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Determination of the Nutritional Status of Wheat Plant by Plant and Soil Analysis in Thrace Region

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Abstract

The aim of this study is to determine nutritional status of wheat plant in Thrace region with plant analysis. Soil and plant samples were collected from different 41 points representative to different soil groups in Thrace region. Both, basic soil analysis and micro nutritional elements (Fe, Cu, Zn, Mn, and B) were examined in these soil samples. Amounts of macro nutritional elements (nitrogen, phosphorus and potassium) and micro nutritional elements (Fe, Cu, Zn, Mn, and B) were also obtained in the plant samples. Amount of nutritional elements in soil and plant samples were compared with the threshold values to make further assessments. Study results indicated that wheat plant was fed enough in terms of macro elements. At some points, competency level was exceeded in terms of nitrogen and potassium. In terms of nutritional status for micro elements; iron, copper, manganese contents were determined at competence level, boron and zinc contents were determined below the competence level at several sample points.

Key words: Wheat, nutrition, plant analysis

Trakya Bölgesinde Buğdayın Beslenme Durumunun Bitki Analizleri İle İncelenmesi

Özet

Bu çalışmada Trakya Bölgesini temsilen farklı büyük toprak gruplarının oranlarına göre belirlenen 41 noktadan çiftçi tarlalarından toprak ve bitki örnekleri vejetasyon döneminde 2004 yılında alınmıştır. Alınan toprak örneklerinin rutin verimlilik analizlerinin yanı sıra, mikro besin elementlerinden demir, bakır çinko, mangan ve bor miktarları belirlenmiştir. Bitki örneklerinde ise makro besin elementlerinden azot, fosfor ve potasyum, mikro besin elementlerinden ise demir, bakır çinko, mangan ve bor miktarları tespit edilmiştir. Topraktaki ve bitkideki besin elementi miktarları kritik değerlerle karşılaştırılarak değerlendirmeler yapılmıştır. Buğday bitkisinin makroelement (N, P, K) beslenmesi bakımından yeterince beslendiği, azot ve potasyum bakımından bazı noktalarda yeterlilik düzeyinin üzerine çıkıldığı belirlenmiştir. Buğday bitkisinin mikrobesin elementi bakımından demir, bakır ve mangan açısından yeterlilik sınırları içerisinde olduğu ancak bor ve çinko içeriklerinde çok sayıda noktada yeterlilik sınırlarının altında olduğu belirlenmiştir.

Anahtar kelimeler: Buğday, bitki besleme, bitki analizleri

Introductıon

Wheat plant is growth worldwidely due to the adaptability to different climatic conditions and also becoming one of the basic foodstuffs. In Thrace region wheat-sunflower alternating system is continued widely for many years.Due to lack of moisture in Central Anatolia, wheat-fallow-wheat rotation is applied but in Thrace region wheat-sunflower-wheat rotation can be applied due to the suitability of rainfall and humidity. Wheat yield is nearly twice the national average in Thrace.

Plants take up available portion of nutrients from the soil. The available portion of the plant nutrients varies according to the climatic conditions, vegetation , slope conditions and the parent material which the soil was formed. Soils are also classified according to these characteristics that make them different. As well as available portion of plant nutrients in soil, available moisture of soil is effective on the yield of plants grown in different soils.

In their study Zengin and Şeker (2003) investigated regression relationships between soil properties and nutrition content (N, P, K, Fe, Cu, Zn, Mn ve B) of wheat plant. Values for each of the nutrition content of wheat plant and soil properties were calculated from regression equation.They stated that properties in the depths of 0-40 cm soil have a significant impact on estimation of the nutrient content of wheat plant and by using these soil properties, nutrient content of wheat plant can be estimated with high accuracy.

In this study soil and plant samples were taken from agricultural lands located in Thrace by considering large soil groups and areas that are covered by these groups. In the soil samples, pH, EC, texture, lime, organic matter, N, P, K, Fe, Cu, Mn,Zn and B, in the plant samples, N, P, K, Fe, Cu, Mn, Zn and B were analysed. Results were evaluated on the basis of large soil groups and competency level of nutrients were investigated.

Material and Method

In the study, for the determination of sampling points, land asset maps of Edirne, Tekirdağ and Kırklareli were used that prepared by General Directorate for Rural Services (Anonymous, 1993, 1993, 1991). Sampling points were distributed to different major soil groups. Soil samples were taken from a depth of 0-20 cm and 3 different points of the field.

Soil reaction (pH) was measured in saturated soil paste using combined electrode pH meter as mentioned by Richards (1954). Salt content of the same suspension by EC meter.Soils textures were determined with Bouyoucos the Hydrometer Method (Bouyoucous, 1951). Lime is determined by Scheibler Calcimeter (Tüzüner, 1990). Organic matter was determined by modified Walkley Black method..Soil available phosphorus was determined according to Olsen (1954). Available potassium, calcium and magnesium are determined using ammonium acetate extraction method (Kacar,2009). Available iron, zinc, copper and manganese were extracted using DTPA method (Lindsay and Norvell, 1978) and measured using ICP. Available boron was determine with Azomethin-H method according to Wolf(1971). Adequacy assessments of soil analysis results were evaluated as reported by Taban.

Plant samples were collected at the beginning of earing stage of wheat as reported by Kacar (1972). Samples were washed, dried, grinded and prepared for analysis. Total N contents were determined by the Kjeldahl method. P content was determined by vanadomolibdophosphoric yellow colour method (Kacar and İnal 2008). K contents of samples was determined by using flamephotometer and micro elements by using atomic absorbtion spectrophotometer after digesting the samples with nitric-percloric acid (Kacar and İnal 2008). Boron was determine with Azomethin-H method according to Wolf (1971).

Results and Discussion

Adequacy Ratio of nutrients in soil and plant samples were calculated for each major soil groups. This calculation were made as following equations:

Adequacy Ratio, %= the number of sample above the critical level x 100 / total soil sample in the major soil group

Overall Adequacy Ratio, %= the number of samples above the critical levelx 100 / total soil samples.

Results of routine soil analysis and macro and micro contents of soil samples are given in Table 1 and 2. As seen in the Table 1, electrical conductivity values of soil samples varied between 0.50 ds/m and 4.42ds/m and pH values varied between 5.04 and 7.90. Organic matter content of soil samples varied from 0.30% to 2.72%.

As seen in the Table 2, the highest phosphorus adequacy ratio was determined in brown forest soils (66.6%). Only in alluvial soils potassium adequacy ratio was found relatively low.Iron, copper and manganese contents were found sufficient in all soil groups. For zinc and boron, the adequacy ratio was found lower in the all soil groups (overall adequacy ratio, respectively, 12.19% and 56.09%).

Plant analysis results are given in Table 3. As seen in the Table 3, adequacy ratio was found % 100 in all soil groups for potassium, nitrogen and phosphorus. Overall adequacy ratio was found %100 for iron and copper, % manganese, %34.14 for zinc and %0.00 for boron.

Correlation between soil and plant analysis results were calculated and given below Table 4.

Table 1. Routine analysis results of soil samples

Major Soil Groups	Sample Point	Saturation %	$ECx10^3$ ds/m	pH	Lime % $CaCO_3$	Organic Matter %	TEXTURES Clay, %	Silt, %	Sand, %	Soil Types
Alluvial Soils	4	46	1.38	6.21	0.10	1.34	23.80	21.73	54.47	SCL
	8	60	2.70	6.79	0.10	1.41	35.00	27.32	37.68	CL
	18	64	3.67	7.55	0.62	1.91	42.80	17.05	40.15	C
	27	44	1.80	5.47	0.00	1.23	19.10	18.13	62.77	SL
	39	33	0.72	5.07	0.00	0.30	11.30	7.48	81.22	SL
Non Calcareous Brown Forest Soil	1	36	1.47	7.79	4.55	1.01	8.78	15.94	75.28	SL
	3	74	1.57	7.76	10.55	1.34	61.60	21.33	17.07	C
	6	64	3.01	6.78	0.31	1.97	38.40	28.93	32.67	CL
	21	67	3.71	7.76	3.02	1.57	43.65	35.39	20.96	C
	24	59	3.07	6.72	0.41	2.03	34.90	20.32	44.78	CL
	29	71	4.17	7.47	0.00	1.58	57.00	19.03	23.97	C
	40	53	3.20	6.82	0.00	0.73	32.70	24.44	42.86	CL
Brown Forest Soils	9	67	4.07	7.24	0.00	1.85	51.00	23.71	25.29	C
	11	67	3.14	7.61	41.76	1.73	56.10	27.39	16.51	C
	31	45	1.82	6.38	0.00	0.91	17.60	18.41	63.99	SL
Non Calcareous Brown Soils	10	67	4.42	7.46	1.37	2.72	57.90	23.87	18.23	C
	14	56	2.95	7.23	0.86	1.34	26.90	26.81	46.29	SCL
	22	52	2.44	6.35	0.15	1.44	30.50	24.44	45.06	SCL
	25	60	2.40	7.73	13.82	1.27	29.52	45.00	25.48	CL
	28	43	1.60	5.59	0.00	0.65	21.20	11.00	67.80	SCL
	33	32	0.50	5.70	0.00	0.67	7.25	22.19	70.56	SL
	35	76	4.25	7.67	13.01	1.77	55.60	21.65	22.75	C
	41	66	3.70	7.68	18.18	1.74	32.70	24.44	42.86	CL
Vertisol Soils	2	50	1.69	7.90	9.01	0.86	21.10	32.25	46.65	L
	5	48	1.24	6.17	0.31	1.29	31.70	28.57	39.73	CL
	7	56	2.61	7.86	1.38	1.29	28.50	28.57	44.25	CL
	12	59	3.37	7.71	3.42	1.98	34.60	22.86	42.54	CL
	13	60	3.15	7.80	1.10	1.66	33.60	25.11	41.29	CL
	15	51	2.39	6.09	0.10	1.24	33.50	20.90	45.60	SCL
	16	63	3.12	7.68	0.00	1.19	44.80	10.60	44.60	C
	17	29	0.35	5.40	0.00	0.98	12.10	8.09	79.81	SL
	19	65	3.56	6.69	0.00	1.29	50.99	16.64	32.37	C
	20	79	4.33	7.84	9.68	1.93	67.90	12.67	19.43	C
	23	60	3.72	7.76	7.59	1.28	48.41	14.35	37.24	C
	26	62	3.79	7.78	8.42	1.15	42.30	18.33	39.37	C
	30	53	4.03	7.70	0.89	1.07	34.40	18.56	47.04	SCL
	32	33	1.06	6.72	0.00	1.07	11.34	20.27	68.39	SL
	34	63	3.95	7.72	10.84	1.62	48.50	25.79	25.71	C
	36	63	3.10	7.53	7.53	0.87	39.60	12.72	47.68	SC
	37	50	1.61	5.04	5.04	0.86	34.40	14.48	51.12	SCL
	38	55	2.57	6.19	6.19	1.34	34.40	14.48	51.12	SCL

Table 2. Macro and micro analysis results of soil samples and adequacy ratios

Major Soil Groups	Sample Point	P_2O_5 kg/da	K_2O kg/da	ppm				
				Fe	Cu	Zn	Mn	B
Critical Level		8.00	30.00	2.50	0.20	0.70	1.00	1.00
Alluvial	4	8.41	48.00	7.60	1.54	0.59	5.82	1.04
	8	3.19	62.53	7.86	1.70	0.22	4.06	0.90
	18	5.81	77.5	12.92	1.17	0.25	1.08	0.99
	27	19.62	26.4	30.02	1.35	0.97	9.38	0.43
	39	19.12	28.16	7.43	1.01	0.30	6.51	0.30
Adequacy Ratio %		60	60	100	100	20	100	20
Non Calcareous Brown Forest Soil	1	3.04	33.46	4.59	0.56	0.21	1.10	0.66
	3	7.17	117.60	8.04	2.51	0.17	0.58	1.06
	6	27.93	105.66	3.08	3.98	2.02	4.43	2.00
	21	2.35	136.53	24.04	1.74	0.23	0.74	1.56
	24	37.60	50.20	68.24	1.94	1.27	7.63	1.42
	29	11.64	84.6	28.34	1.25	0.32	1.29	1.00
	40	23.24	74.03	13.61	2.09	0.62	2.71	1.28
Adequacy Ratio %		57.1	100	100	100	28.5	71.4	85.7
Brown Forest Soils	9	5.59	65.2	14.50	2.62	0.46	2.28	0.36
	11	9.98	80.60	10.36	1.99	0.43	0.50	1.06
	31	13.40	40.96	8.36	0.97	0.51	9.75	0.65
Adequacy Ratio %		66.6	100	100	100	0.0	66.6	33.3
Non Calcareous Brown Soils	10	9.13	81.93	15.76	3.30	0.60	1.37	1.40
	14	14.77	44.06	11.17	0.71	0.40	2.44	1.26
	22	7.82	65.20	5.25	1.58	0.25	5.82	1.01
	25	7.01	48	36.53	1.00	0.30	1.54	1.07
	28	13.04	39.2	18.98	1.00	0.39	9.45	0.29
	33	6.05	37.86	78.8	0.53	0.48	9.63	0.50
	35	4.02	71.33	58.24	1.15	0.19	1.44	1.16
	41	3.59	104.9	4.12	1.69	0.20	1.02	1.20
Adequacy Ratio %		37.5	100	100	100	0.0	100	75
Vertisol	2	3.96	59	5.25	1.06	0.21	1.10	0.91
	5	4.61	61.63	7.77	2.11	0.32	4.69	1.13
	7	3.57	61.66	6.67	1.06	0.21	1.00	0.67
	12	31.52	68.7	6.47	4.18	1.51	0.97	1.71
	13	6.49	71.33	10.35	1.50	0.17	0.92	1.05
	15	11.93	60.33	8.43	2.89	0.30	12.02	0.94
	16	10.30	82.33	21.74	1.53	0.18	1.18	1.06
	17	11.50	43.20	8.26	1.15	0.34	8.79	0.34
	19	12.70	99.53	9.24	1.54	0.46	3.31	1.09
	20	3.03	204.33	7.21	1.75	0.30	0.39	1.33
	23	0.63	84.96	4.94	0.90	0.24	0.82	1.15
	26	0.49	81.93	8.90	0.81	0.21	1.53	1.26
	30	6.01	48.03	8.23	1.37	0.33	0.98	0.56
	32	33.34	39.23	11.1	0.74	1.06	3.99	0.86
	34	3.03	116.3	12.05	2.39	0.14	0.98	1.35
	36	5.90	85.00	22.83	3.47	0.30	1.01	1.24
	37	13.25	53.73	8.80	1.30	0.48	3.63	0.65
	38	21.60	65.16	54.99	1.59	0.25	6.13	0.99
Adequacy Ratio %		44.4	100	100	100	11.1	66.6	55.5
Overall Adequacy Ratio %		48.78	95.12	100	100	12.19	75.60	56.09

Table 3. Plant analysis results and adequacy ratios

Major Soil Groups	Sampling point	N %	P %	K %	Fe ppm	Cu ppm	Zn ppm	Mn ppm	B ppm
Critical Level		1.75-3.0	0.21-0.50	1.51-3.0	10-300	5-50	21-70	16-200	6-14
Alluvial Soils	4	2.70	0.37	2.25	78.16	7.96	15.91	116.66	0.08
	8	2.72	0.31	2.58	68.25	16.00	17.46	124.50	0.14
	18	3.58	0.37	3.21	121.91	17.80	24.66	132.00	1.50
	27	2.54	0.39	3.30	86.53	14.40	23.84	102.50	0.39
	39	2.01	0.28	1.56	73.67	8.06	13.90	310.16	0.36
Adequacy Ratio %		100	100	100	100	100	40	100	0.00
Non Calcareous Brown Forest Soils	1	1.79	0.23	1.90	81.91	7.18	10.28	119.50	0.34
	3	3.14	0.27	3.07	77.00	13.66	20.76	129.33	0.19
	6	3.34	0.41	3.79	105.91	10.56	28.49	71.00	0.96
	21	2.99	0.42	3.69	134.50	19.85	34.80	116.50	2.61
	24	2.67	0.44	3.16	58.16	10.83	20.15	80.50	2.38
	29	2.91	0.33	2.83	112.18	12.25	17.10	89.50	0.36
	40	3.57	0.35	2.98	108.50	14.55	23.56	133.00	0.62
Adequacy Ratio %		100	100	100	100	100	42.85	100	0.00
Brown Forest Soils	9	2.90	0.35	2.32	67.08	12.88	15.53	138.00	0.90
	11	3.09	0.36	2.92	64.58	14.30	16.70	103.66	0.93
	31	1.87	0.34	3.05	132.76	14.53	23.39	93.16	1.58
Adequacy Ratio %		100	100	100	100	100	33.33	100	0,0
Non Calcareous Brown Soils	10	2.56	0.22	2.52	65.83	9.00	10.75	52.00	1.87
	14	1.92	0.41	2.96	74.08	11.33	16.65	88.95	1.62
	22	3.35	0.38	2.32	123.25	14.05	21.74	113.00	2.15
	25	2.64	0.39	2.66	65.66	14.76	20.25	127.66	0.50
	28	2.58	0.37	2.88	109.43	12.38	20.70	128.50	0.39
	33	3.04	0.26	1.93	55.92	7.78	16.04	176.33	1.16
	35	2.78	0.24	2.95	107.33	14.33	17.65	104.50	0.31
	41	2.33	0.27	3.03	77.30	13.15	22.49	140.50	0.53
Adequacy Ratio %		100	100	100	100	100	25	100	0,0
Vertisol Soils	2	2.47	0.28	2.81	83.08	7.33	12.29	117.66	0.51
	5	2.95	0.32	2.98	75.25	13.11	20.37	114.33	0.51
	7	2.96	0.32	2.82	110.58	13.10	12.65	120.16	0.39
	12	2.66	0.44	4.16	69.41	12.61	21.06	165.50	1.28
	13	3.24	0.38	3.04	107.75	13.30	13.40	129.83	0.99
	15	2.63	0.26	2.21	59.33	10.06	12.26	158.33	1.81
	16	1.99	0.42	3.20	112.16	16.61	15.59	163.66	0.93
	17	2.48	0.28	1.53	80.00	7.78	14.08	247.16	1.39
	19	2.97	0.36	2.60	135.66	15.33	23.20	231.50	1.61
	20	3.98	0.40	3.89	124.00	17.58	28.25	106.50	1.61
	23	3.41	0.44	3.49	115.33	14.93	24.93	91.83	2.09
	26	2.70	0.26	2.99	78.58	16.05	19.14	112.83	1.08
	30	2.97	0.28	2.76	131.51	14.00	21.69	96.50	0.28
	32	2.69	0.41	2.81	84.76	7.33	16.30	61.00	0.36
	34	3.05	0.27	3.39	105.73	17.33	27.80	143.33	2.35
	36	2.97	0.23	2.73	96.42	10.28	16.45	68.50	2.23
	37	2.86	0.23	2.41	89.81	10.00	14.58	244.33	1.81
	38	1,83	0,30	2,08	64,42	8,18	13,60	148,00	1,56
Adequacy Ratio %		100	100	100	100	100	33.33	100	0.00
Overall Adequacy Ratio %		100	100	100	100	100	34.14	100	0.00

Table 4. Correlation between soil and plant analysis

Soil/Plant	P	K	Fe	Cu	Mn	Zn	B
pH	0,010	0,271	0,050	0,188	0,260	0,026	0,000
P	0,168						
K		0,325*					
Fe			0,071				
Cu				0,001			
Mn					0,062		
Zn						0,045	
B							0,141

*:%5 significance level

As seen in Table 4, low significance level was detected only for potassium and there was no significant relationship between soil and plant analysis results for other elements.

Study results indicated that wheat plant was fed enough in terms of macro elements. At some points, adequacy level was exceeded in terms of nitrogen and potassium. In terms of nutritional status for micro elements; iron, copper, manganese contents were determined at adequacy level, boron and zinc contents were determined below the adequacy level at several sample points.

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