1.70-3.13%; 1.59-2.39%; 1.89-3.27%; 1.35-2.71%, 1.32-3.11%, 1.32-3.27%, respectively. Also the EC content varied between 0.49-1.61 dS m⁻¹ (Table 1).

The extractable B, Fe, Zn, Mn and Cu contents ranged between 0.16-1.12 mg kg⁻¹, 1.42-5.09 mg kg⁻¹, 0.17-4.63 mg kg⁻¹, 0.02-5.19 mg kg⁻¹, 0.47-1.93 mg kg⁻¹, respectively in General. In General, Se content changed 0-50.830 µg kg⁻¹. In the Central district, the available Se content changed between 1.039-50.830 µg kg⁻¹; in the provinces of Viransehir, Ceylanpinar, Harran and Akcakale, the Se content was found to be less than 1 µg kg⁻¹ (Table 2).

Table 2. Extractable B, Fe, Zn, Mn, Cu and available Se concentrations of soil samples taken from the maize cultivation area in the Sanliurfa province

Province		Extractable elements (mg kg ⁻¹)					Se (µg kg ⁻¹)
		B	Fe	Zn	Mn	Cu	
Center	Minimum	0.17	1.81	0.27	1.90	0.98	1.039
	Maximum	0.77	4.09	4.63	5.19	1.46	50.830
	Average	0.35	3.22	1.60	3.27	1.22	10.320
	Kurtosis	1.56	-0.08	-0.32	0.18	-1.20	6.57
	Skewness	1.46	-0.67	1.24	0.64	-0.27	2.54
	Median	0.24	3.09	0.64	3.15	1.26	2.35
	StdS	0.22	0.82	1.79	1.11	0.18	18.04
	Variance	0.04	0.57	2.74	1.06	0.03	278.84
	DK	63	25	112	34	15	175
Viransehir	Minimum	0.16	2.36	0.33	2.09	1.17	<1ppb
	Maximum	0.25	3.33	2.67	3.68	1.20	<1ppb
	Average	0.22	3.02	0.95	3.02	1.18	<1ppb
	Kurtosis	2.09	3.76	4.61	0.39	-1.56	-2.91
	Skewness	-1.35	-1.88	2.12	-0.75	0.47	-0.24
	Median	0.22	3.18	0.57	2.98	1.18	0.41
	StdS	0.03	0.38	0.97	0.62	0.01	0.15
	Variance	487.69	64.32	1497.26	120.64	23.99	11236.57
	DK	16	13	103	21	1	40
Ceylanpinar	Minimum	0.23	1.42	0.17	2.11	0.47	0
	Maximum	0.44	2.68	4.59	4.87	0.98	<1ppb
	Average	0.34	2.10	1.73	3.43	0.76	<1ppb
	Kurtosis	-0.80	-0.03	-1.64	-1.73	2.78	9.00
	Skewness	0.21	-0.29	0.62	0.05	-0.77	3.00
	Median	0.34	2.06	0.38	3.61	0.76	0.00
	StdS	0.06	0.31	1.37	0.83	0.04	0.00
	Variance	0.00	0.13	2.92	1.01	0.02	0.00
	DK	17	15	79	24	5	0
Harran	Minimum	0.35	2.32	0.21	1.91	0.84	0
	Maximum	0.78	5.09	2.72	4.87	1.37	<1ppb
	Average	0.53	3.34	1.36	3.71	1.06	<1ppb
	Kurtosis	2.65	1.81	-0.48	0.85	-0.30	7.00
	Skewness	1.09	1.09	0.50	-0.80	0.60	2.65
	Median	0.50	3.38	1.18	3.48	1.09	0.00
	StdS	0.13	0.92	0.86	0.99	0.19	0.03
	Variance	0.02	0.73	0.64	0.85	0.03	0.00
	DK	26	28	64	27	18	265
Akcakale	Minimum	0.42	1.57	0.18	0.02	0.74	0
	Maximum	1.12	3.99	1.83	4.82	1.93	<1ppb
	Average	0.62	2.70	0.76	2.88	1.24	<1ppb
	Kurtosis	0.54	-0.43	-1.05	0.63	0.10	0.29
	Skewness	1.21	0.00	0.69	-0.50	0.98	1.38
	Median	0.52	2.65	0.53	2.84	1.13	0.00
	StdS	0.24	0.78	0.61	1.43	0.39	0.36
	Variance	0.05	0.55	0.33	1.84	0.14	0.12
	DK	39	29	80	50	32	170
General	Minimum	0.16	1.42	0.17	0.02	0.47	0.000
	Maximum	1.12	5.09	4.63	5.19	1.93	50.830
	Average	0.44	2.84	1.34	3.22	1.09	3.181
	Kurtosis	1.67	0.28	0.83	0.41	1.56	34.89
	Skewness	1.23	0.48	1.37	-0.38	0.82	5.82
	Median	0.42	2.78	0.67	3.41	1.06	0.00
	StdS	0.22	0.81	1.30	1.11	0.30	8.30
	Variance	0.05	0.64	1.65	1.20	0.09	67.01
	DK	49	29	98	35	28	261

3.2. Micro nutrient content of plant

In General, total B contents ranged from 17.56 to 160.60 mg kg⁻¹, total Fe, Cu, Zn, Mn between 67.97-253.00, 10.93-27.52, 14.36-101.50, 58.30-270.50 mg kg⁻¹, respectively. Se contents ranged between <10-38.48 µg kg⁻¹ in the Center, between 0-27.53 µg kg⁻¹ in Viransehir, depending on the provinces in general ranges from 0 to 38.48 µg kg⁻¹. The samples taken from Ceylanpinar, Harran and Akcakale districts do not contain Se (Table 3).

Table 3. Values for total B, Fe, Zn, Mn, Cu and Se concentrations of maize leaf samples

Province		B	Fe	Zn	Mn	Cu	Se
		%					
Center	Min.	17.56	75.90	26.71	90.87	17.17	<10 ppb
	Max.	32.62	156.10	101.50	157.80	26.54	38.48
	Avr.	26.77	101.56	48.33	113.80	20.89	18.76
Viransehir	Min.	36.43	67.97	24.77	86.07	17.80	nd
	Max.	149.20	97.59	57.27	176.90	25.66	27.53
	Avr.	98.95	88.26	38.67	124.31	19.69	<10 ppb
Ceylanpinar	Min.	79.21	79.92	14.36	67.83	15.00	nd
	Max.	160.60	156.40	88.24	177.40	26.15	nd
	Avr.	113.13	114.41	46.08	119.99	20.21	nd
Harran	Min.	43.72	121.70	27.18	58.30	12.13	nd
	Max.	56.10	253.00	83.17	206.50	19.27	nd
	Avr.	49.24	164.96	52.81	126.63	15.74	nd
Akcakale	Min.	28.02	116.10	17.29	74.18	10.93	nd
	Max.	74.67	243.70	75.19	270.50	27.52	13.32
	Avr.	51.43	166.19	47.13	151.66	18.11	<10 ppb
General	Min.	17.56	67.97	14.36	58.30	10.93	nd
	Max.	160.60	253.00	101.50	270.50	27.52	38.48
	Avarage	67.90	127.08	73.22	127.28	18.93	<10 ppb

nd: not detected.

4. Discussion and Conclusion

4.1. Physical and chemical properties of soils

According to Anonymous (1951); all soil samples of Center, Harran and Viransehir were C; 10% of Akcakale were L, 20% CL, 70% C; 56% of Ceylanpinar were CL, 44% C (Table 4). The vast majority of the studied agricultural lands were heavily textured (C) and the territory of the region is suitable for maize cultivation in terms of structure (Bayram and Elmaci, 2014).

Table 4. Distribution of some pyhsical and chemical properties of soil samples taken from maize cultivation areas according to the limits of adequacy

Properties	Center		Akcakale		Ceylanpinar		Harran		Viransehir		General		
	NS	%	NS	%	NS	%	NS	%	NS	%	NS	%	
Texture (%)	Loamy (L)	-	-	1	10	-	-	-	-	-	-	1	3
	Clayey Loamy (CL)	-	-	2	20	5	56	-	-	-	-	7	18
	Clayey (C)	7	100	7	70	4	44	7	100	5	100	30	79
pH	6.6-7.3	-	-	1	10	-	-	-	-	-	-	1	3
	7.4-7.8	7	100	6	60	9	100	7	100	5	100	34	89
	7.9-8.4	-	-	3	30	-	-	-	-	-	-	3	8
	8.5-9.0	-	-	-	-	-	-	-	-	-	-	-	-
EC (mmhos cm^{-1})	2.5>	7	100	10	100	9	100	7	100	5	100	38	100
	2.6-4.5	-	-	-	-	-	-	-	-	-	-	-	-
	4.6-6.9	-	-	-	-	-	-	-	-	-	-	-	-
	7.0-10.0	-	-	-	-	-	-	-	-	-	-	-	-
10<	-	-	-	-	-	-	-	-	-	-	-	-	
CaCO ₃ (%)	0-2.5	2	29	-	-	-	-	-	-	-	-	2	5
	2.6-5.0	1	14	-	-	-	-	-	-	-	-	1	3
	5.1-10.0	1	14	-	-	-	-	-	2	40	3	8	
	10.1-20.0	-	-	3	30	1	11	-	-	3	60	7	18
	20.0<	3	43	7	70	8	89	7	100	-	-	25	66
O.M (%)	0-2	2	29	5	50	1	11	3	43	2	40	13	34
	2-5	5	71	5	50	8	89	4	57	3	60	25	66
	5-10	-	-	-	-	-	-	-	-	-	-	-	-

NS: Number of samples.

According to Kellogg (1952), all of the soils of Center, Ceylanpinar, Harran and Viransehir were mild alkaline; 10% of Akcakale neutral, 60% mild alkaline, 30% alkaline. Generally 3% of the soil were neutral, 89% mild alkaline, 8% alkaline (Table 4). Considering that maize vegetation can show the best growth in 6-7 pH range (Larson and Hanway, 1977; Zengin and Ozbahce, 2011), as a results of our study the soil of the region is suitable for maize farming in terms of pH. However, in order to decrease the pH in the alkaline reacting soil, powdered sulfur should be used in the autumn, preferably with farmyard or physiological acid fertilizers (Deliboran et al., 2014). Depending on the causes of alkalinity, opening of drainage channels, washing with water, soil jibs application can be done.

All of soils were unsalted class, the research area does not constitute a problem for salinity. If the soil salinity increases to 10 mmhos cm^{-1} , it is impossible to obtain the yield (Doorenhos and Kassam 1979; Kilic, 2005). In term of CaCO_3 , 29% of the Center were low, 14% limy, 14% high, 43% extreme limy. In Harran, Akcakale, Ceylanpinar, Viransehir and General, all of the soils were very high and extreme limy class (Table 4). The lime content of the research soils were high when considering that the maize plant grows well in the low-medium limy soil.

29% of Center, 50% of Akcakale, 11% of Ceylanpinar, 43% of Harran, 40% of Viransehir and 39% of General soils were humus-poor class (Table 4), all soils were poor class. There is a generally high correlation between the OM and Zn content which is caused by the chelating compounds are cleaved during the decomposition of the OM, by increasing the Zn availability by making zinc-chelate compound (Aktas, 1995). For these reasons, it is thought that importance should be attached to organic fertilization.

Table 5. Distribution of determined extractable B, Fe, Zn, Cu, Mn and available Se concentrations of the soil samples taken from maize cultivation areas according to the limits of adequacy

Properties	Center		Akcakale		Ceylanpinar		Harran		Viranşehir		Gernel			
	NS	%	NS	%	NS	%	NS	%	NS	%	NS	%		
Extractable B (mg kg^{-1})	<0.50	Very low	5	71	5	50	9	100	2	29	5	100	26	68
	0.50-0.99	Low	2	29	4	40	-	-	5	71	-	-	11	29
	1.00-	Adaquate	-	-	1	10	-	-	-	-	-	-	1	3
	2.49	Much	-	-	-	-	-	-	-	-	-	-	-	-
	2.50-4.99	Very much	-	-	-	-	-	-	-	-	-	-	-	-
>5.00														
Extractable Fe (mg kg^{-1})	2.5>	Lack	1	14	3	30	8	89	2	29	1	20	15	39
	2.5-4.5	Show deficieny	6	86	7	70	1	11	4	57	4	80	22	58
	4.5<	Good	-	-	-	-	-	-	1	14	-	-	1	3
Extractable Zn (mg kg^{-1})	0.5>	Lack	2	29	5	50	5	56	1	14	2	40	15	39
	0.5-1.0	Show defcieny	2	29	1	10	-	-	2	29	2	40	7	18
	1.0<	Good	3	42	4	40	4	44	4	57	1	20	16	42
Extractable Cu (mg kg^{-1})	0.2>	Inadequate	-	-	-	-	-	-	-	-	-	-	-	-
	0.2<	Adaquate	7	100	10	100	9	100	7	100	5	100	38	100
Extractable Mn (mg kg^{-1})	1>	Inadequate	-	-	1	10	-	-	-	-	-	-	-	-
	1<	Adaquate	7	100	9	90	9	100	7	100	5	100	38	100
Available Se ($\mu\text{g kg}^{-1}$)	100>	Poor	7	100	10	100	9	100	7	100	5	100	38	100
	100-1000	Middle	-	-	-	-	-	-	-	-	-	-	-	-
	1000<	Rich	-	-	-	-	-	-	-	-	-	-	-	-

NS: Number of samples.

When extractable B contents of soil are evaluated according to Wolf (1971); in Center, Ceylanpinar, Viransehir and Harran 100% were very low/low; in Akcakale 90% were very low/low, 10% adequate. In general, 97% were very low/low, 3% adequate class, boron deficiency was observed in 97% of the maize cultivated fields (Table 5). Low content of OM and high amount of lime, over-drought and over-precipitation are factors that reduce the use of available B (Keren et al., 1985; Goldberg, 1997). Soil pH is the most important soil characteristic that affects the intake by the boron plants. Boron uptake is decreased in plants due to increase in soil pH or excess calcification (Bartleta and Picarelli, 1973). According to the results, it has been determined that the B contents of soils that its pH was very low and low class was changed between 7.10-8 and slightly alkaline. When all of the above mentioned information is evaluated together, it is thought that boron deficiency indications in plant leaves are well observed, and boron deficiency is observed leaf analysis with soil analyzes, and foliar applications of boron fertilizer from leaf.

As a result of the classification reported by Lindsay and Norvell (1978), extractable Cu, Mn contents were adequate class, extractable Fe of Ceylanpinar soils were lack, the vast of the other provinces showed deficiencies class. For extractable Zn, 29% of Center were lack, 29% show deficiency, 42% good; 50% of Akcakale soils were lack, 10% show deficiencies, 40% good; 56% of Ceylanpinar were lack, 44% good; 14% of Harran were lack, 29% show deficiency, 57% good; about 80% of Viransehir were lack and show deficiency, 20% good class; in Generally 39% of soils were lack, 18% deficient, 42% good class (Table 5).

It has been determined that except 14% of Harran soils, all districts soils have a nutritional problems in terms of Fe, and about 57% of soils at all district have a problem in terms of Zn nutrition. Fe and Zn deficiency are the most common micronutrient deficiencies in soils. Fe and Zn deficiency is mainly caused by factors affecting the availability of iron to the soil and plant. These factors can be listed as low amount of Fe that can be taken to the soil, high amount of lime in the soil, high pH, high HCO₃⁻ ion concentration, excess of other heavy metals and low reduction capacity of plant roots. Higher pH due to excess lime and high amount of Ca²⁺ and HCO₃⁻ ions in the soil solution reduces the Fe and Zn availability in calcareous soil. In addition, sulfide formation and drainage disorders reduce Zn availability. There is usually a high correlation between soil organic matter coverage and extractable Zn coverage, when the OM is broken, due to chelating compounds, zinc-chelate compound is formed and zinc availability is increased (Aktas, 1995). In the research, the soils that have deficiency extractable Fe and Zn have a mildly alkaline character and a high/very high and over-calcified lime content, humus-poor and less humus. The low level of extractable Zn of soil can be lead to Zn deficiency in the plant, which causes considerable yield losses. Plant species show different tolerance to Zn deficiency. It is known that the response to Zn deficiency and Zn application is largely different between grain varieties or cultivars. Maize is only one of these plant species (Ozer, 1999; Ozguven and Katkat, 2001).

The results of the analysis were evaluated by Fine et al. (1971); all of the soil samples were in the poor class of Se (Table 5). Cakmak et al. (2009) reported that Se concentration of favorable soil collected from different parts of Turkey; in the South East Anatolia Region, is changed between 2.2 and 6.0 µg kg⁻¹, with an average of 2.2 µg kg⁻¹. It is seen that the results of the low content of Se in the soil taken from the maize grown fields are overlapped with the findings of the researcher.

4.2. Nutrient content of plant

Table 6. Distrubution of total B, Fe, Zn, Mn, Cu and Se concentrations of maize leaf samples according to the limits of adequacy

Limit values		Center		Akcakale		Ceylanpinar		Harran		Viransehir		General		
		NS	%	NS	%	NS	%	NS	%	NS	%	NS	%	
B (mg kg ⁻¹)	2-4	Low	-	-	-	-	-	-	-	-	-	-	-	
	5-25	Adequate	4	57	-	-	-	-	-	-	-	4	11	
	26-60	High	3	43	9	90	-	-	7	100	2	40	21	55
	61<	Very high	-	-	1	10	9	100	-	-	3	60	13	34
Fe (mg kg ⁻¹)	10-20	Low	-	-	-	-	-	-	-	-	-	-	-	
	21-250	Adequate	7	100	10	100	9	100	6	86	5	100	37	97
	251-350	High	-	-	-	-	-	-	1	14	-	-	1	3
Zn (mg kg ⁻¹)	15-24	Low	-	-	-	-	2	22	-	-	-	-	2	5
	25-100	Adequate	6	86	10	100	7	78	7	100	5	100	35	92
	101-150	High	1	14	-	-	-	-	-	-	-	-	1	3
Mn (mg kg ⁻¹)	10-19	Low	-	-	-	-	-	-	-	-	-	-	-	
	20-200	Adequate	6	100	8	80	9	100	6	86	5	100	35	92
	201-300	High	-	-	2	20	-	-	1	14	-	-	3	8
Cu (mg kg ⁻¹)	2-5	Low	-	-	-	-	4	44	-	-	4	80	8	21
	6-20	Adequate	4	57	8	80	5	56	7	100	1	20	25	66
	21-70	High	3	43	2	20	-	-	-	-	-	-	5	13
Se (µg kg ⁻¹)	20	Low	3	43	10	100	9	100	7	100	4	80	33	87
	20-200	Adequate	4	57	-	-	-	-	-	-	1	20	5	13
	200<	High	-	-	-	-	-	-	-	-	-	-	-	-

NS: Number of samples.

Compared with the reference B values, 57% of Center leaves were adequate, 43% high; in Akcakale 100% of Akcakale, Ceylanpinar, Harran and Viransehir were high/very high class (Table 6). It is seen that maize-grown areas do not have any nutritional problems in term of B, due to the leaves have sufficient levels of B, while extractable B levels of soils is very low and low (Table 5).

It was determined that leaves samples were adequate and high in terms of Fe, Zn and Mn (Table 6). When leaf and soil nutrient contents are evaluated together, the fact that the leaves contain enough Fe, even though almost half of the soil of all the provinces is in the deficient, shows that there is no nutritional problem related to this element. Although nearly half of the soil is in the deficient or deficient range of Zn, the fact that the leaves contain enough Zn suggests that there is no nutritional problem related to this element except Ceylanpinar district. It can be said that there is no problem in terms of Mn due to sufficient Mn contain of all soil and leaves samples in all districts. However, except 44% and 80% of Ceylanpinar and Viransehir districts are in the low class respectively, all the districts samples are in the adequate class for Cu (Table 6). For this reason, it can be said that nutritional problems are experienced in these two districts in terms of Cu, and nutrition problems are not experienced in other districts (Table 5; 6).

According to the Ozbek et al. (2001), 100% of Akcakale, Ceylanpinar and Harran soils were low, 43% of Center were low, 57% adequate; 80% of Viransehir were low, 20% enough class (Table 5). Leaf samples which appear in the sufficient group are insufficient in terms of Se feeding considering that they are in sufficient group with a very small difference when considering Se content. Considering that the available Se contents of soils are insufficient in all regions (Table 5), it appears that there is a feeding problem in terms of Se feeding in maize grown areas. According to Alloway (1968); Adams et al. (2002); Broadley et al. (2007), it is desirable that the concentration of Se in consumed foods is between 100-1000 $\mu\text{g kg}^{-1}$ for adequate nutrition of both humans and animals. Miller et al. (1991) indicate that at least 0.1-0.3 mg kg^{-1} Se should be used in animal feed, 0.1-1 mg kg^{-1} Se is sufficient, and $>5 \text{ mg kg}^{-1}$ is toxic effect. Deliboran et al. (2016) showed that the Se content of maize was increased with Se application from leaves, that the Se content of leaves was 626.95 $\mu\text{g kg}^{-1}$ and the Se content of grain was 523.37 $\mu\text{g kg}^{-1}$ in 100 g ha^{-1} dose of sodium selenate, and this is adequate for animal feed. As our research, the low content of Se in the leaves taken from the maize grown areas indicates that there is no contribution to the feeding of selenium using this leaves as silage in terms of animals Se feeding.

It is considered that the results of this study carried out in Sanliurfa province, effective fertilization program is very important in terms of being economical and ecological its method and time. Also, quality and high yield production can be achieved with balanced fertilization, the addition of organic fertilizers and other technical applications.

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